Kathmandu Valley Water Supply Improvement Project (Phase 2)

Bidding Document

For

Procurement

Of

Distribution Network Improvement Works in Kirtipur

Contract No.: PID/SKV/DNI2-Kirtipur

Volume I: Main Bidding Document

Volume II: Employer's Requirements

Volume III: Drawings

Issued on: 16 June 2026

Invitation for Bids No.: PID/SKV-R-01

OCB No: PID/SKV/DNI2-Kirtipur

Employer: Project Implementation Directorate, Kathmandu Upatyaka Khanepani Limited (PID/KUKL)

Country: Nepal

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Section 1: Instructions to Bidders

This section specifies the procedures to be followed by Bidders in the preparation and submission of their Bids. Information is also provided on the submission, opening, evaluation of bids, and award of contract.

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A. General

1. Scope of Bid

1.1 In connection with the Invitation for Bids (IFB) indicated in the Bid Data Sheet (BDS), the Employer, as indicated in the BDS, issues this Bidding Document for the procurement of Works as specified in Section 6 (Works' Requirements). The name, identification, and number of contracts of the open competitive bidding (OCB) are provided in the BDS.

1.2 Throughout this Bidding Document,

(a) the term "in writing" means communicated in written form and delivered against receipt;

(b) except where the context requires otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and

(c) "day" means calendar day.

2. Source of Funds

2.1 The Borrower or Recipient (hereinafter called "Borrower") indicated in the BDS has applied for or received financing (hereinafter called "funds") from the Asian Development Bank (hereinafter called "ADB") toward the cost of the project named in the BDS. The Borrower intends to apply a portion of the funds to eligible payments under the contract(s) for which this Bidding Document is issued.

2.2 Payments by the ADB will be made only at the request of the Borrower and upon approval by ADB in accordance with the terms and conditions of the Financing Agreement between the Borrower and ADB (hereinafter called "Financing Agreement"), and will be subject in all respects to the terms and conditions of that Financing Agreement. No party other than the Borrower shall derive any rights from the Financing Agreement or have any claim to the funds.

3. Fraud and Corruption

3.1 ADB requires Borrowers (including beneficiaries of ADB-financed activity) and their personnel, as well as firms and individuals participating in an ADB-financed activity, including but not limited to, Bidders, Suppliers, and Contractors, agents, subcontractors, subconsultants, service providers, subsuppliers, manufacturers (including their respective officers, directors, employees and personnel) under ADB-financed contracts to observe the highest standard of ethics during the procurement and execution of such contracts in accordance with ADB's Anticorruption Policy (1998, as amended from time to time). In pursuance of this policy, ADB

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;

(ii) "fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(iv) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;

(v) "abuse" means theft, waste, or improper use of assets related to ADB-related activity, either committed intentionally or through reckless disregard;

(vi) "conflict of interest" means any situation in which a party has interests that could improperly influence that party's performance of official duties or responsibilities, contractual obligations, or compliance with applicable laws and regulations; and

(vii) "integrity violation" means any act, as defined under ADB's Integrity Principles and Guidelines (2015, as amended from time to time), which violates ADB's Anticorruption Policy, including (i) to (vi) above and the following: obstructive practice, violations of ADB sanctions, retaliation against whistleblowers or witnesses, and other violations of ADB's Anticorruption Policy, including failure to adhere to the highest ethical standards.

(b) will reject a proposal for award if it determines that the Bidder recommended for award or any of its officers, directors, employees, personnel, subconsultants, subcontractors, service providers, suppliers or manufacturers has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations in competing for the Contract;

(c) will cancel the portion of the financing allocated to a contract if it determines at any time that representatives of the Borrower or of a beneficiary of ADB financing engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations during the procurement or the execution of that contract, without the Borrower having taken timely and appropriate action satisfactory to ADB to remedy the situation, including by failing to inform ADB in a timely manner at the time they knew of the integrity violations;

(d) will impose remedial actions on a firm or an individual, at any time, in accordance with ADB's Anticorruption Policy and Integrity Principles and Guidelines, including declaring ineligible, either indefinitely or for a stated period of time, to participate[1] in ADB-financed, -administered, or -supported activities or to benefit from an ADB-financed, -administered, or -supported contract, financially or otherwise, if it at any time determines that the firm or individual has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations; and

(e) will have the right to require that a provision be included in bidding documents and in contracts financed, administered, or supported by ADB, requiring Bidders, suppliers and contractors, consultants, manufacturers, service providers and other third parties engaged or involved in ADB-related activities, and their respective officers, directors, employees and personnel, to permit ADB or its representative to inspect the site and their assets, accounts and records and other documents relating to the bid submission and

[1] Whether as a Contractor, Subcontractor, Consultant, Manufacturer or Supplier, or Service Provider; or in any other capacity (different names are used depending on the particular Bidding Document).

contract performance and to have them audited by auditors appointed by ADB.

3.2 All Bidders, consultants, contractors, suppliers, manufacturers, service providers, and other third parties engaged or involved in ADB-related activities, and their respective officers, directors, employees and personnel, are required to cooperate fully in any investigation when requested by ADB to do so. As determined on a case-by-case basis by ADB, such cooperation is set out in detail in the Integrity Principles and Guidelines.

3.3 All Bidders, consultants, contractors and suppliers shall require their officers, directors, employees, personnel, agents to ensure that, in its contracts with its subconsultants, Subcontractors, and other third parties engaged or involved in ADB-related activities, such subconsultants, Subcontractors, and other third parties similarly are required to cooperate fully in any investigation when requested by ADB to do so.

3.4 The Employer hereby puts the Bidder on notice that the Bidder or any Joint Venture partner of the Bidder (if any) may not be able to receive any payments under the Contract if the Bidder or any of its Joint Venture partners, as appropriate, is, or is owned (in whole or in part) by a person or entity subject to applicable sanctions.

3.5 Furthermore, Bidders shall be aware of the provision stated in Sub-Clause 1.17 and Part C [Corrupt and Fraudulent Practices] of the Particular Conditions of Contract.

4. Eligible Bidders

4.1 A Bidder may be a natural person, private entity, or government-owned enterprise subject to ITB 4.5—or any combination of them with a formal intent to enter into an agreement or under an existing agreement in the form of a Joint Venture. In the case of a Joint Venture,

(a) all partners shall be jointly and severally liable; and

(b) the Joint Venture shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the Joint Venture during the bidding process and, in the event the Joint Venture is awarded the Contract, during contract execution.

4.2 A Bidder, and all parties constituting the Bidder, shall have the nationality of an eligible country, in accordance with Section 5 (Eligible Countries). A Bidder shall be deemed to have the nationality of a country if the Bidder is a citizen or is constituted, incorporated, or registered, and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed Subcontractors or Suppliers for any part of the Contract including related services.

4.3 A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidder may be considered to be in a conflict of interest with one or more parties in the bidding process if any of, including but not limited to, the following apply:

(a) they have controlling shareholders in common; or

(b) they receive or have received any direct or indirect subsidy from any of them; or

(c) they have the same legal representative for purposes of this bid; or

(d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to material information about or improperly influence the bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or

(e) a Bidder participates in more than one bid in this bidding process, either individually or as a partner in a Joint Venture, except for alternative offers permitted under ITB 13 of the Bidding Document. This will result in the disqualification of all Bids in which it is involved. However, subject to any finding of a conflict of interest in terms of ITB 4.3(a)-(d) above, this does not limit the participation of a Bidder as a Subcontractor in another Bid or of a firm as a Subcontractor in more than one Bid; or

(f) a Bidder, Joint Venture partner, associates, parent company, or any affiliated entity, participated as a Consultant in the preparation of the design or technical specifications of the works that are the subject of the Bid; or

(g) a Bidder was affiliated with a firm or entity that has been hired (or is proposed to be hired) by the Employer or Borrower as Engineer for the contract; or

(h) a Bidder would be providing goods, works, or nonconsulting services resulting from or directly related to consulting services for the preparation or implementation of the project specified in the BDS ITB 2.1 that it provided or were provided by any affiliate that directly or indirectly controls, is controlled by, or is under common control with that firm; or

(i) A Bidder that has a financial or familial relationship with Employer's personnel including personnel of project implementing/executing agency, or of a recipient of a part of the loan who: (i) are directly or indirectly involved in the preparation of the bidding documents or specifications of the contract, and/or the bid evaluation process of such contract; or (ii) would be involved in the implementation or supervision of such contract unless the conflict stemming from such relationship has been resolved in a manner acceptable to ADB throughout the procurement process and execution of the contract.

4.4 A firm will not be eligible to participate in any procurement activities under an ADB-financed, -administered, or -supported project while under temporary suspension or debarment by ADB pursuant to its Anticorruption Policy (see ITB 3), whether such debarment was directly imposed by ADB, or enforced by ADB pursuant to the Agreement for Mutual Enforcement of Debarment Decisions. A bid from a temporarily suspended or debarred firm will be rejected and such bid may be in breach of debarment conditions, thereby subject to further ADB's investigation.

4.5 Government-owned enterprises in the Employer's country shall be eligible only if they can establish that they (i) are legally and financially autonomous, (ii) operate under commercial law, and (iii) are not a dependent agency of the Employer.

4.6 A Bidder shall not be under suspension from bidding by the Employer as the result of the execution of a Bid–Securing Declaration.

4.7 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.

4.8 Bidders shall be excluded if, by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, the Borrower's country prohibits any import of goods from, or payments to, a particular country, person or entity in respect of goods or services originating in that country. Where the Borrower's country prohibits payments to a particular person or entity or for particular goods or services by such an act of compliance, that firm shall be excluded.

4.9 In case a prequalification process has been conducted prior to the bidding process, this bidding is open only to prequalified Bidders.

5. Eligible Materials, Equipment and Services

5.1 The materials, equipment, and services to be supplied under the Contract shall have their origin in eligible source countries as defined in ITB 4.2, and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, Bidders may be required to provide evidence of the origin of materials, equipment, and services.

5.2 For purposes of ITB 5.1 above, "origin" means the place where the materials and equipment are mined, grown, produced, or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.

B. Contents of Bidding Document

6. Sections of Bidding Document

6.1 The Bidding Document consist of Parts I, II, and III, which include all the sections indicated below, and should be read in conjunction with any addenda issued in accordance with ITB 8.

PART I Bidding Procedures

Section 1 - Instructions to Bidders (ITB)

Section 2 - Bid Data Sheet (BDS)

Section 3 - Evaluation and Qualification Criteria (EQC)

Section 4 - Bidding Forms (BDF)

Section 5 - Eligible Countries (ELC)

PART II Requirements

Section 6 - Works' Requirements (WRQ)

PART III Conditions of Contract and Contract Forms

Section 7 - General Conditions of Contract (GCC)

Section 8 - Particular Conditions of Contract (PCC)

Section 9 - Contract Forms (COF)

6.2 The IFB issued by the Employer is not part of the Bidding Document.

6.3 The Employer is not responsible for the completeness of the Bidding Document and their addenda, if they were not obtained directly from the source stated by the Employer in the IFB.

6.4 The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of the bid.

7. Clarification of Bidding Document, Site Visit, Pre-Bid Meeting

7.1 A prospective Bidder requiring any clarification on the Bidding Document shall contact the Employer in writing at the Employer's address indicated in the BDS or raise his inquiries during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond in writing to any request for clarification, provided that such request is received no later than 21 days prior to the deadline for submission of bids. The Employer shall forward copies of its response to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 22.2.

7.2 The Bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

7.3 The Bidder and any of its personnel or agents will be granted permission by the Employer to enter its premises and lands for the purpose of such visit, but only upon the express condition that the Bidder, its personnel, and agents will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

7.4 The Bidder's designated representative is invited to attend a pre-bid meeting, if provided for in the BDS. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

7.5 The Bidder is requested to submit any questions in writing, to reach the Employer not later than 1 week before the meeting.

7.6 Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.

7.7 Nonattendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.

8. Amendment of Bidding Document

8.1 At any time prior to the deadline for submission of Bids, the Employer may amend the Bidding Document by issuing addenda.

8.2 Any addendum issued shall be part of the Bidding Document and shall be communicated in writing to all who have obtained the Bidding Document from the Employer in accordance with ITB 6.3.

8.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their Bids, the Employer may, at its discretion, extend the deadline for the submission of Bids, pursuant to ITB 22.2

C. Preparation of Bids

9. Cost of Bidding

9.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

10. Language of Bid

10.1 The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in the language specified in the BDS. Supporting documents and printed literature that are part of the Bid may be in another language provided they are accompanied by an accurate translation of the relevant passages in the language specified in the BDS, in which case, for purposes of interpretation of the Bid, such translation shall govern.

11. Documents Comprising the Bid

11.1 The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Bid containing the documents listed in ITB 11.2 and the other the Price Bid containing the documents listed in ITB 11.3, both envelopes enclosed together in an outer single envelope.

11.2 The Technical Bid shall comprise the following:

(a) Letter of Technical Bid;

(b) Bid Security or Bid-Securing Declaration, in accordance with ITB 19;

(c) alternative Bids, if permissible, in accordance with ITB 13;

(d) written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB 20.2;

(e) documentary evidence in accordance with ITB 17, establishing the Bidder's qualifications to perform the contract;

(f) Technical Proposal in accordance with ITB 16; and

(g) any other document required in the BDS.

11.3 The Price Bid shall comprise the following:

(a) Letter of Price Bid;

(b) completed Price Schedules, in accordance with ITB 12 and ITB 14;

(c) alternative price Bids, at Bidder's option and if permissible, in accordance with ITB 13; and

(d) any other document required in the BDS.

11.4 In addition to the requirements under ITB 11.2, Bids submitted by a Joint Venture shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful Bid shall be signed by all partners and submitted with the Bid, together with a copy of the proposed agreement.

12. Letters of Bid and Schedules

12.1 The Letters of Technical Bid and Price Bid, and the Schedules, including the Bill of Quantities, shall be prepared using the relevant forms furnished in Section 4 (Bidding Forms). The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested and as required in the BDS.

13. Alternative Bids

13.1 Unless otherwise indicated in the BDS, alternative Bids shall not be considered.

13.2 When alternative times for completion are explicitly invited, a statement to that effect will be included in the BDS, as will the method of evaluating different times for completion.

13.3 Except as provided under ITB 13.4 below, Bidders wishing to offer technical alternatives to the requirements of the Bidding Document must first price the Employer's design as described in the Bidding Document and shall further provide all information necessary for a complete evaluation of the alternative by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methodology and other relevant details. Only the technical alternatives, if any, of the lowest evaluated Bidder conforming to the basic technical requirements shall be considered by the Employer.

13.4 When specified in the BDS, Bidders are permitted to submit alternative technical solutions for specified parts of the Works. Such parts will be identified in the BDS and described in Section 6 (Works' Requirements). The method for their evaluation will be stipulated in Section 3 (Evaluation and Qualification Criteria).

14. Bid Prices and Discounts

14.1 The prices and discounts quoted by the Bidder in the Letter of Price Bid and in the Bill of Quantities shall conform to the requirements specified below.

14.2 The Bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items against which no rate or price is entered by the Bidder will not be paid for by the Employer when executed and shall be deemed covered by the rates for other items and prices in the Bill of Quantities. Unit rates and prices for all items of the Works described in the Bill of Quantities shall be expressed in positive values. If unit rates and prices are expressed in negative values, the bid will be rejected.

14.3 The price to be quoted in the Letter of Price Bid, in accordance with ITB 12.1, shall be the total price of the Bid, excluding any discounts offered. Absence of the total bid price in the Letter of Price Bid may result in the rejection of the Bid.

14.4 The Bidder shall quote any discounts and the methodology for their application in the Letter of Price Bid, in accordance with ITB 12.1.

14.5 The prices shall be either fixed or adjustable as specified in the BDS.

(a) In the case of Fixed Price, prices quoted by the Bidder shall be fixed during the Bidder's performance of the contract and not subject to variation on any account. A Bid submitted with an adjustable price will be treated as nonresponsive and rejected.

(b) In the case of Adjustable Price, prices quoted by the Bidder shall be subject to adjustment during performance of the contract to reflect changes in the cost elements such as labor, material, transport, and contractor's equipment in accordance with the provisions of the Conditions of Contract. A Bid submitted with a fixed price will be treated as nonresponsive and be rejected. The Bidder shall furnish the indexes and weightings for the price adjustment formulas in the Tables of Adjustment Data included in Section 4 (Bidding Forms) and the Employer may require the Bidder to justify its proposed indexes and weightings. Any bid that omits indexes and weightings shall be subject to clarification with the Bidder.

14.6 If so indicated in ITB 1.1, bids are being invited for individual contracts or for any combination of contracts (packages). Bidders wishing to offer any price reduction for the award of more than one Contract shall specify in their bid the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Price reductions or discounts shall be submitted in accordance with ITB 14.4, provided the Bids for all contracts are submitted and opened at the same time.

14.7 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 28 days prior to the deadline for submission of bids, shall be included in the rates and prices and the total Bid Price submitted by the Bidder.

15. Currencies of Bid and Payment

15.1 The unit rates and the prices shall be quoted by the Bidder entirely in the currency specified in the BDS.

15.2 Bidders shall indicate the portion of the bid price that corresponds to expenditures incurred in the currency of the Employer's country in the Schedule of Payment Currencies included in Section 4 (Bidding Forms).

15.3 Bidders expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Employer's country and wishing to be paid accordingly may indicate the other currencies in the Schedule of Payment Currencies included in Section 4 (Bidding Forms).

15.4 The rates of exchange to be used by the Bidder for currency conversion during bid preparation shall be the selling rates for similar transactions prevailing on the date 28 days prior to the deadline for submission of bids published by the source specified in the BDS. If exchange rates are not so published for certain currencies, the Bidder shall state the rates used and the source. Bidders should note that for the purpose of payments, the exchange rates confirmed by the source specified in the BDS as the selling rates prevailing 28 days prior to the deadline for submission of Bids shall apply for the duration of the Contract so that no currency exchange risk is borne by the Bidder.

15.5 Foreign currency requirements indicated by the Bidders in the Schedule of Payment Currencies shall include but not limited to the specific requirements for

(a) expatriate staff and labor employed directly on the Works;

(b) social, insurance, medical and other charges relating to such expatriate staff and labor, and foreign travel expenses;

(c) imported materials, both temporary and permanent, including fuels, oil and lubricants required for the Works;

(d) depreciation and usage of imported Plant and Contractor's Equipment, including spare parts, required for the Works;

(e) foreign insurance and freight charges for imported materials, Plant and Contractor's Equipment, including spare parts; and

(f) overhead expenses, fees, profit, and financial charges arising outside the Employer's country in connection with the Works.

15.6 Bidders may be required by the Employer to clarify their foreign currency requirements, and to substantiate that the amounts included in the unit rates and prices and shown in the Schedule of Payment Currencies are reasonable and responsive to ITB 15.3 above, in which case a detailed breakdown of its foreign currency requirements shall be provided by the Bidder.

15.7 Bidders should note that during the progress of the Works, the foreign currency requirements of the outstanding balance of the Contract Price may be adjusted by agreement between the Employer and the Contractor in order to reflect any changes in foreign currency requirements for the Contract, in accordance with Sub-Clause 14.15 of the Conditions of Contract. Any such adjustment shall be effected by comparing the percentages quoted in the bid with the amounts already used in the Works and the Contractor's future needs for imported items.

16. Documents Comprising the Technical Proposal

16.1 The Bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule, environmental, health and safety (EHS) management plan commensurate with the proposed scope of works, EHS Code of Conduct, and any other information as stipulated in Section 4 (Bidding Forms), in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the work requirements and the completion time.

17. Documents Establishing the Qualifications of the Bidder

17.1 To establish its qualifications to perform the Contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding information sheets included in Section 4 (Bidding Forms).

17.2 Domestic Bidders, individually or in Joint Ventures, applying for eligibility for domestic preference shall supply all information required to satisfy the criteria for eligibility as described in ITB 36.

18. Period of Validity of Bids

18.1 Bids shall remain valid for the bid validity period specified in the BDS. The bid validity period starts from the date fixed for the bid submission deadline date prescribed by the Employer in accordance with ITB 22.1. A bid valid for a shorter period shall be rejected by the Employer as nonresponsive.

18.2 In exceptional circumstances, prior to the expiration of the bid validity period, the Employer may request Bidders to extend the period of validity of their Bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 19, it shall also be extended 28 days beyond the deadline of the extended validity period. A Bidder may refuse the request without forfeiting its bid security. A

Bidder granting the request shall not be required or permitted to modify its Bid.

19. Bid Security/Bid-Securing Declaration

19.1 Unless otherwise specified in the BDS, the Bidder shall furnish as part of its Bid, in original form, either a Bid-Securing Declaration or a bid security as specified in the BDS. In the case of a bid security, the amount and currency shall be as specified in the BDS.

19.2 If a Bid-Securing Declaration is required pursuant to ITB 19.1, it shall use the form included in Section 4 (Bidding Forms). The Employer will declare a Bidder ineligible to be awarded a Contract for a specified period of time, as indicated in the BDS, if the Bid-Securing Declaration is executed.

19.3 If a bid security is specified pursuant to ITB 19.1, the bid security shall be, at the Bidder's option, in any of the following forms:

(a) an unconditional bank guarantee (hard copy of the bank guarantee or in the form of SWIFT message MT760), or

(b) an irrevocable letter of credit, or

(c) a cashier's or certified check

all from a reputable source from an eligible country as described in Section 5 (Eligible Countries). In the case of a bank guarantee, the bid security shall be submitted either using the Bid Security Form included in Section 4 (Bidding Forms) or another form acceptable to the Employer. The form must include the complete name of the Bidder. The bid security shall be valid for 28 days beyond the original validity period of the bid, or beyond any period of extension if requested under ITB 18.2.

19.4 Unless otherwise specified in the BDS, any Bid not accompanied by a substantially compliant bid security or Bid-Securing Declaration, if one is required in accordance with ITB 19.1, shall be rejected by the Employer as nonresponsive.

19.5 If a bid security is specified pursuant to ITB 19.1, the bid security of substantially nonresponsive Technical Bids shall be returned before opening the Price Bids. The bid security of unsuccessful Bidders at Price Bid evaluation shall be returned promptly upon the successful Bidder's furnishing of the performance security pursuant to ITB 45.

19.6 If a bid security is specified pursuant to ITB 19.1, the bid security of the successful Bidder shall be returned promptly once the successful Bidder has signed the Contract and furnished the required performance security.

19.7 The bid security may be forfeited or the Bid Securing Declaration executed, if

(a) notwithstanding ITB 24.3, a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letters of Technical Bid and Price Bid, except as provided in ITB 18.2; or

(b) the successful Bidder fails to

(i) sign the Contract in accordance with ITB 44;

(ii) furnish a performance security in accordance with ITB 45;

(iii) accept the arithmetical correction of its Bid in accordance with ITB 34; or

(iv) furnish a domestic preference security, if so required.

19.8 If the bid security is required as per ITB 19.1, the bid security of a Joint Venture shall be in the name of the Joint Venture that submits the Bid. If the Joint Venture has not been legally constituted at the time of bidding, the bid security shall be in the name of any or all of the Joint Venture partners. If the Bid-Securing Declaration is required as per ITB 19.1, the Bid-Securing Declaration of a Joint Venture shall be in the name of the Joint Venture that submits the Bid. If the Joint Venture has not been legally constituted at the time of bidding, the Bid-Securing Declaration shall be in the names of all future partners as named in the letter of intent mentioned in ITB 4.1.

20. Format and Signing of Bid

20.1 The Bidder shall prepare one original set of the Technical Bid and one original set of the Price Bid comprising the Bid as described in ITB 11 and clearly mark it "ORIGINAL - TECHNICAL BID" and "ORIGINAL - PRICE BID." Alternative Bids, if permitted in accordance with ITB 13, shall be clearly marked "ALTERNATIVE." In addition, the Bidder shall submit copies of the Technical and Price Bids, in the number specified in the BDS**,** and clearly mark each of them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.

20.2 The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as specified in the BDS and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. If a Bidder submits a deficient authorization, the Bid shall not be rejected in the first instance. The Employer shall request the Bidder to submit an acceptable authorization within the number of days as specified in the BDS. Failure to provide an acceptable authorization within the period as stated in the Employer's request shall cause the rejection of the Bid. If either the Letter of Technical Bid or Letter of Price Bid or Bid-Securing Declaration (if applicable) is not signed, the Bid shall be rejected.

20.3 Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the Bid.

D. Submission and Opening of Bids

21. Sealing and Marking of Bids

21.1 Bidders shall submit their Bids as specified in the BDS. Procedures for submission, sealing, and marking are as follows:

(a) Bidders submitting Bids by mail or by hand shall enclose the original of the Technical Bid, the original of the Price Bid, and each copy of the Technical Bid and each copy of the Price Bid, in separate sealed envelopes, duly marking the envelopes as "ORIGINAL - TECHNICAL BID," "ORIGINAL - PRICE BID," and "COPY NO… - TECHNICAL BID" and "COPY NO…. - PRICE BID." These envelopes, the first containing the originals and the others containing copies, shall then be enclosed in one single envelope per set. If permitted in accordance with ITB 13, alternative Bids shall be similarly sealed, marked and included in the sets. The rest of the procedure shall be in accordance with ITB 21.2 and ITB 21.5.

(b) Bidders submitting Bids electronically shall follow the electronic bid submission procedures specified in the BDS.

21.2 The inner and outer envelopes shall

(a) bear the name and address of the Bidder;

(b) be addressed to the Employer in accordance with BDS 22.1; and

(c) bear the specific identification of this bidding process indicated in the BDS 1.1.

21.3 The outer envelopes and the inner envelopes containing the Technical Bid shall bear a warning not to open before the time and date for the opening of Technical Bid, in accordance with ITB 25.1.

21.4 The inner envelopes containing the Price Bid shall bear a warning not to open until advised by the Employer in accordance with ITB 25.7.

21.5 If all envelopes are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the Bid.

22. Deadline for Submission of Bids

22.1 Bids must be received by the Employer at the address and no later than the date and time indicated in the BDS.

22.2 The Employer may, at its discretion, extend the deadline for the submission of Bids by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.

23. Late Bids

23.1 The Employer shall not consider any Bid that arrives after the deadline for submission of bids, in accordance with ITB 22. Any bid received by the Employer after the deadline for submission of Bids shall be declared late, rejected, and returned unopened to the Bidder.

24. Withdrawal, Substitution, and Modification of Bids

24.1 A Bidder may withdraw, substitute, or modify its Bid – Technical or Price – after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITB 20.2 (except for withdrawal notices, which do not require copies). The corresponding substitution or modification of the Bid must accompany the respective written notice. All notices must be

(a) prepared and submitted in accordance with ITB 20 and ITB 21 (except for withdrawal notices, which do not require copies), and in addition, the respective envelopes shall be clearly marked “WITHDRAWAL,” “SUBSTITUTION,” “MODIFICATION”; and

(b) received by the Employer no later than the deadline prescribed for submission of Bids, in accordance with ITB 22.

24.2 Bids requested to be withdrawn in accordance with ITB 24.1 shall be returned unopened to the Bidders.

24.3 No Bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of Bids and the expiration of the period of bid validity specified by the Bidder on the Letters of Technical Bid and Price Bid or any extension thereof.

25. Bid Opening

25.1 The Employer shall open the Technical Bids in public at the address, on the date and time specified in the BDS in the presence of Bidders` designated representatives and anyone who chooses to attend. Any specific electronic bid opening procedures required if electronic bidding is permitted in accordance with ITB 21.1, shall be as specified in the BDS. The Price Bids will remain unopened and will be held in custody of the Employer until the specified time of their opening. If the Technical Bid and the Price Bid are submitted together in one envelope, the Employer may reject the entire Bid. Alternatively, the Price Bid may be immediately resealed for later evaluation.

25.2 First, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding Bid shall not be opened, but returned to the Bidder. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening.

25.3 Second, outer envelopes marked "SUBSTITUTION" shall be opened. The inner envelopes containing the Substitution Technical Bid and/or Substitution Price Bid shall be exchanged for the corresponding envelopes being substituted, which are to be returned to the Bidder unopened. Only the Substitution Technical Bid, if any, shall be opened, read out, and recorded. Substitution Price Bid will remain unopened in accordance with ITB 25.1. No envelope shall be substituted unless the corresponding substitution notice contains a valid authorization to request the substitution and is read out and recorded at bid opening.

25.4 Next, outer envelopes marked "MODIFICATION" shall be opened. No Technical Bid and/or Price Bid shall be modified unless the corresponding modification notice contains a valid authorization to request the modification and is read out and recorded at the opening of Technical Bids. Only the Technical Bids, both Original as well as Modification, are to be opened, read out, and recorded at the opening. Price Bids, both Original as well as Modification, will remain unopened in accordance with ITB 25.1.

25.5 All other envelopes holding the Technical Bids shall be opened one at a time, and the following read out and recorded:

(a) the name of the Bidder;

(b) whether there is a modification or substitution;

(c) the presence of a bid security or Bid-Securing Declaration, if required; and

(d) any other details as the Employer may consider appropriate.

Only Technical Bids and alternative Technical Bids read out and recorded at bid opening shall be considered for evaluation. Unless otherwise specified in the BDS, all pages of the Letter of Technical Bid are to be initialed by at least three representatives of the Employer attending bid opening. No Bid shall be rejected at the opening of Technical Bids except for late bids, in accordance with ITB 23.1.

25.6 The Employer shall prepare a record of the opening of Technical Bids that shall include, as a minimum, the name of the Bidder and whether there is a withdrawal, substitution, or modification; alternative proposals; and the presence or absence of a bid security or Bid-Securing Declaration, if one was required. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's

signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted Bids on time, and posted online when electronic bidding is permitted.

25.7 At the end of the evaluation of the Technical Bids, the Employer will invite bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Price Bids. The date, time, and location of the opening of Price Bids will be advised in writing by the Employer. Bidders shall be given reasonable notice of the opening of Price Bids.

25.8 The Employer will notify in writing Bidders who have been rejected for submitting nonresponsive Technical Bids and return their Price Bids unopened together with their bid securities, before opening the Price Bids of the substantially responsive Bidders.

25.9 The Employer shall conduct the opening of Price Bids of all Bidders who submitted substantially responsive Technical Bids, in the presence of Bidders` representatives who choose to attend at the address, on the date, and time specified by the Employer. The Bidder's representatives who are present shall be requested to sign a register evidencing their attendance.

25.10 All envelopes containing Price Bids shall be opened one at a time and the following read out and recorded:

(a) the name of the Bidder;

(b) whether there is a modification or substitution;

(c) the Bid Prices, including any discounts and alternative offers; and

(d) any other details as the Employer may consider appropriate.

Only Price Bids discounts, and alternative offers read out and recorded during the opening of Price Bids shall be considered for evaluation. Unless otherwise specified in the BDS, all pages of the Letter of Price Bid and Bill of Quantities are to be initialed by at least three representatives of the Employer attending bid opening. No Bid shall be rejected at the opening of Price Bids.

25.11 The Employer shall prepare a record of the opening of Price Bids that shall include, as a minimum, the name of the Bidder, the Bid Price (per lot if applicable), any discounts, and alternative offers. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted Bids on time, and posted online when electronic bidding is permitted.

E. Evaluation and Comparison of Bids

26. Confidentiality

26.1 Information relating to the examination, evaluation, comparison, and postqualification of Bids and recommendation of contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on the Contract award is communicated to all Bidders.

26.2 Any attempt by a Bidder to influence the Employer in the evaluation of the Bids or Contract award decisions may result in the rejection of its Bid.

26.3 Notwithstanding ITB 26.2, from the time of bid opening to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it may do so in writing.

27. Clarification of Bids

27.1 To assist in the examination, evaluation, and comparison of the Technical and Price Bids, the Employer may, at its discretion, ask any Bidder for a clarification of its Bid. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the substance of the Technical Bid or prices in the Price Bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Price Bids, in accordance with ITB 34.

27.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its Bid may be rejected.

28. Deviations, Reservations, and Omissions

28.1 During the evaluation of Bids, the following definitions apply:

(a) "Deviation" is a departure from the requirements specified in the Bidding Document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and

(c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.

29. Examination of Technical Bids

29.1 The Employer shall examine the Technical Bid to confirm that all documents and technical documentation requested in ITB 11.2 have been provided, and to determine the completeness of each document submitted.

29.2 The Employer shall confirm that the following documents and information have been provided in the Technical Bid. If any of these documents or information is missing, the offer shall be rejected.

(a) Letter of Technical Bid;

(b) written confirmation of authorization to commit the Bidder;

(c) Bid Security or Bid-Securing Declaration, if applicable; and

(d) Technical Proposal in accordance with ITB 16.

30. Responsiveness of Technical Bid

30.1 The Employer's determination of a Bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB11.

30.2 A substantially responsive Technical Bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that,

(a) if accepted, would:

(i) affect in any substantial way the scope, quality, or performance of the Works specified in the Contract; or

(ii) limit in any substantial way, inconsistent with the Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or

(b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive Bids.

30.3 The Employer shall examine the technical aspects of the Bid submitted in accordance with ITB 16, Technical Proposal, in particular, to confirm that all requirements of Section 6 (Works' Requirements) have been met without any material deviation, reservation, or omission.

30.4 If a Bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

31. Nonmaterial Nonconformities

31.1 Provided that a Bid is substantially responsive, the Employer may waive any nonconformities in the Bid that do not constitute a material deviation, reservation, or omission.

31.2 Provided that a Technical Bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Technical Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the Price Bid. Failure of the Bidder to comply with the request may result in the rejection of its Bid.

31.3 Provided that a Technical Bid is substantially responsive, the Employer shall rectify quantifiable nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the method indicated in Section 3 (Evaluation and Qualification Criteria).

32. Qualification of the Bidder

32.1 The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether Bidders meet the qualifying criteria specified in Section 3 (Evaluation and Qualification Criteria).

32.2 The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 17.1. Unless permitted in the BDS, the determination shall not take into consideration the qualifications of other firms such as the Bidder's subsidiaries, parent entities or affiliates.

32.3 An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. The Employer reserves the right to reject the bid of any bidder found to be in circumstances described in Sub-Clause GCC 15.2.1 (g) or Sub-Clause PCC 15.2.1 (h). A negative determination shall result into the disqualification of the Bid, in which event the Employer shall return the unopened Price Bid to the Bidder.

33. Subcontractors

33.1 Unless otherwise stated in the BDS, the Employer does not intend for the contractor to execute any specific elements of the Works through nominated subcontractors.

33.2 If subcontractors are proposed for any of the key activities listed in Section 3 (Evaluation and Qualification) Criteria 2.4.2, they shall be considered as "Specialist Subcontractors" and shall meet qualification requirements for the relevant key activities.

34. Correction of Arithmetical Errors

34.1 During the evaluation of Price Bids, the Employer shall correct arithmetical errors on the following basis:

(a) If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected.

(b) If there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected.

(c) If there is a discrepancy between the bid price in the Summary of Bill of Quantities and the bid amount in item (c) of the Letter of Price Bid, the bid price in the Summary of Bill of Quantities will prevail and the bid amount in item (c) of the Letter of Price Bid will be corrected.

(d) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a), (b) and (c) above.

34.2 If the Bidder that submitted the lowest evaluated bid does not accept the correction of errors, its Bid shall be disqualified and its bid security may be forfeited or its Bid-Securing Declaration executed.

35. Conversion to Single Currency

35.1 For evaluation and comparison purposes, the currency(ies) of the Bid shall be converted into a single currency as specified in the BDS.

36. Domestic Preference

36.1 Unless otherwise specified in the BDS, domestic preference shall not apply.

37. Evaluation and Comparison of Price Bids

37.1 The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted.

37.2 To evaluate the Price Bid, the Employer shall consider the following:

(a) the bid price, excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities, but including Daywork items, where priced competitively;

(b) price adjustment for correction of arithmetic errors in accordance with ITB 34.1;

(c) price adjustment due to discounts offered in accordance with ITB 14.4;

(d) converting the amount resulting from applying (a) to (c) above, if relevant, to a single currency in accordance with ITB 35;

(e) adjustment for nonmaterial nonconformities in accordance with ITB 31.3;

(f) assessment whether the bid is abnormally low in accordance with ITB 38; and

(g) application of all the evaluation factors indicated in Section 3 (Evaluation and Qualification Criteria).

37.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.

37.4 If this Bidding Document allows Bidders to quote separate prices for different contracts, and the award to a single Bidder of multiple contracts, the methodology to determine the lowest evaluated price of the contract combinations, including any discounts offered in the Letter of Price Bid, is specified in Section 3 (Evaluation and Qualification Criteria).

37.5 The Employer shall compare all substantially responsive Bids to determine the lowest evaluated Bid price, in accordance with ITB 37.2.

38. Abnormally Low bids

38.1 An abnormally low bid is one where the bid price, in combination with other elements of the bid, appears to be so low that it raises concerns as to the capability of the Bidder to perform the contract for the offered bid price.

38.2 When the offered bid price appears to be abnormally low, the Employer shall undertake a three-step review process as follows:

(a) identify abnormally low costs and unit rates by comparing them with the engineer's estimates, other substantially responsive bids, or recently awarded similar contracts;

(b) clarify and analyze the bidder's resource inputs and pricing, including overheads, contingencies and profit margins; and

(c) decide whether to accept or reject the bid.

38.3 With regard to ITB 38.2 (b) above, the Employer will seek a written explanation from the bidder of the reasons for the offered bid price, including a detailed analysis of costs and unit prices, by reference to the scope, proposed methodology, schedule, and allocation of risks and responsibilities. This may also include information regarding the economy of the manufacturing process; the services to be provided, or the construction method to be used; the technical solutions to be adopted; and any exceptionally favorable conditions available to the bidder for the works, equipment or services proposed.

38.4 After examining the explanation given and the detailed price analyses presented by the bidder, the Employer may:

(a) accept the bid, if the evidence provided satisfactorily accounts for the low bid price and costs, in which case the bid is not considered abnormally low;

(b) accept the bid, but require that the amount of the performance security be increased at the expense of the bidder to a level sufficient to protect the Employer against financial loss. The amount of the performance security shall generally be not more than 20% of the contract price; or

(c) reject the bid if the evidence provided does not satisfactorily account for the low bid price, and make a similar determination for the next ranked bid, if required.

39. Unbalanced or Front-Loaded Bids

39.1 If the Bid, which results in the lowest evaluated Bid Price, is seriously unbalanced or front-loaded in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analyses for any or all

items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed, as well as the pricing and sources of materials, equipment and labor.

39.2 After the evaluation of the information and detailed price analyses presented by the Bidder, the Employer may as appropriate:

(a) accept the Bid; or

(b) accept the Bid, but require that the total amount of the Performance Security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract subject to ITB 45.2; or

(c) reject the Bid and make a similar determination for the next ranked bid.

40. Employer's Right to Accept Any Bid, and to Reject Any or All Bids

40.1 The Employer reserves the right to accept or reject any Bid, and to annul the bidding process and reject all Bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all Bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.

41. Notice of Intention for Award of Contract

41.1 If Standstill provisions apply as specified in the BDS, the standstill period shall be defined in the BDS to specify the duration subsequent to notification of intention for award of contract (before making the actual contract award) within which any unsuccessful bidder can challenge the proposed award.

F. Award of Contract

42. Award Criteria

42.1 The Employer shall award the Contract to the Bidder whose offer has been determined in line with ITB 37 to ITB 39 above to be the lowest evaluated Bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

43. Notification of Award

43.1 Prior to the expiration of the period of bid validity and upon expiry of the standstill period specified in ITB 41.1, or upon satisfactory resolution of a complaint filed within standstill period, if applicable, the Employer shall transmit the Notification of Award through issuance of Letter of Acceptance using the form included in Section 9 (Contract Forms) to the successful Bidder, in writing, that its Bid has been accepted.

43.2 Unless standstill period applies, upon notification of award through issuance of Letter of Acceptance, unsuccessful Bidders may request in writing to the Employer for a debriefing seeking explanations on the grounds on which their Bids were not selected. The Employer shall promptly respond in writing and/or in a debriefing meeting to any unsuccessful Bidder who, after publication of contract award, requests a debriefing.

43.3 Until a formal contract is prepared and executed, the notification of award through issuance of Letter of Acceptance shall constitute a binding Contract.

43.4 Within 2 weeks of the award of contract or expiry of the standstill period, where such period applies, or, if a complaint has been filed within the standstill period, upon receipt of ADB's confirmation of satisfactory resolution of the complaint, the borrower shall publish in an English

language newspaper or widely known and freely accessible website the results identifying the bid and lot or package numbers, as applicable and the following information:

(a) name of each Bidder who submitted a Bid;

(b) bid prices as read out at bid opening;

(c) name and evaluated prices of each Bid that was evaluated;

(d) name of Bidders whose bids were rejected and the reasons for their rejection; and

(e) name of the winning Bidder, and the price it offered, as well as the duration and summary scope of the contract awarded.

44. Signing of Contract

44.1 The Employer shall send the successful Bidder the Contract Agreement together with or promptly after the issuance of Letter of Acceptance.

44.2 Within 35 days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

45. Performance Security

45.1 Within 28 days of the receipt of notification of award through issuance of Letter of Acceptance from the Employer, the successful Bidder shall furnish the performance security in accordance with the conditions of contract, subject to ITB 38 and ITB 39, using for that purpose the Performance Security Form included in Section 9 (Contract Forms), or another form acceptable to the Employer. If the bank issuing performance security is located outside the Employer's country, it shall be counter-guaranteed or encashable by a bank in the Employer's country.

45.2 Failure of the successful Bidder to submit the abovementioned performance security or to sign the Contract Agreement shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security or execution of the Bid-Securing Declaration. In that event, the Employer may award the Contract to the next lowest evaluated Bidder whose offer is substantially responsive and is determined by the Employer to be qualified to perform the Contract satisfactorily.

45.3 The above provision shall also apply to the furnishing of a domestic preference security if so required.

46. Bidding-Related Complaints

46.1 The procedures for dealing with Bidding-Related Complaints arising out of this bidding process are specified in the BDS.

Section 2: Bid Data Sheet

This section consists of provisions that are specific to each procurement and supplement the information or requirements included in Section 1 (Instructions to Bidders).

A. General

ITB 1.1	The number of the Invitation for Bids (IFB) is: **PID/SKV-R-01**
ITB 1.1	The Employer is: **Project Implementation Directorate, Kathmandu Upatyaka Khanepani Limited (PID/KUKL)**
ITB 1.1	The name of the open competitive bidding (OCB) is **Distribution Network Improvement Works in Kirtipur** The identification number of the OCB is: **PID/SKV/DNI2-Kirtipur** The number and identification of lots (Contracts) comprising this OCB is: • **PID/SKV/DNI1-Bhaktapur** • **PID/SKV/DNI2- Kirtipur** • **PID/SKV/DNI3-MadhyapurThimi** • **PID/SKV/DNI4- Kapan and Jorpati North** • **PID/SKV/DNI5- Jorpati South and Pepsicola**
ITB 2.1	The Borrower is: Nepal
ITB 2.1	The name of the Project is: **Kathmandu Valley Water Supply Improvement Project (Phase 2)**

B. Contents of Bidding Documents

ITB 7.1	For **clarification purposes** only, the Employer's address is: Attention: Project Director Project Implementation Directorate Kathmandu Upatyaka Khanepani Limited Street Address:1235/59 Tankaprasad Acharya GhumtiSadak, Anamnagar City: Kathmandu Country: Nepal Telephone: 977 1 5705916/5705771 Electronic mail address: pidmail@kuklpid.org.np
ITB 7.4	A Pre-Bid meeting shall take place.

	Date: 1 July 2026 Time: 1300 Hrs NPT (Nepal Standard Time) Place: Project Implementation Directorate Kathmandu Upatyaka Khanepani Limited 1235/59 Tankaprasad Acharya GhumtiSadak, Anamnagar, Kathmandu, Nepal Telephone: 977 1 5705916/5705771 Electronic mail address: pidmail@kuklpid.org.np A site visit conducted by the Employer will not be organized.

C. Preparation of Bids

ITB 10.1	The language of the Bid is: English
ITB 11.2 (g)	The Bidder shall submit with its Technical Bid the following additional documents: • Bank Voucher/Cash Receipt for cost of bid document • Firm/Company Registration Certificate (by all Firms in case of Joint Venture) • In case a Bidder is a Joint Venture, the Bidder shall submit a JV undertaking document, setting out the legal undertaking between the two or more partners as a JV. This document shall be signed by all the partners who are members of the JV, and shall be addressed to the Employer and shall include: a) each such member's undertaking to be jointly and severally liable to the Employer for the performance of the Contractor's obligations under the Contract; b) identification and authorization of the leader of the JV; and c) identification of the separate scope or part of the Works (if any) to be carried out by each member of the JV. The national bidder involved if any shall submit VAT registration including tax clearance for the fiscal year 2081/82 and renewed license certificate.
ITB 11.3 (d)	The Bidder shall submit with its Price Bid the following additional documents: **None**
ITB 12.1	The units and rates in figures entered into the Bill of Quantities and Daywork Schedule should be typewritten, if written by hand, must be in print form. Bill of Quantities and Daywork Schedule not presented accordingly may be considered nonresponsive.
ITB 13.1	Alternative Bids **shall not** be permitted.
ITB 13.2	Alternative times for completion **shall not** be permitted.

ITB 13.4	Alternative technical solutions shall be permitted for the following parts of the Works: **Not Applicable**
ITB 14.5	The prices quoted by the Bidder shall be **adjustable for the construction of Works and System Stabilization Services during performance of the Contract.** The formula for adjusting the prices and explanatory details are specified in the GCC Clause 13.7. Bidder shall fill out the Tables of Adjustment Data in Section 4 (Bidding Forms)."
ITB 14.5 (b)	Delete the following sentence in the ITB Sub-Clause 14.5 (b) "A Bid submitted with a fixed price will be subject to clarification"
ITB 15.1	The unit rates and the prices shall be quoted by the Bidder entirely in **Nepalese Rupees (NPR)**.
ITB 15.4	The rates of exchange shall be the selling rates 28 days prior to the deadline for submission of bids published by **Nepal Rastra Bank (Central Bank of Nepal)**
ITB 18.1	The bid validity period shall be **120** days.
ITB 19.1	The Bidder shall furnish a bid security in the amount of **NPR 18 Million or equivalent to USD 0.12 Million**.
ITB 19.2	**Not Applicable**
ITB 19.4	Add the following at the end of Sub-clause: Subject to the succeeding sentences, any bid not accompanied by an irrevocable and callable bid security shall be rejected by the Employer as nonresponsive. If a Bidder submits a bid security that (i) deviates in form, amount, and/or period of validity, or (ii) does not provide sufficient identification of the Bidder (including, without limitation, failure to indicate the name of the Joint Venture or, where the Joint Venture has not yet been constituted, the names of all future Joint Venture Partners), the Employer shall request the Bidder to submit a compliant bid security within 14 (fourteen) days of receiving such a request. Failure to provide a compliant bid security within the prescribed period of receiving such a request shall cause the rejection of the Bid.
ITB 20.1	In addition to the original Bid, the number of copies is: **i) One hard copy of Technical Bid and Price Bid and** **ii) One soft copy of the Technical Bid (Removable drive)**
ITB 20.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of:

	An organizational document, board resolution or its equivalent, or power of attorney specifying the representative's authority to sign the Bid on behalf of, and to legally bind, the Bidder. If the Bidder is an intended or an existing Joint Venture, the power of attorney should be signed by all partners and specify the authority of the named representative of the Joint Venture to sign on behalf of, and legally bind, the intended or existing Joint Venture. If the Joint Venture has not yet been formed, also include evidence from all proposed Joint Venture partners of their intent to enter into a Joint Venture in the event of a contract award in accordance with ITB 11.4.
ITB 20.2	The Bidder shall submit an acceptable authorization within **14** days.

D. Submission and Opening of Bids

ITB 21.1	Bidders shall submit their Bids by mail or by hand.
ITB 21.1 (b)	Electronic bidding submission procedures shall be: **Not Applicable**
ITB 22.1	For **bid submission purposes** only, the Employer's address is: Attention: The Project Director Project Implementation Directorate Kathmandu Upatyaka Khanepani Limited Street address: 1235/59 Tankaprasad Acharya Ghumti Sadak, Anamnagar City: Kathmandu Country: Nepal **The deadline for bid submission is:** Date: 17 July 2026 Time: 1200 Hrs NPT
ITB 25.1	The opening of the Technical Bid shall take place at: Project Implementation Directorate Kathmandu Upatyaka Khanepani Limited Street Address: 1235/59 Tankaprasad Acharya GhumtiSadak, Anamnagar City: Kathmandu Country: Nepal Date: 17 July 2026 Time: **Immediately after bid submission deadline**
ITB 25.1	Electronic bid opening procedure shall be as follows: **Not Applicable**
ITB 25.5	The Letter of Technical Bid shall be initialed by **3** representatives of the Employer attending Bid opening.
ITB 25.10	The Letter of Price Bid and Bill of Quantities shall be initialed by **3** representatives of the Employer attending Bid opening.

E. Evaluation and Comparison of Bids

ITB 32.2	The qualifications of other firms such as the Bidder's subsidiaries, parent entities, or affiliates shall not be permitted.
ITB 33.1	The Employer does not intend for the contractor to execute any specific elements of the Works through nominated subcontractors.
ITB 35.1	The currency that shall be used for bid evaluation and comparison purposes to convert all bid prices expressed in various currencies into a single currency is: **Nepalese Rupees** The source of selling exchange rate shall be: **Nepal Rastra Bank** The date for the selling exchange rate shall be: **28 days prior to the deadline for submission of the bids.**
ITB 36.1	Domestic preference shall not apply.
ITB 41.1	Standstill provisions shall apply. The duration of standstill period will be **7 (seven) days** from the date of notice of intention for award of contract. The Employer shall, at the start of the standstill period, notify in writing each Bidder that submitted a bid, of its intention to award a contract to the successful Bidder at the end of standstill period. The notification using the form included in Section 9 (Contract Forms) shall include the following information: (a) the name of each Bidder who submitted a Bid; (b) the bid prices as read out at bid opening; (c) the name and evaluated prices of each Bid that was evaluated; (d) the name of Bidders whose bids were rejected and the reasons for their rejection; (e) the name of the winning Bidder, and the price it offered, as well as the duration and summary scope of the contract awarded; and (f) a statement of the reason(s) the bid of the unsuccessful Bidder to whom the notification is addressed was unsuccessful, unless the price information under (e) of this paragraph already reveals the reason.

F. Award of Contracts

ITB 46.1	The procedures for Bidding-Related Complaints are referenced in the Procurement Regulations for ADB Borrowers (Appendix 7). The Bidder should submit its complaint following these procedures, in writing, to: For the attention: Title/position: Project Director Employer: PID,KUKL E-mail address: pidmail@kuklpid.org.np

Section 3: Evaluation and Qualification Criteria
- Without Prequalification -

This Section contains all the criteria that the Employer shall use to evaluate bids and qualify Bidders. In accordance with ITB 32 to ITB 36, no other methods, criteria and factors shall be used. The Bidder shall provide all the information requested in the forms included in Section 4 (Bidding Forms).

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1. Evaluation

In addition to the criteria listed in ITB 37.2 (a)–(f), other relevant factors are as follows:

1.1 Adequacy of Technical Proposal

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity to successfully implement the contract considering its proposed site organization, method statement, mobilization, and construction schedule (to be described by the Bidder in sufficient detail to demonstrate the adequacy of its work methods, scheduling, and material sourcing) including the extent to which they are presented in a consistent manner and comply with requirements stipulated in Section 6 (Works' Requirements) without material deviation, reservation, or omission.

Noncompliance with equipment and key personnel requirements described in Section 6 (Works' Requirements) shall not normally be a ground for bid rejection, and such noncompliance will be subject to clarification during bid evaluation and rectification prior to contract award.

1.2 Completion Time

Not Applicable

1.3 Technical Alternatives

Not Applicable

1.4 Specialist Subcontractors

Only the specific experience of Specialist Subcontractors for key activities specified in criterion 2.4.2 Construction Experience in Key Activities will be considered. The experience of Specialist Subcontractors in contracts of similar size and nature, and their financial resources shall not be added to those of the Bidder for purposes of qualification of the Bidder.

1.5 Quantifiable Nonconformities and Omissions

Subject to ITB 14.2 and ITB 37.2, the evaluated cost of quantifiable nonconformities including omissions, is determined as follows:

Pursuant to ITB 31.3, the cost of all quantifiable nonmaterial nonconformities shall be evaluated, including omissions in Daywork where competitively priced but excluding omission of prices in the Bill of Quantities. The Employer will make its own assessment of the cost of any nonmaterial nonconformities and omissions for the purpose of ensuring fair comparison of Bids.

1.6 Domestic Preference

Not Applicable

1.7 Other Criteria

1.7.1 Environmental, Health and Safety Management Plan (EHSMP)

Any bid not accompanied by the EHSMP may be rejected by the Employer as nonresponsive. If a Bidder submits a EHSMP that is not commensurate with the risks and impacts of the proposed works and activities in the bidding document, the Employer shall issue a request for clarification to request for further information from the Bidder. The Bidder must submit the

requested information within **7 (seven) days** of receiving such a request. Failure to provide a satisfactory response to the request for further information within the prescribed period of receiving such a request may cause the rejection of the Bid.

1.7.2 Sustainable Procurement

Not Applicable

1.7.3 Life Cycle Costs (for Financial Evaluation)

Not Applicable

1.8 Multiple Contracts

Five Contract Packages: PID/SKV/DNI1-Bhaktapur, PID/SKV/DNI2-Kirtipur, PID/SKV/DNI3-Madhyapur Thimi, PID/SKV/DNI4-Kapan and Jorpati North, PID/SKV/DNI5-Jorpati South and Pepsicola are grouped in multiple contracts.

Pursuant to ITB 37.4, the Employer shall evaluate and compare Bids on the basis of a contract, or a combination of contracts, or as a total of contracts in order to arrive at the least-cost combination for the Employer by taking into account discounts offered by Bidders in case of award of multiple contracts.

If a Bidder as defined in ITB 4.1 submits several successful (lowest evaluated substantially responsive) bids, the evaluation will also include an assessment of the Bidder's capacity to meet the following aggregated requirements as presented in the bid:

- 2.3.2: Average Annual Construction Turnover;
- 2.3.3: Financial Resources;

2. Qualification

2.1 Eligibility

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	

2.1.1 Nationality

Nationality in accordance with ITB 4.2.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Forms ELI - 1; ELI - 2 with attachments

2.1.2 Conflict of Interest

No conflicts of interest in accordance with ITB 4.3.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Letter of Technical Bid

2.1.3 ADB Eligibility

Not having been declared ineligible by ADB, as described in ITB 4.4.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Letter of Technical Bid

2.1.4 Government-Owned Entity

Bidder required to meet conditions of ITB 4.5.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Forms ELI - 1; ELI - 2 with attachments

2.1.5 United Nations Eligibility

Not having been excluded by an act of compliance with a United Nations Security Council resolution in accordance with ITB 4.8.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Letter of Technical Bid

2.2 Historical Contract Nonperformance

2.2.1 History of Nonperforming Contracts[2]

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Non-performance of a contract[a] did not occur as a result of contractor default since **1 January 2021.**	Must meet requirement	Must meet requirement	Must meet requirement [b]	Not applicable	Form CON-1

[a] Nonperformance, as decided by the Employer, shall include all contracts where (i) nonperformance was not challenged by the contractor, including through referral to the dispute resolution mechanism under the respective contract; and (ii) contracts that were so challenged but fully settled against the contractor. Nonperformance shall not include contracts where the Employer's decision was overruled by the dispute resolution mechanism. Nonperformance must be based on all information on fully settled disputes or litigation, i.e. dispute or litigation that has been resolved in accordance with the dispute resolution mechanism under the respective contract and where all appeal instances available to the Bidder have been exhausted.

[b] This requirement also applies to contracts executed by the Bidder as Joint Venture partner.

2.2.2 Suspension Based on Execution of Bid-Securing Declaration

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Not under suspension based on execution of a Bid-Securing Declaration pursuant to ITB 4.6.	Must meet requirement	Must meet requirement	Must meet requirement	Not applicable	Letter of Technical Bid

[2] Non submission of History of Non-Performing Contract (form Con -1) related document shall not normally be a ground for bid rejection, and such noncompliance will be subject to clarification during bid evaluation. If the bidder submits a compliance document within 7 (seven) days in response to the clarification letter issued by the Employer, then such a bid may be considered compliant in this aspect.

2.2.3 Pending Litigation and Arbitration

Pending litigation and arbitration criterion shall apply.

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
All pending litigation, arbitration, or other material events impacting the net worth and/or liquidity of the bidder, if any, shall be treated as resolved against the Bidder and so shall in total not represent more than **fifty (50) percent** of the Bidder's net worth calculated as the difference between total assets and total liabilities.	Must meet requirement	Not applicable	Must meet requirement	Not applicable	Form CON - 1

2.2.4 Declaration: Environmental, Health and Safety Past Performance

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Declare[3] any contracts that have been suspended or terminated and/or performance security called by an employer for reasons related to the noncompliance of any environmental, health and safety contractual obligations in the past five years.	Must make the declaration. If the bidder proposes Specialist Subcontractor/s to meet EQC 2.4.2, those Specialist Subcontractor/s must also make the declaration	Not applicable	Each partner must make the declaration. If the bidder proposes Specialist Subcontractor/s to meet EQC 2.4.2, those Specialist Subcontractor/s must also make the declaration	Not applicable	Form CON-2

[3] Non submission of Declaration: Environmental, Health and Safety Past Performance (form Con -2) related document shall not normally be a ground for bid rejection, and such noncompliance will be subject to clarification during bid evaluation. If the bidder submits a compliance document within 7 (seven) days in response to the clarification letter issued by the Employer, then such a bid may be considered compliant in this aspect.

2.3 Financial Situation

2.3.1 Historical Financial Performance

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Submission of audited financial statements or, if not required by the law of the Bidder's country, other financial statements acceptable to the Employer, for the last **Five (5)** years to demonstrate the current soundness of the Bidder's financial position. As a minimum, the Bidder's net worth for the last year calculated as the difference between total assets and total liabilities should be positive.	Must meet requirement	Not applicable	Must meet requirement	Not applicable	Form FIN - 1 with attachments

2.3.2 Average Annual Construction Turnover

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Minimum average annual construction turnover of **USD 6.39 Million or equivalent** calculated as total certified payments received for contracts in progress or completed, within the last **Five (5)** years.	Must meet requirement	Must meet requirement	Must meet **Twenty-Five (25%)** of the requirement	Must meet **Forty (40%)** of the requirement	Form FIN - 2

2.3.3 Financial Resources

If the bid evaluation process and the decision for the award of the Contract takes more than 1 year from the date of bid submission, Bidders may be asked to resubmit their current contract commitments and latest information on financial resources supported by latest audited accounts or audited financial statements, or if not required by the law of the Bidder's country, other financial statements acceptable to the Employer, and the Bidders' financial capacity, will be reassessed on this basis.

Criteria	**Compliance Requirements**				**Documents**
Requirement	**Single Entity**	**Joint Venture**			**Submission Requirements**
		All Partners Combined	**Each Partner**	**One Partner**	
For Single Entities The Bidder must demonstrate that its financial resources defined in FIN - 3, less its financial obligations for its current contract commitments defined in FIN - 4, meet or exceed the total requirement for the Subject Contract of **USD 0.9 Million or equivalent**	Must meet requirement	Not applicable	Not applicable	Not applicable	Form FIN – 3 and Form FIN – 4
For Joint Ventures (1) One partner must demonstrate that its financial resources defined in FIN - 3, less its financial obligations for its own current contract commitments defined in FIN - 4, meet or exceed its required share of **40%** from the total requirement for the Subject Contract. AND	Not applicable	Not applicable	Not applicable	Must meet requirement	Form FIN – 3 and Form FIN – 4
(2) Each partner must demonstrate that its financial resources defined in FIN - 3, less its financial obligations for its own current contract commitments defined in FIN - 4, meet or exceed its required share of **25%** from the total requirement for the Subject Contract. AND	Not applicable	Not applicable	Must meet requirement	Not applicable	Form FIN – 3 and Form FIN – 4
(3) The Joint Venture must demonstrate that the combined financial resources of all partners defined in FIN - 3, less all the partners' total financial obligations for the current contract commitments defined in FIN - 4, meet or exceed the total requirement for the Subject Contract of **USD 0.9 Million or equivalent**	Not applicable	Must meet requirement	Not applicable	Not applicable	Form FIN – 3 and Form FIN – 4

2.4 Construction Experience

2.4.1 Contracts of Similar Size and Nature

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
Participation as a contractor, Joint Venture partner, or Subcontractor, in **at least one** contract that has been satisfactorily and substantially completed within the last **ten (10) years** and that is similar to the proposed works, where the value of the Bidder's participation exceeds **USD 6.39 Million or equivalent.** The similarity of the Bidder's participation shall be based on: [a, b] - Construction of Water Supply Infrastructures	Must meet requirement	Must meet requirement	Must have experience of at least one contract in construction of Water Supply Infrastructures with contract value of at least **USD 1.99 Million or equivalent**.	Must meet requirement	Form EXP – 1[d]

[a] For contracts under which the Bidder participated as a Joint Venture partner or Subcontractor, only the Bidder's share, by value, shall be considered to meet this requirement.

[b] For contracts implemented by a Joint Venture contractor, if the Bidder comprises the same Joint Venture, the 'Single Entity' requirements will apply.

[d] In addition to the submission requirement Form EXP – 1, the Bidder shall provide the following supporting documents:

1. Copy of Signed Contract Agreement, and
2. Copy of Taking-Over Certificate, Contract Completion Certificate or Performance Certificate,

in sufficient detail to verify the contract name, value and completion time (or substantial completion). If the documents are other than in English, an accurate certified translation of these documents in English shall be provided.

2.4.2 Construction Experience in Key Activities

2.4.2 (a) Must be complied with by the Bidder. In case of a Joint Venture Bidder, the Bidder or at least one of the partners must meet the requirement in the key activity. For contracts under which the Bidder participated as a Joint Venture partner, only the Bidder's designated scope of works[1] under the contracts shall be considered to meet this requirement.

Table A

Criteria	Compliance Requirements		Documents
Requirement	**Single Entity**	**Joint Venture**	**Submission Requirements**
For the above or other contracts executed during the period stipulated in 2.4.1, a minimum construction experience is required in the following key activities:	Must meet requirement	Must meet requirement	Form EXP – 2[a]
Supplying, laying and installation **of 32 km of DI /Steel pipe/HDPE line (75 mm or above diameter) in single contract** that have been successfully or substantially completed			

[a] Submission requirements: Form EXP – 2 shall be supported by documents such as copies of Signed Contract Agreement, Taking-Over Certificate or Contract Completion Certificate indicating the contract name, value. completion date (or percentage of substantial completion), activities performed by Joint Venture partners, and other relevant details sufficient to demonstrate compliance with the requirements.

[1] For contracts under which the Bidder participated as a Joint Venture partner or Subcontractor and the Bidder's designated scope of works is not explicitly stated in the Submission Requirements (Table A), only the Bidder's share, by value, shall be considered to have carried out the scope of works of contracts for evaluation purpose.

2.4.2. (b) The Employer accepts any of the following activities to be subcontracted. They may be complied with by the Bidder or by its proposed Specialist Subcontractor.

If the key activity is to be undertaken by a Specialist Subcontractor, the Employer shall require evidence of the subcontracting agreement from the Bidder.

Table B

Criteria	Compliance Requirements		Documents
Requirement	**Single Entity or Its Specialist Subcontractors**	**Joint Venture or Its Specialist Subcontractors**	**Submission Requirements**
For the above or other contracts executed during the period stipulated in 2.4.1, a minimum construction experience is required in the following key activities:	Must meet requirement	Must meet requirement	Form EXP – 2[a]
Design and Installation of supervisory control and data acquisition **(SCADA)** system in at least one infrastructure project.			

[a] Submission requirements: Form EXP – 2 shall be supported by documents such as Signed Contract Agreement, Taking-Over Certificate or Contract Completion Certificate indicating the contract name, value. completion date (or percentage of substantial completion), activities performed by Joint Venture partners, and other relevant details sufficient to demonstrate compliance with the requirements.

2.4.3 Specific Experience in Managing Environmental, Health and Safety Aspects

Not Applicable

2.5 Organizational Environmental, Health and Safety System

2.5.1 Environmental, Health and Safety Certification

Not Applicable

2.5.2 Environmental, Health and Safety Documentation

Not Applicable

2.5.3 Environmental, Health and Safety Dedicated Personnel

Criteria	Compliance Requirements		Documents
Requirement	**Single Entity or Its Specialist Subcontractors**	**Joint Venture or Its Specialist Subcontractors**	**Submission Requirements**
Availability of in-house personnel dedicated to EHS issues: 1. Environmental, Health and Safety (EHS) Officer	Must meet requirements	One member must meet requirements	Form EXP – 6

Section 4: Bidding Forms
- Without Prequalification -

This section contains the forms to be completed by the Bidder and submitted as part of its Bid.

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Letter of Technical Bid

-Note-

The Bidder must accomplish the Letter of Technical Bid on its letterhead clearly showing the Bidder's complete name and address.

Date: .....

OCB No.: .....

Invitation for Bid No.: .....

To: [insert complete name of the Employer]

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8.

(b) We acknowledge that we have read and understand ADB's Anticorruption Policy (1998) and Integrity Principles and Guidelines (2015), both as amended from time to time.

(c) We offer to execute in conformity with the Bidding Documents the following Works: [insert narrative]

(d) Our Bid consisting of the Technical Bid and the Price Bid shall be valid for a period of **120** days starts from the date fixed for the bid submission deadline in accordance with ITB 22.1, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

(e) Our firm, including any Subcontractors or Suppliers for any part of the Contract, have nationalities from eligible countries in accordance with ITB 4.2.

(f) We, our directors, key officers, key personnel, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 4.3.

If there is any conflict of interest, please state details:

(i) Parties involved in the conflict of interest: _____

(ii) Details about the conflict of interest: _____

(g) We are not participating, as a Bidder, either individually or as partner in a Joint Venture, in more than one Bid in this bidding process in accordance with ITB 4.3(e), other than alternative offers submitted in accordance with ITB 13.

(h) Our firm, Joint Venture partners, our respective direct and indirect shareholders, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the contract, are not subject to, or not controlled by any entity or individual that is subject to, a temporary suspension or a debarment imposed by the Asian Development Bank or a debarment imposed by the Asian Development Bank

in accordance with the Agreement for Mutual Enforcement of Debarment Decisions between the Asian Development Bank and other development banks.[4]

(i) We have checked all the parties mentioned in the declaration above against ADB's published sanctions list accessed via https://www.adb.org/who-we-are/integrity/sanctions.

(j) Our firm, Joint Venture partners, our respective direct and indirect shareholders, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the contract, are not under ongoing investigation and/or sanctions proceedings by the Asian Development Bank or any multilateral development bank.

If under ongoing investigation and/or sanctions proceedings by the Asian Development Bank or any multilateral development bank, please state details:

(i) Name of the multilateral development bank: _____

(ii) Reason for the ongoing investigation / allegations: _____

(k) Our firm, Joint Venture partners, our respective direct and indirect shareholders, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the Contract, are not temporarily suspended, debarred, declared ineligible, or subject to any national and/or international sanctions by any country, any international organization, any multilateral development bank and other donor agency.

If so temporarily suspended, debarred, declared ineligible, or subject to any national and/or international sanctions by any country, any international organization, any multilateral development bank and other donor agency, please state details (as applicable to each Joint Venture partner, their respective direct or indirect shareholders, directors, key officers, key personnel, associate, parent company, affiliate, subsidiaries, Subcontractors, consultants, subconsultants, manufacturers, service providers and/or Suppliers):

(i) Name of Institution: _____

(ii) Period of the temporary suspension, debarment, ineligibility, or national or international sanction [start and end date]: _____

(iii) Reason for the temporary suspension, debarment, ineligibility, or national or international sanction: _____

(l) Our firm, Joint Venture partners, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers, Suppliers, key officers, directors and key personnel have never been charged or convicted with any criminal offense (including felonies but excluding misdemeanors) or infractions and/or violations of ordinance; nor charged or found liable in any civil or administrative proceedings in the last 10 years; or undergoing investigation for such, or subject to any criminal, civil or administrative orders, monitorship or enforcement actions.

[4] These institutions include African Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, and the World Bank Group. According to paragraph 9 of the Agreement, other international financial institutions may join upon the consent of all Participating Institutions and signature of a Letter of Adherence by the international financial institution substantially in the form provided (Annex B to the Agreement). Upon adherence, such international financial institution shall become a Participating Institution for purposes of the Agreement. Bidders are advised to check www.adb.org/integrity for updates.

If so charged, convicted/found liable, under ongoing investigation, or subject to orders, monitorship or enforcement actions, please state details:

(i) Nature of the offense, violation, proceedings, investigation, and/or monitorship or enforcement actions: _____

(ii) Court, area of jurisdiction and/or the enforcement agency: _____

(iii) Resolution [i.e. dismissed; settled; or convicted/duration of penalty]: _____

(iv) Other relevant details [please specify]:

(m) Our firm, Joint Venture partners, our respective direct and indirect shareholders, directors, key officers, key personnel, associates, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers, can make and receive payments through the international banking system or otherwise discharge the Employer's obligation upon initiation of wire transfer.

If unable to make or receive funds through the international banking system or otherwise discharge the Employer's obligation upon initiation of wire transfer, please state the details:

(i) Nature of the restriction: _____

(ii) Jurisdiction of the restriction: _____

(iii) Other relevant details: _____

(n) Our firm, Joint Venture partners, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers, key officers, directors and key personnel are not from a country which is prohibited to export goods or services to, or receive any payments from the Employer's country and/or are not prohibited to receive payments for particular goods or services by the Employer's country by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations.

(o) We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract.[5]

Name of Recipient	Address	Reason	Amount
.....	.....	.....	.....
.....	.....	.....	..... .

(p) We understand that it is our obligation to notify the Employer of any changes in connection with the matters described in paragraphs (f), (h), (j), (k), (l), (m), (n) and (o) of this Letter of Technical Bid.

(q) [We are not a government-owned enterprise] / [We are a government-owned enterprise but meet the requirements of ITB 4.5].[6]

(r) We have not been suspended nor declared ineligible by the Employer based on execution of a Bid-Securing Declaration in accordance with ITB 4.6.

(s) At any time following submission of our Bid, we shall permit, and shall cause our Joint Venture partners, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants,

5 If none has been paid or is to be paid, indicate "None".

6 Use one of the two options as appropriate.

manufacturers, service providers or Suppliers for any part of the contract to permit ADB or its representative to inspect our site, assets, accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by ADB. We understand that failure of this obligation may constitute obstructive practice that may result in debarment and/or contract termination.

(t) Regardless of whether the contract will be awarded to us, we shall preserve all accounts, records and other documents related to bid submission for at least 3 years from the date of submission of the bid or the period prescribed in applicable law, whichever is longer.

(u) If we are awarded the contract, we shall preserve all accounts, records and other documents related to the procurement and execution of the contract for at least 5 years after completing the works contemplated in the relevant contracts or the period prescribed in applicable law, whichever is longer.

(v) If our Bid is accepted, we commit to mobilizing key equipment and personnel in accordance with the requirements set forth in Section 6 (Works' Requirements) and our technical proposal, or as otherwise agreed with the Employer.

(w) We certify on behalf of the Bidder, that the information provided in the bid has been fully reviewed, given in good faith, and to the best of our knowledge is true and complete. We understand that it is our obligation to inform the Employer of any changes to the information as and when it becomes known to us. We understand that any misrepresentation that knowingly or recklessly misleads, or attempts to mislead may lead to the automatic rejection of the Bid or cancellation of the contract, if awarded; and may result in remedial actions, in accordance with ADB's Anticorruption Policy (1998, as amended to date) and Integrity Principles and Guidelines (2015, as amended from time to time).

Name: [insert complete name of person signing the bid]

In the capacity of [insert legal capacity of person signing the bid]

Signed: [insert signature of person whose name and capacity are shown above]

Duly authorized to sign the Bid for and on behalf of [insert complete name of the Bidder]

Date: [insert date of signing]

Letter of Price Bid

-Note-

The Bidder must accomplish the Letter of Price Bid on its letterhead clearly showing the Bidder's complete name and address.

Date: .....

OCB No.: .....

Invitation for Bid No.: .....

To: [insert complete name of the Employer]

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8.

(b) We acknowledge that we have read and understand ADB's Anticorruption Policy (1998) and Integrity Principles and Guidelines (2015), both as amended from time to time.

(c) We offer to execute in conformity with the Bidding Documents and the Technical Bid submitted for the following Works. [insert narrative]

(d) The total price of our Bid, excluding any discounts offered in item (d) below is:

[amount of foreign currency in words], [amount in figures], and [amount of local currency in words], [amount in figures]

The total bid price from the Summary of Bill of Quantities should be entered by the bidder inside this box. Absence of the total bid price in the Letter of Price Bid may result in the rejection of the bid.

(e) The discounts offered and the methodology for their application are: [insert discounts and methodology for their application if any]

(f) Our Bid shall be valid for a period of [insert bid validity period as specified in ITB 18.1 of the BDS] days starts from the date fixed for the bid submission deadline in accordance with ITB 22.1, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

(g) If our Bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents.

(h) We understand that this bid, together with your written acceptance thereof included in your notification of award through the issuance of Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed.

(i) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

(j) At any time following submission of our Bid, we shall permit, and shall cause our Joint Venture partners, directors, key officers, key personnel, associates, parent company, affiliates or subsidiaries, including any Subcontractors, consultants, subconsultants, manufacturers, service providers or Suppliers for any part of the contract to permit ADB or its representative to inspect our site, assets, accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by ADB. We understand that failure of this obligation may constitute obstructive practice that may result in debarment and/or contract termination.

(k) Regardless of whether the contract will be awarded to us, we shall preserve all accounts, records and other documents related to bid submission for at least 3 years from the date of submission of the bid or the period prescribed in applicable law, whichever is longer.

(l) If we are awarded the contract, we shall preserve all accounts, records and other documents related to the procurement and execution of the contract for at least 5 years after completing the works contemplated in the relevant contracts or the period prescribed in applicable law, whichever is longer.

(m) We confirm and stand by our commitments and other declarations made in connection with the submission of our Letter of Technical Bid.

(n) We certify on behalf of the Bidder, that the information provided in the bid has been fully reviewed, given in good faith, and to the best of our knowledge is true and complete. We understand that it is our obligation to inform the Employer of any changes to the information as and when it becomes known to us. We understand that any misrepresentation that knowingly or recklessly misleads, or attempts to mislead may lead to the automatic rejection of the Bid or cancellation of the contract, if awarded; and may result in remedial actions, in accordance with ADB's Anticorruption Policy (1998, as amended to date) and Integrity Principles and Guidelines (2015, as amended from time to time).

Name: [insert complete name of person signing the bid]

In the capacity of [insert legal capacity of person signing the bid]

Signed: [insert signature of person whose name and capacity are shown above]

Duly authorized to sign the Bid for and on behalf of [insert complete name of the Bidder]

Date: [insert date of signing]

Bid Security
Bank Guarantee

[Bank's name, and address of issuing branch or office][7]

Beneficiary: ……[Name and address of the Employer]……..

Date: ……..

Bid Security No.: ……

We have been informed that [name of the Bidder] (hereinafter called "the Bidder") has submitted to you its bid dated [please specify] (hereinafter called "the Bid") for the execution of [name of contract] under Invitation for Bids No. [please specify] ("the IFB").

Furthermore, we understand that, according to your conditions, bids must be supported by a bid guarantee.

At the request of the Bidder, we [name of bank] hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [amount in words] [amount in figures] upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the bid conditions, because the Bidder

(a) has withdrawn its Bid during the period of bid validity specified by the Bidder in the Letter of Bid; or
(b) does not accept the correction of errors in accordance with the Instructions to Bidders (hereinafter "the ITB"); or
(c) having been notified of the acceptance of its Bid by the Employer during the period of bid validity, (i) fails or refuses to execute the Contract Agreement, or (ii) fails or refuses to furnish the performance security, in accordance with the ITB, or (iii) fails or refuses to furnish a domestic preference security, if required.

This guarantee will expire (a) if the Bidder is the successful Bidder, upon our receipt of copies of the Contract Agreement signed by the Bidder and the Performance Security issued to you upon the instruction of the Bidder; or (b) if the Bidder is not the successful Bidder, upon the earlier of (i) our receipt of a copy of your notification to the Bidder of the name of the successful Bidder, or (ii) 28 days after the expiration of the Bidder's bid.

Consequently, any demand for payment under this guarantee must be received by us at the office indicated above on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758 except that the supporting statement under Article 15(a) is hereby excluded.

……
[Authorized signature(s) and bank's seal (where appropriate)]

[7] All italicized text is for use in preparing this form and shall be deleted from the final document.

Bid-Securing Declaration

Not Applicable

Affiliate Company Guarantee

Not Applicable

Technical Proposal

Personnel

Equipment

Site Organization

Method Statement

Mobilization Schedule

Construction Schedule

Environmental, Health and Safety Management Plan (EHSMP)

Environmental, Health and Safety Code of Conduct

Personnel

Form PER – 1: Proposed Personnel

Bidder should provide the details of the proposed personnel and their experience record in the relevant Information Forms below for each candidate:

1.	**Title of position**
	Name
2.	**Title of position**
	Name
3.	**Title of position**
	Name
4.	**Title of position**
	Name
5.	**Title of position**
	Name
6.	**Title of position**
	Name
etc.	**Title of position**
	Name

NOTE

All titles of positions will be as listed in Section 6 (Works' Requirements).

Form PER – 2: Resumé of Proposed Personnel

The Bidder shall provide all the information requested below. Use one form for each position.

Position		
Personnel information	**Full Legal Name**	**Date of Birth**
	Known as	**Place of Birth**
	Nationality	**Citizenship**
	Type of Government ID **Attach a copy of ID to this form**	**ID number**
	Professional qualifications	
Present employment	**Name of employer**	
	Address of employer	
	Telephone	**Contact (manager / personnel officer)**
	Fax	**E-mail**
	Job title	**Years with present employer**

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

From	To	Company/Project/Position/Relevant Technical and Management Experience

Equipment

Form EQU: Equipment

The Bidder shall provide adequate information and details to demonstrate clearly that it has the capability to meet the equipment requirements indicated in Section 6 (Works' Requirements), using the Forms below. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

Item of Equipment		
Equipment Information	**Name of manufacturer**	**Model and power rating**
	Capacity	**Year of manufacture**
Current Status	**Current location**	
	Details of current commitments	
Source	**Indicate source of the equipment** ☐ **Owned** ☐ **Rented** ☐ **Leased** ☐ **Specially manufactured**	

Omit the following information for equipment owned by the Bidder.

Owner	**Name of owner**	
	Address of owner	
	Telephone	**Contact name and title**
	Fax	**Telex**
Agreements	**Details of rental / lease / manufacture agreements specific to the project**	

Site Organization

Method Statement

Mobilization Schedule

The Mobilization Schedule should reflect the no-objection request and approval step for Site-Specific Environmental, Health and Safety Management Plan as per Contract Conditions.

Construction Schedule

The construction schedule shall include the following key milestones:

Environmental, Health and Safety Management Plan (EHSMP)

The Bidder shall submit an outline Environmental, Health and Safety Management Plan (EHSMP) commensurate with the risks and impacts of the proposed works and activities These strategies and plans shall describe in detail the actions, materials, equipment, management processes etc. that will be implemented by the Contractor, and its subcontractors.

In developing these strategies and plans, the Bidder shall have regard to the EHS provisions of the contract and EHS risks including those as may be more fully described in Section 6 (Works' Requirements).

Environmental, Health and Safety Code of Conduct

Environmental, Health and Safety Code of Conduct for Contractor's Personnel Form

NOTE TO BIDDER

The minimum content of the EHS Code of Conduct form as set out by the Employer shall not be substantially modified. However, the Bidder may add requirements as appropriate, including to take into account Contract-specific issues/risks.

The Bidder shall initial and submit the EHS Code of Conduct form as part of its bid.

ENVIRONMENTAL, HEALTH AND SAFETY
CODE OF CONDUCT FOR CONTRACTOR'S PERSONNEL

We are the Contractor, [enter name of Contractor]. We have signed a contract with [enter name of Employer] for [enter description of the Works]. These Works will be carried out at [enter the Site and other locations where the Works will be carried out]. Our contract requires us to implement measures to address environmental, health and safety risks related to the Works.

This EHS Code of Conduct is part of our measures to deal with environmental, health and safety risks related to the Works. It applies to all our staff, laborers and other employees at the Works Site or other places where the Works are being carried out. It also applies to the personnel of each subcontractor and any other personnel assisting us in the execution of the Works. All such persons are referred to as "**Contractor's Personnel**" and are subject to this EHS Code of Conduct.

This EHS Code of Conduct identifies the behavior that we require from all Contractor's Personnel.

Our workplace is an environment where unsafe, offensive, abusive or violent behavior will not be tolerated and where all persons should feel comfortable raising issues or concerns without fear of retaliation.

REQUIRED CONDUCT

Contractor's Personnel shall:

1. carry out his/her duties competently and diligently;

2. comply with this EHS Code of Conduct and all applicable laws, regulations and other requirements, including requirements to protect the health, safety and well-being of other Contractor's Personnel and any other person;

3. maintain a safe working environment including by:
   (a) ensuring that workplaces, machinery, equipment and processes under each person's control are safe and without risk to health;
   (b) wearing required personal protective equipment;
   (c) using appropriate measures relating to chemical, physical and biological substances and agents; and
   (d) following applicable emergency operating procedures.

4. report work situations that he/she believes are not safe or healthy and remove himself/herself from a work situation which he/she reasonably believes presents an imminent and serious danger to his/her life or health;

5. treat other people with respect, and not discriminate against specific groups such as women, people with disabilities, migrant workers or children;

6. report violations of this EHS Code of Conduct; and

7. not retaliate against any person who reports violations of this EHS Code of Conduct, whether to us or the Employer, or who makes use of the grievance mechanism for Contractor's Personnel or the project's Grievance Redress Mechanism.

RAISING CONCERNS

If any person observes behavior that he/she believes may represent a violation of this EHS Code of Conduct, or that otherwise concerns him/her, he/she should raise the issue promptly. This can be done by call [ ] to reach the Contractor's hotline (if any) and leave a message.

The person's identity will be kept confidential, unless reporting of allegations is mandated by the country law. Anonymous complaints or allegations may also be submitted and will be given all due and appropriate consideration. We take seriously all reports of possible misconduct and will investigate and take appropriate action. We will provide warm referrals to service providers that may help support the person who experienced the alleged incident, as appropriate.

CONSEQUENCES OF VIOLATING THE ENVIRONMENTAL, HEALTH AND SAFETY CODE OF CONDUCT

Any violation of this EHS Code of Conduct by Contractor's Personnel may result in serious consequences, up to and including termination of the employment/engagement contract and possible referral to legal authorities.

FOR CONTRACTOR'S PERSONNEL:

I have received a copy of this EHS Code of Conduct written in a language that I comprehend. I understand that if I have any questions about this EHS Code of Conduct, I can contact [enter name of Contractor's contact person(s) with relevant experience] requesting an explanation.

Name of Contractor's Personnel: [insert name]
Signature: _____
Date: [day month year]: _____

Countersignature of authorized representative of the Contractor:
Signature: _____
Date: [day month year]: _____

Bidders Qualification

To establish its qualifications to perform the contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall provide the following information requested in the corresponding Information Sheets.

Form ELI - 1: Bidder's Information Sheet

Bidder's Information			
		Information of the Bidder	**If the Bidder is a subsidiary or branch, information of any parent company/companies**
Names	**Full legal name(s)**		
	Full trading name(s) (if any)		
Addresses	**Registered address(es)**		
	Trading address(es)		
	Postal address(es) (if different from trading address)		
Type of organization			
Country of constitution/incorporation/registration			
Year of constitution/incorporation/ registration			
Corporate or registration number			
In case of a Joint Venture, legal name of each partner			
Bidder's authorized representative (name, address, telephone number(s), fax number(s), e-mail address)			

Attached are copies of the following documents:

1) In case of a single entity, articles of incorporation or constitution and company incorporation/registration of the legal entity named above, in accordance with ITB 4.1 and ITB 4.2.
2) Authorization to represent the firm or Joint Venture named above, in accordance with ITB 20.2.
3) In case of a Joint Venture, a letter of intent to form a Joint Venture or Joint Venture agreement, in accordance with ITB 4.1.
4) In case of a government-owned enterprise, any additional documents not covered under 1 above required to comply with ITB 4.5.

Form ELI - 2: Joint Venture Information Sheet

Each partner of the Joint Venture and Specialist Subcontractor must fill out this form separately.

Joint Venture / Specialist Subcontractor Information			
Bidder's legal name			
		Information of Joint Venture Partner or Specialist Subcontractor	**If any Joint Venture Partner or Specialist Subcontractor is a subsidiary or branch, information of any parent company/companies**
Names	**Full legal name(s)**		
	Full trading name(s) (if any)		
Addresses	**Registered address(es)**		
	Trading address (es)		
	Postal address (es) (if different from trading address)		
Type of organization			
Country of constitution/incorporation/ registration			
Year of constitution/incorporation/ registration			
Corporate or registration number			
Joint Venture Partner's or Specialist Subcontractor's authorized representative information (name, address, telephone number(s), fax number(s), e-mail address)			
Attached are copies of the following documents: 1) Articles of incorporation or constitution and company incorporation/registration of the legal entity named above, in accordance with ITB 4.1 and ITB 4.2. 2) Authorization to represent the firm named above, in accordance with ITB 20.2. *3)* In the case of a government-owned enterprise, documents establishing legal and financial autonomy and compliance with commercial law, in accordance with ITB 4.5.			

Form CON - 1: Historical Contract Nonperformance

Each Bidder must fill out this form in accordance with Criteria 2.2.1 and 2.2.3 of Section 3 (Evaluation and Qualification Criteria) to describe any history of nonperforming contracts and pending litigation or arbitration formally commenced against it.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Table 1: History of Nonperforming Contracts

Choose one of the following:

❑ No nonperforming contracts.

❑ Below is a description of nonperforming contracts involving the Bidder (or each Joint Venture partner if Bidder is a Joint Venture).

Year	Description	Amount of Nonperformed Portion of Contract ($ equivalent)	Total Contract Amount ($ equivalent)
[insert year]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Reason(s) for nonperformance: [indicate main reason(s)]	[insert amount]	[insert amount]

Table 2: Pending Litigation and Arbitration

Choose one of the following:

❑ No pending litigation, arbitration or any other material events impacting the net worth and/or liquidity of the bidder.

❑ Below is a description of all pending litigation, arbitration involving the Bidder or any other material events impacting the net worth and/or liquidity of the bidder (or each Joint Venture partner if Bidder is a Joint Venture).

Year	Matter in Dispute	Value of Pending Claim in $ Equivalent	Value of Pending Claim as a Percentage of Net Worth
[insert year]	Contract Identification, as applicable: [indicate complete contract name/ number, and any other identification] Name of Employer, parties involved in the material events impacting the net worth and/or liquidity of the bidder: [insert full name] Address of Employer, parties involved in the material events impacting the net worth and/or liquidity of the bidder: [insert street/city/country] Matter of Dispute: [indicate full description of dispute] Party who initiated the dispute: [indicate "Employer" or "Contractor"] Status: [indicate status of dispute]	[insert amount]	[insert amount]

NOTE

Table 2 of this form shall only be included if Criterion 2.2.3 of Section 3 (Evaluation and Qualification Criteria) is applicable.

Form CON – 2: EHS Performance Declaration

Each Bidder must fill out this form in accordance with Criterion 2.2.4 of Section 3 (Evaluation and Qualification Criteria).

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

In case of a Specialist Subcontractors, each Specialist Subcontractor must fill out this form and provide the Specialist Subcontractor's name:

Specialist Subcontractor: _____

Environmental and Health and Safety Performance Declaration in accordance with Section 3 (Evaluation and Qualification Criteria)

☐ **No suspension or termination of contract**: An employer has not suspended or terminated a contract and/or called the performance security for a contract for reasons related to Environmental or Health and Safety performance since the date specified in Section 3 (Evaluation and Qualification Criteria), Criterion 2.5.

☐ **Declaration of suspension or termination of contract**: The following contract(s) has/have been suspended or terminated and/or Performance Security called by an employer(s) for reasons related to Environmental or Health and Safety performance since the date specified in Section 3 (Evaluation and Qualification Criteria), Criterion 2.5. Details are described below:

☐ **Declaration of request for replacement of Key Environment, Health and Safety Personnel**: The following contract(s) has/have experienced a request by the Employer to replace Environmental, Health and Safety Personnel for reasons related to Environmental or Health and Safety performance since the date specified in Section 3 (Evaluation and Qualification Criteria), Criterion 2.5. Details are described below:

☐ **Declaration of past fatality resulted from EHS issues on site**: The following contract(s) has/have experienced a fatality resulted from EHS issues on site since the date specified in Section 3 (Evaluation and Qualification Criteria), Criterion 2.5. Details are described below:

Year	Suspended or terminated portion of contract	Contract Identification	Total Contract Amount (current value, currency, exchange rate and USD equivalent)
[insert year]	[insert amount and percentage]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Reason(s) for suspension or termination: [indicate main reason(s) e.g. discharge over environmental limit, workers did not have required health and safety permits to undertake high risk work, work carried out was not adhered to approved construction methodology and quality control plan]	[insert amount]
[insert year]	[insert amount and percentage]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Reason(s) for suspension or termination: [indicate main reason(s)]	[insert amount]
…	…	[list all applicable contracts]	…
Performance Security called by an employer(s) for reasons related to EHS performance			

Year	Contract Identification	Total Contract Amount (current value, currency, exchange rate and USD equivalent)
[insert year]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Reason(s) for suspension or termination: [indicate main reason(s) e.g. discharge over environmental limit, workers did not have required health and safety permits to undertake high risk work, work carried out was not adhered to approved construction methodology and quality control plan]	[insert amount]
Key EHS personnel replacement requested by the Employer for reasons related to EHS performance		
Year	**Contract Identification and Reasons**	**Personnel replacement action and results**
[insert year]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Reason(s) for requesting for replacement: [indicate main reason(s)]	[insert description]
Fatality due to EHS issues on Site		
Year	**Contract Identification**	**Follow-on actions taken by the contractor**
[insert year]	Contract Identification: [indicate complete contract name/ number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Description of fatality event: Causation:	[insert description]

Form FIN - 1: Historical Financial Performance

Each Bidder must fill out this form.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Financial Data for Previous _____ Years [$ Equivalent]		
Year 1:	**Year 2:**	**Year ___:**

Information from Balance Sheet

Total Assets (TA)			
Total Liabilities (TL)			
Net Worth = TA – TL			
Current Assets (CA)			
Current Liabilities (CL)			

Most Recent Working Capital		To be obtained for most recent year and carried forward to FIN - 3 Line 1; in case of Joint Ventures, to the corresponding Joint Venture Partner's FIN – 3.

Information from Income Statement

Total Revenues			
Profits Before Taxes			
Profits After Taxes			

❑ Attached are copies of financial statements (balance sheets including all related notes and income statements) for the last _____ years, as indicated above, complying with the following conditions:

1) Unless otherwise required by Section 3 of the Bidding Document, all such documents reflect the standalone financial situation of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries, or affiliates.
2) Historical financial statements must be audited by a certified accountant.
3) Historical financial statements must be complete, including all notes to the financial statements.
4) Historical financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

Form FIN - 2: Average Annual Construction Turnover

Each Bidder must fill out this form.

The information supplied should be the Annual Turnover of the Bidder or each partner of a Joint Venture for the total certified payments received from the clients for contracts in progress or completed, converted to US dollars at the rate of exchange at the end of the period reported.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Annual Turnover Data for the Last _____ Years (Construction only)			
Year	**Amount Currency**	**Exchange Rate**	**$ Equivalent**
Average Annual Construction Turnover			

Form FIN – 3: Availability of Financial Resources

Bidders must demonstrate sufficient financial resources, usually comprising of Working Capital supplemented by credit line statements or overdraft facilities and others to meet the Bidder's financial requirements for its current contract commitments, and the subject contract.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Financial Resources		
No.	**Source of financing**	**Amount ($ equivalent)**
1	Working Capital (to be taken from FIN - 1)	
2	Credit Line[a]	
3	Other Financial Resources	
Total Available Financial Resources		

[a] To be substantiated by a letter from the bank issuing the line of credit.

Form FIN- 4: Financial Requirements for Current Contract Commitments

Bidders (or each Joint Venture partner) should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

In case of a Joint Venture, each Joint Venture Partner must fill out this form separately and provide the Joint Venture Partner's name:

Joint Venture Partner: _____

Current Contract Commitments						
No.	**Name of Contract**	**Employer's Contact (Address, Tel, Fax)**	**Contract Completion Date**	**Outstanding Contract Value (X) [a]**	**Remaining Contract Period in months (Y) [b]**	**Monthly Financial Resources Requirement (X / Y)**
1						
2						
3						
4						
Total Monthly Financial Requirement for Current Contract Commitments						**$** . . . . .

[a] Remaining outstanding contract values to be calculated from 28 days prior to the bid submission deadline ($ equivalent based on the foreign exchange rate as of the same date).

[b] Remaining contract period to be calculated from 28 days prior to bid submission deadline.

Form FIN - 5: Self-Assessment Tool for Bidder's Compliance to Financial Resources (Criterion 2.3.3 of Section 3)

This form requires the same information submitted in Forms FIN - 3 and FIN - 4. All conditions of "Available Financial Resources Net of CCC ≥ Requirement for the Subject Contract" must be satisfied to qualify.

Form FIN - 5A: For Single Entities

For Single Entities: (A)	Total Available Financial Resources from FIN – 3 (B)	Total Monthly Financial Requirement for Current Contract Commitments (CCC) from FIN – 4 (C)	Available Financial Resources Net of CCC D = (B - C)	Requirement for the Subject Contract (E)	Results: Yes or No [*D must be greater than or equal to E*] (F)
_____ (Name of Bidder)				. . . . .	

Form FIN - 5B: For Joint Ventures

For Joint Ventures: (A)	Total Available Financial Resources from FIN – 3 (B)	Total Monthly Financial Requirement for Current Contract Commitments (CCC) from FIN – 4 (C)	Available Financial Resources Net of CCC D = (B - C)	Requirement for the Subject Contract (E)	Results: Yes or No [*D must be greater than or equal to E*] (F)
One Partner:					
_____ (Name of Partner)				. . . . .	
Each Partner:					
_____ (Name of Partner 1)				. . . . .	
_____ (Name of Partner 2)				. . . . .	
_____ (Name of Partner 3)				. . . . .	
All partners combined	∑ D = Sum of available financial resources net of current contract commitments for all partners		∑ D = _____	. . . . .	

NOTE

Form FIN – 5 is made available for use by the bidder as a self-assessment tool, and by the Employer as an evaluation work sheet, to determine compliance with the financial resources requirement as stated in 2.3.3. Failure to submit Form FIN - 5 by the Bidder shall not lead to bid rejection.

Form EXP – 1: Contracts of Similar Size and Nature

Fill out one (1) form per contract. Each contract shall be supported by documents such as Signed Contract Agreement, Taking-Over Certificate, Contract Completion Certificate or Performance Certificate.

The exchange rate to be used to calculate the value of the contract for conversion to a specific currency shall be the selling rate of the Borrower's Central bank on the date of the contract.

Contract of Similar Size and Nature		
Contract No . . . . . **of**	**Contract Identification**	
Award Date		**Completion Date**
Total Contract Amount	**$**	
If partner in a Joint Venture or Subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**
Employer's name **Address** **Telephone number** **Fax number** **E-mail**		
Description of the Similarity in Accordance with Criterion 2.4.1 of Section 3 (Evaluation and Qualification Criteria)		
To be copied from Section 3, Sub-Clause 2.4.1		

Form EXP – 2: Construction Experience in Key Activities

Fill out one (1) form per contract. Each contract shall be supported by documents such as Signed Contract Agreement, Taking-Over Certificate or Contract Completion Certificate.

Each Bidder must fill out this form.

If complied by Specialist Subcontractor, each Specialist Subcontractor must fill out this form and provide the Specialist Subcontractor's name:

Specialist Subcontractor: _____

Contract with Similar Key Activities		
Contract No . . . . . **of**	**Contract Identification**	
Award Date		**Completion Date**
Total Contract Amount	**$**	
If partner in a Joint Venture or Subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**
Employer's name **Address** **Telephone number** **Fax number** **E-mail**		
Description of the Key Activities in Accordance with Criterion 2.4.2 of Section 3 (Evaluation and Qualification Criteria)		

Form EXP – 3: Specific Experience in Managing Environmental, Health and Safety Aspects

Not Applicable

Form EXP – 4: Environmental, Health and Safety Certification

Not Applicable

Form EXP – 5: Environmental, Health and Safety Documentation

Not Applicable

Form EXP – 6: Environmental, Health and Safety Dedicated Personnel

Please provide CV [Form PER-2] of the in-house personnel of the main contractor/Joint Venture partners for the EHS positions specified in Section 6 (Works' Requirements):

- Environmental, Health and Safety (EHS) Officer

Schedules

Schedule of Payment Currencies

For .....insert name of Section of the Works .....

Separate tables may be required if the various sections of the Works (or of the Bill of Quantities) will have substantially different foreign and local currency requirements. In such a case, the Employer should prepare separate tables for each Section of the Works.

	A	B	C	D
Name of Payment Currency	**Amount of Currency**	**Rate of Exchange to Local Currency**	**Local Currency Equivalent C = A x B**	**Percentage of Net Bid Price (NBP) 100xC / NBP**
Local Currency		**1.00**		
Foreign Currency #1 _____				
Foreign Currency #2 _____				
Foreign Currency #3 _____				
Net Bid Price				**100.00**
Provisional Sums Expressed in Local Currency		**1.00**		
BID PRICE				

NOTE

The rates of exchange shall be the selling rates 28 days prior to the deadline for submission of bids published by the source specified in BDS 15.

Schedule of Cost Indexation

The formulae for price adjustment shall be of the following general type:

Pn= a + b Ln / Lo + c En/ Eo + d Mn/Mo + ...

where:

"Pn" is the adjustment multiplier to be applied to the estimated contract value in the relevant currency of the work carried out in period "n", this period being a month unless otherwise stated in the Contract Data;

"a" is a fixed coefficient, stated in the relevant table of adjustment data, representing the non-adjustable portion in contractual payments;

"b", "c", "d", ... are coefficients representing the estimated proportion of each cost element related to the execution of the Works as stated in the relevant table of adjustment data; such tabulated cost elements may be indicative of resources such as labor, equipment and materials;

"Ln", "En", "Mn", ... are the current cost indices or reference prices for period "n", expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the date 49 days prior to the last day of the period (to which the particular Payment Certificate relates); and

"Lo", "Eo", "Mo", ... are the base cost indices or reference prices, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the Base Date.

The weightings (coefficients) for each of the factors of cost stated in the table(s) of adjustment data shall only be adjusted if they have been rendered unreasonable, unbalanced or inapplicable, as a result of Variations.

The cost indices stated in the Table of Adjustment Data shall be used. If their source is in doubt, it shall be determined by the Engineer. For this purpose, reference shall be made to the values of the indices at stated dates.

If the currency in which the Contract price is expressed is different from the currency of the country of origin of the indices, a correction factor will be applied to avoid incorrect adjustments of the Contract Price. The correction factor shall be: Z0 / Z1, where,

Z0 = the number of units of currency of the origin of the indices which equal to one unit of the currency of the Contract Price at the Base Date, and
Z1 = the number of units of currency of the origin of the indices which equal to one unit of the currency of the Contract Price at the Date of Adjustment.

Tables of Adjustment Data

Table A - Local Currency Payment

Index Code	Index Description	Source of Index*	Base Value and Date	Range of Weighting	Bidder's Proposed Weighting
a.	Nonadjustable	—	—	a: 0.15	a: 0.15
b. Labor				b: 0.15-0.25	b:
c. Equipment (Construction)				c: 0.05-0.15	c:
d. Construction Material				d. 0.4-0.55	d:
			Total		**1.00**

Following source of index shall apply.
(a) Labor: "National Salary and Wage Rate Index"- "Construction Labor" of Nepal Rastra Bank
(b) Material: "National Wholesale Price Index" - Construction Materials" of Nepal Rastra Bank
(c) Equipment usage: "National Wholesale Price Index" - Machinery and Equipment" of Nepal Rastra Bank

Table B - Foreign Currency Payment

Name of Currency: [Insert name of currency. If the bidder wishes to quote in more than one foreign currency, this table should be repeated for each foreign currency such as #1, #2 and #3]

Index Code	Index Description	Country of Origin ; Currency of Index	Source of Index	Base Value and Date	Rang of Weighting	Bidder's Proposed Weighting
a.	NONADJUSTABLE		—	—	a: 0.15	a: 0.15
b. Equipment (Construction)					b: 0.1-0.15	b:
c. construction Material (DI Pipes, fitting valves etc.)					c: 0.5-0.75	c:
				Total		**1.00**

NOTES

As per GCC 1.1.4, "Base Date" means the date 28 days prior to the latest date for submission of the bid.

For a given currency, the "Source of Index" should be issued or published within the country to which the currency relates.

Tables of Adjustment Data shall only be included if prices are to be quoted as adjustable prices in accordance with ITB 14.5.

Bill of Quantities

PREAMBLE TO BILL OF QUANTITIES (BOQ)

PART A — GENERAL

1. Application of the Bill of Quantities

The Bill of Quantities shall be read in conjunction with the General Conditions of Contract (GCC), Particular Conditions of Contract (PCC) and Employer's Requirements (Technical Specifications, and Drawings).

2. Estimated and Provisional Quantities

The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the quantities of work ordered and carried out. Works shall be measured, as per outlined mode of measurement by the Contractor and verified by the Engineer and valued at the rates and prices tendered in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of the Contract.

3. Coverage of Rates and Prices

The rates and prices tendered in the priced Bill of Quantities shall, except insofar as it is otherwise provided under the Contract, include all works necessary to complete the works (including design of temporary works, design of permanent works as necessary, preparation of working drawings, site survey for pipeline alignment, layout of structures, etc.) including all constructional equipment, labor, supervision, materials, erection, testing, maintenance, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out, expressly or implied in the Contract. The above cost should be included in contractor quoted rate in respective item to be executed at the site.

4. Currency of Quotation

The rates and prices shall be quoted entirely in Nepalese Rupees, while the foreign currency requirements, included in said rates and prices, are given in the Schedule attached to the Letter of Bid.

5. Whole Cost of Compliance

The whole cost of complying with the provisions of the Contract shall be included in the items provided in the priced Bill of Quantities; and where no items are provided, the cost shall be deemed to be included in the rates and prices entered for the related Items of Work.

6. General Directions and Descriptions

General directions and descriptions of work and materials are not necessarily repeated or summarized in the Bill of Quantities and the cost is deemed to be included in the rates and prices for completing the works described in the Contract Documents.

7. Provisional Sums

Provisional Sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with Sub-Clause 13.4 of the General Conditions.

8. Method of Measurement

The method of measurement of completed work for payment shall be in accordance with the mode of measurement clauses following the item of works as per Employer's Requirements, Section VI: Works Requirements, the Standard Specification for Civil and Road Works and / or Standard Specification for Road and Bridge Works, issued by the Ministry of Physical Infrastructure and Transport, Department of Roads, Government of Nepal, and / or the Specifications of Building Construction (Civil) Works, issued by the Government of Nepal and / or NS: 389: Method of Measurement of Building and Civil Engineering Works, as applicable. In the case of lump sum items which comprise a number of work activities, the activities shall not be measured separately and payment shall be based on the lump sum item or on pro-rata basis / cost breakdown as instructed by the Engineer. However, if required by the Engineer, the Contractor must provide a detailed breakdown of the cost of each activity to be performed for the stipulated task given in the BOQ of such items.

9. Lump Sum Items — Preliminary and General Work (BOQ A2)

Lump Sum items in Bill of Quantities A2 for Preliminary and General Work will be paid prorated based on physical work done (i.e. the value of work done in monetary terms). They will not be paid on the basis of the time of the contract period which has elapsed. The Lump Sum amounts stated in Section A2 shall be deemed to be fully inclusive of all costs, overheads, and expenses necessary to execute the Preliminary and General Work for the entire duration of the Contract, including any period of extension.

10. Schedule of Payment for Supply and Installation Items

The schedule of payment for Supply and Installation of Pipe (primary lines, secondary and tertiary pipes), pipe fittings, Valves, Meters and Electromechanical equipment, lump-sum items like Electro-Chlorinators, Household connections shall be governed by Schedule of Payments: Sub-Clause 14.5 (c) of Part B Specific Provisions of Section 8 Particular Conditions of Contract.

PART B — DAYWORKS

11. Dayworks

11.1 General

Reference is made to Clause 13.5 of the General Conditions of Contract. Work shall not be executed on a daywork basis except on the written order of the Engineer. The rates for dayworks entered in the schedules shall be applicable to any quantity of daywork ordered by the Engineer. Nominal quantities are indicated against each of the item of daywork.

11.2 Dayworks Labor

In calculating payments due to the Contractor for the execution of daywork, the hours for labor shall be reckoned from the time of arrival of the labor at the job site to execute the particular item of daywork to the time of departure, but excluding meal breaks and rest periods. Only the time of classes of labor directly doing work ordered by the Engineer and for which they are competent to perform shall be measured, but not the time of foremen or other supervisory personnel.

The Contractor shall be entitled to payment for the total time that labor is employed on daywork, calculated at the rates entered by the Contractor.

Rates in the Dayworks Schedules shall apply to labor of trade and qualification as described and to labor of other trades with similar skills and qualifications.

11.3 Dayworks Materials

The Contractor shall be entitled to payment in respect of materials used for daywork in accordance with Sub-Clause 13.5 of the General Conditions of Contract. The Contractor shall be entitled to payments in respect of Materials at the rates entered by him in the Schedule of Daywork. The said rates shall be deemed to include any applicable taxes, freight, insurance, and handling expenses for delivery to the storage or stockpile on the Site.

The costs of hauling materials for use on work ordered to be carried out as daywork from the storage or stockpile on the Site to the place where it is to be used will be paid in accordance with the terms for Labor and Construction Equipment.

PART C — SURVEY AND INVESTIGATION

12. Survey & Investigation

The Contractor shall undertake necessary survey and investigation to review and validate all the data and information for design of the system components.

Survey and Investigation activities shall be carried out with necessary direction of the Engineer. Additional survey and investigation activities (example trial trenching to assess localized presence of utilities) may be taken up separately, as may be necessitated during the course of the work.

The cost of Survey and Investigation activities are to be included in the rates for work items and no separate item or payment will be made, except for: GIS based Data Collection and Data Updating and Management in item 12.2 below; and Trial Trenches and Pits in item 12.3 below.

12.1 Topographic Survey & Contour Survey

Topographical survey and level survey along existing road network shall be measured in KM correct to 3 decimal places. Length shall be measured along the centre line of road / pathway.

Area mapping and Contour survey shall be based on the actual area surveyed and mapped in AutoCAD, and measured in Hectares up to 3 decimal places.

The rate shall include all cost of equipment, manpower, mobilization, establishment of Ground Control points, establishment of benchmark at sites, installation of pillar, protection of the benchmarks and Control points, preparation of drawings all complete to finish to the satisfaction of the Engineer.

The Contractor shall ensure availability of all survey equipment, to facilitate checking of the alignment and levels by the Engineer or his representative, during the entire period of the contract.

12.2 GIS based Data Collection and Data Updating and Management

Consumer Survey

The Contractor shall undertake GIS based Consumer survey for all consumers, properties as stipulated in Employer's Requirements Section VI Clause 4.9. The Contractor shall be responsible for updating / validating the Consumer survey data during the course of providing / installing the water meter to the consumers.

Consumer survey shall be enumerated in numbers and shall relate to the number of properties / households for which data is collected and validated, by the Employer.

The rate shall include cost of manpower, including all necessary mobile / tabs required to capture the data as per the requirements of the Employer as may be necessary. The cost for updating the consumer survey database during the course of providing water connection shall be included within the quoted rate.

GIS based Asset Database

Bill of Quantities lump sum items are provided for the following works.

The Contractor shall undertake Preparation of GIS based map of all assets created (pipelines, service connections, etc). In parallel with the laying, jointing and testing of the pipeline works, the Contractor shall prepare the GIS database of the "as built" assets as stipulated in Employer's Requirements Section VI-A General Requirements Item 9.10 and Section VI-B Particular Requirements Appendix E. GIS data capture of pipeline network should follow the laying, jointing and sectional hydro-testing and the detailed asset data should be validated prior to backfilling.

The GIS database creation and submittals shall be considered acceptable, when the same is reviewed and validated by the Engineer, within the timelines indicated. The details shall include all asset data below ground and over ground as outlined.

The length of pipeline network including all related assets, will be measured in kilometers. The length of service connection shall also be measured in lengths, as laid for all consumer connections.

Note: **Section VI-B Particular Requirements Appendix E outlines the tentative GIS attributes to be collected from the site. The Engineer reserves the right to update / modify the GIS attribute List.**

12.3 Trial Trenches and Pits

Prices for carrying out trial trenches / pits shall include all earthworks needed, site clearance, excavation by manual or mechanical means, re-backfill and compaction, surface / road temporary reinstatement, etc., at any depth in order to fully determine the types, sizes and locations of underground utilities, soil conditions, rock level, etc. Locations and dimensions to be approved by the Engineer. The cost of manual excavation as instructed by the Engineer or required by site conditions or safety considerations is to be included in the rate.

PART D — COMMISSIONING, SURPLUS MATERIALS, SYSTEM STABILISATION SERVICES & WATER AUDIT

13. Trial Run and Commissioning

The Contractor shall submit to the Engineer, step-wise DMA wise commissioning plan after successful hydraulic pressure and disinfection testing including the Primary main. The Trial run and Commissioning Plan shall be approved by the Engineer for each DMA. Trial run and Commissioning shall be undertaken as per Section VI-C Technical Specifications Clause 3.5.

The trial run and commissioning activities are inherent to the works and no separate payment shall be made.

14. Surplus Pipes, Fittings and Valves

Any surplus pipes, fittings and valves quantities (not exceeding 10% of BOQ) generated after the completion of works and deemed necessary for the future use of PID / KUKL shall be paid for at a rate as per following:

(a) DI Pipes: 18% less than the Contractor's quoted rate for the supply, laying and jointing of respective diameter of DI Pipe.

(b) DI Fittings: 18% less than the Contractor's quoted rate for the supply, installation and jointing of respective diameter of DI fittings.

(c) HDPE Pipes and Pipe Fittings: 25% less than the Contractor's quoted rate for the supply, laying and jointing of respective diameter of HDPE Pipe.

(d) Valves, Meters and Hydrants: 15% less than the Contractor's quoted rate for the supply, installation and jointing of respective diameter of Valves, meters and hydrants.

15. System Stabilisation Services (SSS)

The Contractor shall provide System Stabilisation Services for the Water Supply Distribution System for a minimum period of 12 months, post commissioning of each Section of the Contract Works, progressively. Detailed responsibility of the Contractor in managing each Section of the Water Supply Distribution system is outlined in Employer's Requirements, Section VI-D: Technical Specifications System Stabilisation Services (SSS).

The Contractor shall be compensated for the SSS in accordance with Employer's Requirements, Section VI-D: Technical Specifications System Stabilisation Services, Clause 14 Payment Terms.

The reporting period for the performance of the WS Distribution system shall be in months. The mode of measurement for undertaking the services, shall be in months. Pro-rata basis shall be applied for any part of month, in which any DMA / Sub-DMA is managed.

The number of WS Connections, managed and maintained shall be as per GIS database and shall be considered only where meters are read and reported as functional.

16. Water Audit for Consumer Connections

Water audit for Consumers shall be carried out with directions of the Employer / Engineer and as outlined in Employer's Requirements, Section VI-D, Clause 11. The water audit form shall be duly signed and submitted to the Engineer for claim. The Contractor shall be paid for Water Audit activity carried out successfully and shall be considered based on the duly signed Water Audit form.

The rate for each Water Audit shall be included in the SSS monthly rate. It will include the cost of initial and follow-up visits to the consumer property, carrying out the necessary investigations at consumer premises and identifying the reasons for high consumption, and engagement of technical staff adept at carrying water audit including necessary equipment.

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
1	Work No. A1: Provisional Sum Works	Provisional Sum for Third Party Inspection including participation of Employer and /or its representatives on requirement, for testing of pipes, valves, fittings and all accessories at the manufacturer's premises as specified in document SECTION VI-A: Clause 13.4 WORKS REQUIREMENTS and as instructed by Engineer	PS	1	4100000	Four Million One Hundred Thousand Rupees	4100000
2	Work No. A1: Provisional Sum Works	Provisional Sum for permanent relocation costs of water and sanitation utilities, as specified in document SECTION VI-B: Clause 4.1, A1.2 (C) WORKS REQUIREMENTS	PS	1	4900000	Four Million Nine Hundred Thousand Rupees	4900000
3	Work No. A1: Provisional Sum Works	Provisional Sum for permanent relocation costs of other utilities (including but not limited to telecommunication and other communication services, electricity including re-alignment of cables and new chambers, shifting of poles of any capacities/kind and transformers of any type/capacities), as specified in document SECTION VI-B: Clause 4.1, A 1.2, (c) WORKS REQUIREMENTS	PS	1	3400000	Three Million Four Hundred Thousand Rupees	3400000
4	Work No. A1: Provisional Sum Works	Knowledge Transfer and capacity building with Training to project personnel on Operation & Maintenance management	PS	1	1000000	One Million Rupees	1000000

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
5	Work No. A1: Provisional Sum Works	Cost for complying with any other requirement not covered in BOQ, General or Particular Conditions of Contract which may have a financial implication and instructed by the Engineer during execution of the Work.	PS	1	34100000	Thirty Four Million One Hundred Thousand Rupees	34100000
6	Work No. A1: Provisional Sum Works	Structural and functional assessment of existing of Lyaku reservoir, including structural study, tightness test of the tank, disinfection and sterilizing and all the necessary work to condition the tank for full operational use according to the engineer's criteria	PS	1	200000	Two Hundred Thousand Rupees	200000
7	Work No. A1: Provisional Sum Works	Allocation of Provisional Sum for deposits required to obtain road cutting permissions from the Department of Roads (DOR) or other relevant authorities, as specified in document SECTION VI-C: Clause 1.2.4.1 WORKS REQUIREMENTS	PS	1	30000000	Thirty Million Rupees	30000000
8	Work No. A1: Provisional Sum Works	Provisional Sums for System Stabilization as specified in SECTION VI-D: TECHNICAL SPECIFICATIONS SYSTEM STABILISATION SERVICES (SSS)	PS	1	500000	Five Hundred Thousand Rupees	500000
		Total of Work No. A1: Provisional Sum Works					**78,200,000.00**

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
9	Work No. A2: Preliminary and General Work	Provision and complete installation of all Site Offices (1) for the Engineer of required equipment and office premises, etc. as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 6.1.	LS	1			
10	Work No. A2: Preliminary and General Work	Maintenance of all Site Offices for the Engineer of required numbers, equipment, office premises, including payment of rents, fees and charges for services, stationary, office consumables, cleaning, provision of one peon, round the clock guard in each office, regular supply of personal protective equipment to the Engineer's team and visits, topographic survey assistance, etc. all as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 6.1.	LS	1			
11	Work No. A2: Preliminary and General Work	Provision and complete installation of all contractor's temporary facilities for whole construction period, including labour camps, stores, testing laboratory, etc., as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 7.1 & 7.2.	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
12	Work No. A2: Preliminary and General Work	Maintenance of all contractor's temporary facilities for whole construction period including cost of labour camps, stores, testing laboratory, water, electricity, etc., and other services with proper maintenance, as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 7.1, 7.2 and 7.15.	LS	1			
13	Work No. A2: Preliminary and General Work	Provision and installation of signboards as per contract drawing, at all project offices and at required location at each section of the Contract as SECTION VI-A: WORKS REQUIREMENTS Clause 7.17 or directed by the Engineer.	Nos.	3			
14	Work No. A2: Preliminary and General Work	Supply, operation and maintenance of following vehicles on rent with fuel and lubricant, including insurance, maintenance during construction period cost, and immediate replacement if needed, on monthly basis for Engineer or his staff as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 6.3 and as itemized below Four Wheel Drive Pick up at least 2200 CC with driver on rent, as per the specifications.	Month	30			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
15	Work No. A2: Preliminary and General Work	Supply, operation and maintenance of following vehicles on rent with fuel and lubricant, including insurance, maintenance during construction period cost, and immediate replacement if needed, on monthly basis for Engineer or his staff as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 6.3 and as itemized belowMotorbikes of at least 150 CC on rent, as per the specifications.	Month	60			
16	Work No. A2: Preliminary and General Work	Provision of Monthly Progress Reports as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 9.7.5 (Works Progress As-Built Drawings, GIS database, Photographs, Compliance with Safe guards Checklist, OHS performance Report and EMP performance Report shall also be added), including preparation, copies and submission, to be paid only after content and quality check approval of the Engineer.	LS	1			
17	Work No. A2: Preliminary and General Work	Provision of Occupational Health and Safety OHS Plan and Procedures as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 9.2, including preparation, copies and submission, to be paid only after content and quality check approval of the Engineer.	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
18	Work No. A2: Preliminary and General Work	Provision of Work site Specific Environmental Management Plan (SEMP) and procedures as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 9.4 , including preparation, copies and submission, to be paid only after content and quality check approval of the Engineer.	LS	1			
19	Work No. A2: Preliminary and General Work	Provision of Quality Control Plan and Procedures with required manpower and equipments as specified in document SECTION VI-A: WORKS REQUIREMENTS Clauses 9.5 and 13, including preparation, copies and submission, to be paid only after content and quality check approval of the Engineer.	LS	1			
20	Work No. A2: Preliminary and General Work	Provision of Traffic Management Plan and Procedures including necessary all required manpower and equipment as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 9.3, including preparation, copies and submission, to be paid only after content and quality check approval of the Engineer.	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
21	Work No. A2: Preliminary and General Work	Provision for carrying out trial trenches/pits (with all earthworks needed such as site clearance, excavation by manual means, as per BoQ B1 Excavation of Pipeline Trenches item, re-backfill and compaction, surface/road temporary reinstatement, etc.) at any depth in order to determine the underground utilities, soil condition, rock level, etc., locations and dimensions to be approved by the Engineer as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 10.	cum	100			
22	Work No. A2: Preliminary and General Work	Environmental and Occupational Health & Safety In Site Management as per document SECTION VI--B: PARTICULAR REQUIREMENTS (APPENDIXES-D)Provision of Personal Protective Equipment (hard helmet, Reflector Vest, Mask, Gloves, Safety Shoes or Gum Boot, Face Shield) to all Construction workers, with log registration of the handover signed and/or finger printed by the worker, including subcontractor's workers, as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 9.2.1	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
23	Work No. A2: Preliminary and General Work	Environmental and Occupational Health & Safety In Site Management as per document SECTION VI--B: PARTICULAR REQUIREMENTS (APPENDIXES-D) Sprinkling of water thrice a day (Morning, Afternoon and Evening) for air pollution control during the dry period along the excavated trench until blacktopping for road reinstatement is completed SECTION VI-B: WORKS REQUIREMENTS Clause 4.1 A1.2, Appendix D or as per requirement and direction of Engineer all complete	Km	58			
24	Work No. A2: Preliminary and General Work	Environmental and Occupational Health & Safety In Site Management as per document SECTION VI--B: PARTICULAR REQUIREMENTS (APPENDIXES-D)Supply and use initially for baseline measurement and then regularly as specified in SECTION VI-B: WORKS REQUIREMENTS Clause 4.1 A1.2, Appendix D, Air Quality measurement equipment for air quality monitoring and Gas detecting device. Final handover to the Employer at the end of contract	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
25	Work No. A2: Preliminary and General Work	Environmental and Occupational Health & Safety In Site Management as per document SECTION VI--B: PARTICULAR REQUIREMENTS (APPENDIXES-D) Supply and use initially for baseline measurement and then regularly as specified in SECTION VI-B: WORKS REQUIREMENTS Clause 4.1 A1.2, Appendix D, Noise measurement equipment for noise monitoring. Final Turnover to the Employer at the end of the contract	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
26	Work No. A2: Preliminary and General Work	Working at Night: Provide canopy type Mobile Diesel Generator Set, lighting arrangement, necessary accessories (lamps, lamp stands, cables, fuel, lubricant, etc.) and other associated equipment, machinery and extra manpower for construction during night time/night shift (each night shift comprises 8 hours of working and several working sites may need different shifts at the same night) for proper illumination of the working gang and surrounding area, as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 11.8. The rate includes supply, operation and maintenance of all the equipment. If the night shift is less than 8 hours of working period, then the payment will be made on pro-rata basis	Shift	117			
27	Work No. A2: Preliminary and General Work	As built drawing and GIS Database for Taking-Over Preparation and submission of AS-BUILT DRAWINGS, at the completion of each PART/SECTION for taking-over certificate, as per document SECTION VI-A: WORKS REQUIREMENTS Clause 9.10.1, to be paid after content and quality check approval of the Engineer	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
28	Work No. A2: Preliminary and General Work	As built drawing and GIS Database for Taking-Over Preparation and submission of GIS DATABASE at the completion of each PART/SECTION for taking-over certificate, as per document SECTION VI-A: WORKS REQUIREMENTS 9.10.2, to be paid after content and quality check approval of the Engineer	LS	1			
29	Work No. A2: Preliminary and General Work	As built drawing and GIS Database for Taking-OverConduct a complete Topographic Survey on roads / streets / pathways/ divided plots approx. area/ Area of undivided land including the customer survey connection details where all pipelines are to be laid, previous to the submittal of the working drawings. The work to include benchmarks execution and shifting, preparation and submittal of Drawings in CAD (compatible format as requested by the Engineer) with names of Road, localities, major landmarks (i.e. Schools, institutions, commercial places etc.), historical places, descriptions including proper legends, geo reference of all landmarks etc., as specified in document SECTION VI-A: WORKS REQUIREMENTS Clause 9.1.	Km	57			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
30	Work No. B1: Earth Material Related Works	Excavation for Primary pipelines trenches by manual and/or mechanical means, including: - site clearance, cutting and removal of existing pavement or land, store of all reusable pavement material for further reinstatement, - excavation of pipe trenches in all soils/rock with vertical sides as per drawings, width measurement clear width in typical drawing, depth measurement actual depth, - including any extra excavation: for soft soil or rocks, fittings, bends, flanges and sockets, for battered sides, for shoring, for preparation of trench bottom, etc., - Separation of Suitable soil from unsuitable soil during excavation and temporary storage, transport lead and lift of excavated material, - final safe disposal of surplus material including transport and lead and lift, - dewatering,all complete works as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 3.1.5.4 and direction of the Engineer, with all lead and lift.	cum	3729			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
31	Work No. B1: Earth Material Related Works	Excavation for Distribution pipelines trenches by manual and/or mechanical means, including: - site clearance, cutting and removal of existing pavement or land, store of all reusable pavement material for further reinstatement, - excavation of pipe trenches in all soils/rock with vertical sides as per drawings, width and depth measurement clear width and fixed depth in typical drawing, - including any extra excavation: for soft soil or rocks, fittings, bends, flanges and sockets, for battered sides, for shoring, for preparation of trench bottom, etc., - Separation of Suitable Soil from unsuitable soil during excavation and temporary storage, transport lead and lift of excavated material, - final safe disposal of surplus material including transport and lead and lift, - dewatering,all complete works as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 3.1.5.4 and direction of the Engineer, with all lead and lift.	cum	45255			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
32	Work No. B1: Earth Material Related Works	Excavation for structures (except pipeline works), for any depth and in all types of soil by mechanical or manual means, including: - site clearance, cutting and removal of existing pavement or land, store of all reusable pavement material for further reinstatement, - excavation in all soils with vertical sides as per drawings, including extra excavation for soft soil, extra excavation for battered sides, extra excavation for slope protection, - Separation of Suitable Soil from unsuitable soil during excavation and temporary storage, transport lead and lift of excavated material, - final safe disposal of surplus material including transport and lead and lift, - dewatering,all complete works as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.2.4.4 and direction of the Engineer with all lead and lift.	cum	6139			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
33	Work No. B1: Earth Material Related Works	Shoring on both trench sides: Design, Supply of materials, manpower and equipment for installation and deinstallation, erection of conventional vertical pillars, bracing, and hardwood/metal plates sheeting, on both sides of trenches deeper than 1.50 meters, or else interlocking sheet piles, or prefabricated metallic box type shoring in deeper trenches. Shoring as required to support the trench walls to eliminate sliding and settling, and as may be otherwise required to protect the workmen and existing utilities, structures, nearby buildings, trees, poles, etc. All such sheeting, bracing, and shoring shall comply with the document SECTION VI-C: WORKS REQUIREMENTS Clause 3.1.5.5 . Contractor shall submit the designs and drawings for all type of trench shoring, and seek necessary approval from the Engineer, prior to commencement of the works.	sq.m.	7269			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
34	Work No. B1: Earth Material Related Works	Protection of structure excavation: Design, Supply of materials, manpower and equipment for installation and deinstallation, erection of conventional vertical pillars, bracing, and hardwood/metal plates sheeting, of all foundation structure excavation side slopes, or else interlocking sheet piles in deeper areas. Slope protection as required to support the soil excavation sides to eliminate sliding and settling, and as may be otherwise required to protect the workmen and existing utilities, structures, nearby buildings, trees, poles, etc. All such sheeting, bracing, and shoring shall comply with the document SECTION VI-C: WORKS REQUIREMENTS Clause 1.2.4.5. Contractor shall submit the designs and drawings for all type of slope protection, and seek necessary approval from the Engineer, prior to commencement of the works.	sq.m.	1415			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
35	Work No. B1: Earth Material Related Works	Provide, place and compact with Selected imported material Max. 63 mm River Gravel bed in Structure Foundation as per drawings and/or instruction of the Engineer, including supply of material at site, watering, compaction, dressing, etc., all complete work with all necessary lead and lift and safe disposal of surplus material as per SECTION VI-C: WORKS REQUIREMENTS Clause 1.2.4.12.	cum	255			
36	Work No. B1: Earth Material Related Works	Place and compact trench main backfilling and structural backfill with suitable material from excavation, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 3.1.5.10 and clause 1.2.4.11, and Drawings, and conditioned to prior approval of the Engineer	cum	24039			
37	Work No. B1: Earth Material Related Works	Provide, place and compact imported appropriate sand for cradle bedding, and embedment backfill for DI pipe, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 3.1.5.9 and Drawings, and conditioned to prior approval of the Engineer	cum	1113			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
38	Work No. B1: Earth Material Related Works	Provide, place and compact imported suitable material for trench main backfill (above blanket cover) and for Structural backfill as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 3.1.5.10 and clause 1.2.4.11 and Drawings, and conditioned to prior approval of the Engineer	cum	3643			
39	Work No. B1: Earth Material Related Works	Dismantling of Existing Kwacho Tank with mechanical or manual means and disposal of earthwork and debris at suitable location with manual transportation upto 150 m distance as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and conditioned to prior approval of the Engineer.	cum	117			
40	Work No. B2: Brick and Stone work	Supply of materials at site and complete the Flat Brick Soling for Structure Work on top of sand bed of minimum 50mm thick by First Class Brick in the base of foundation of Structure and road Reinstatement as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.4.4.8 , drawings and to the satisfaction of the Engineer including filling of minor depression and void by sand with all lead and lift all complete	sq.m.	10152			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
41	Work No. B2: Brick and Stone work	Supply of materials at site and complete the Stone Boulder Soling Work on top of sand bed in the base of foundation as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.5.9, drawings and to the satisfaction of the Engineer including filling of minor depression and void by sand with all lead and lift all complete	sq.m.	217			
42	Work No. B2: Brick and Stone work	Supply of materials at site and complete the First Class Brick Work with 1: 4 Cement Sand Ratio for chamber construction and Structure reinstatement with minimum 50mm thick First Class Brick, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 1.4, drawings and instruction of the Engineer, with all lead and lift	cum	181			
43	Work No. B2: Brick and Stone work	Supply of materials at site and complete the Stone Masonry Wall with 1: 4 Cement Sand Ratio construction for any structures work, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 1.5, drawings and instruction of the Engineer, with all lead and lift	cum	189			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
44	Work No. B3: Concrete Related Work	Supply of materials, place and complete M10 concrete work for PCC of any size and any shape as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.3 and Drawings and by instruction of the Engineer, with proper vibration and curing of the work including all lead and lift	cum	1301			
45	Work No. B3: Concrete Related Work	Supply of materials, place and complete M20 concrete work for RCC of any size and any shape as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.3 and Drawings and by instruction of the Engineer, with proper vibration, curing of the work including all lead and lift	cum	517			
46	Work No. B3: Concrete Related Work	Supply of materials, place and complete M30 concrete work for RCC of any size and any shape as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.3 and Drawings and by instruction of the Engineer, with proper vibration, curing of the work including all lead and lift	cum	4075			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
47	Work No. B3: Concrete Related Work	Supply of materials and complete Reinforcement Steel of grade Fe500D Works for any RCC Works for structures and reinstatement as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.3.3.6 and drawings and directed by the Engineer, including cutting, bending, placing in position of binding by Bind Wire, including all lap length/wastage, etc., (lap length and wastage will not be additionally paid and shall be included in the rate price, but not in measurement) with all lead and lift	kg	801167			
48	Work No. B3: Concrete Related Work	Supply of Wooden or Metal Formwork, Steel Tubular Props and other material for complete centering-shuttering of formwork and the auxiliary needed scaffolding and falsework, in chambers, for all structural elements, including shuttering, propping, installation and removal of formwork, scaffolding and falsework, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.3.4.3 and Drawings and by instruction of the Engineer, for sub structure and super structure of RCC/PCC Works with all lead and lift	sq.m.	1187			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
49	Work No. B3: Concrete Related Work	Supply of Wooden or Metal Formwork, Steel Tubular Props and other material for complete centering-shuttering of formwork and the auxiliary needed scaffolding and falsework, in Kirtipur OHT upto height of 32 m from ground, for all structural elements, including shuttering, propping, installation and removal of formwork, scaffolding and falsework, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.3.4.3 and Drawings and by instruction of the Engineer, for sub structure and super structure of RCC/PCC Works with all lead and lift	sq.m.	3149			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
50	Work No. B3: Concrete Related Work	Supply of Wooden or Metal Formwork, Steel Tubular Props and other material for complete centering-shuttering of formwork and the auxiliary needed Scaffolding and false works for foundation of Kirtipur OHT and KirtipurPump house , for all structural elements, including shuttering, propping, installation and removal of formwork, scaffolding and falsework, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.3.4.3 and Drawings and by instruction of the Engineer, for sub structure and super structure of RCC/PCC Works with all lead and lift	sq.m.	5019			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
51	Work No. B3: Concrete Related Work	Provide, boring and installing bored cast-in-situ RCC Pile diameter 800 mm and height minimum 15 m, excluding reinforcement and concrete, in all types of soil, including mobilizations and demobilizations, location and relocation of all the equipment, material and labor in each pile, any other ancillary works (included temporary or permanent casing if needed), bentonite and any other consumable, disposal to approved site of all excavated materials, bentonite muds and waste materials, and final tests, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 9.0 and Drawings, and by instruction of the Engineer, including all lead and lift.	m	990			
52	Work No. B4: Concrete Surface Finishing Work	Supply of material and complete Cement Sand Plastering Work of 12.5mm thick in 1:4 Cement Sand ratio in external concrete surfaces (not wet), mixing, laying, leveling, proper curing, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.6 and Drawings, and by instruction of the Engineer, including all lead and lift	sq.m.	10643			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
53	Work No. B4: Concrete Surface Finishing Work	Supply of materials at site and complete Cement Punning work of 3mm thick (Cement: Sand ratio of 1:1) on plastered surface, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause1.7.5.3 and Drawings, and by instruction of the Engineer, including all lead and lift	sq.m.	2677			
54	Work No. B4: Concrete Surface Finishing Work	Supply, preparation and application of Enamel Paint in external reservoir walls finishing, in two coats, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause1.7.3 and Drawings, and by instruction of the Engineer (color selection as well), including all lead and lift	sq.m.	5662			
55	Work No. B4: Concrete Surface Finishing Work	Supply, preparation and application in two coats of water-based food grade epoxy resin coating in inner walls of reservoirs having volume solids not less than 50% and application rate better than 8m3 /kg per coat, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.7.3 and Drawings, and by instruction of the Engineer, including all lead and lift	sq.m.	1045			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
56	Work No. B4: Concrete Surface Finishing Work	Application of Cover Protection in roof of SRT & PS (including ventilation chimneys), with a Polyethylene Waterproof membrane of four layers construction (strengthening, Aging-resistance, waterproof, adhesion and water proofing compound with SBR bond @ 1liter per ten square meter, primer glue @ 1 kg per 100 Sqm bonding agent @ 6 kg per 100 sq.m) included a protection layer of 5 cm of PCC (M-15) as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.7.3 and Drawings, and by instruction of the Engineer, including all lead and lift	sq.m.	350			
57	Work No. B5: Surface Reinstatement	Aggregate Layers Supplying, mixing, laying/spreading, watering, levelling and compaction of Granular sub base layer material for surface reinstatement, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.2, drawings and instruction of the Engineer, with all lead and lift	cum	4411			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
58	Work No. B5: Surface Reinstatement	Aggregate Layers Supplying, mixing, laying/spreading, watering, levelling and compaction of the granular capping layer with sufficient compaction over the pipeline trench for surface reinstatement, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.2 , drawings and instruction of the Engineer, with all lead and lift	cum	2855			
59	Work No. B5: Surface Reinstatement	Aggregate LayersSupplying, mixing, laying/spreading, watering, levelling and compaction of crushed stone base layer material for surface reinstatement, as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.3, drawings and instruction of the Engineer, with all lead and lift	cum	7580			
60	Work No. B5: Surface Reinstatement	Reinstatement for Asphalt Roads Subgrade preparation by scarifying existing surface and re-compaction for the asphalt road reinstatement beyond the trench width , as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.1.4, drawings and instruction of the Engineer, with all lead and lift	sq.m.	18941			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
61	Work No. B5: Surface Reinstatement	Reinstatement for Asphalt Roads Supply, mix, spray (manual and/or mechanical) and cure the Prime Coat with Emulsion cold mix asphalt reinstatement, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.5, drawings and instruction of the Engineer, with all lead and lift	sq.m.	10231			
62	Work No. B5: Surface Reinstatement	Reinstatement for Asphalt Roads Supply, heat, mix, spray (manual and / or mechanical) and cure the Prime Coat for the asphalt reinstatement, as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.5, drawings and instruction of the Engineer, with all lead and lift	sq.m.	18941			
63	Work No. B5: Surface Reinstatement	Reinstatement for Asphalt Roads Providing and applying tack coat with hot Bitumen at the specified rate as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.6 the prepared surfaces including cleaning as per Technical Specification.	sq.m.	10231			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
64	Work No. B5: Surface Reinstatement	Reinstatement for Asphalt RoadsSupplying, heating, mixing, laying, compacting, curing Cold Asphalt Mix for reinstatement, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.10, drawings and instruction of the Engineer, with all lead and lift	cum	404			
65	Work No. B5: Surface Reinstatement	Reinstatement for Asphalt Roads Supplying, heating, mixing, laying, compacting, curing the Asphalt Mix Concrete for the asphalt reinstatement, as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.8, drawings and instruction of the Engineer, with all lead and lift	cum	1878			
66	Work No. B5: Surface Reinstatement	Reinstatement for Asphalt Roads Providing and laying open-graded premix carpet of 20 mm thickness composed of Clause 13.2 mm to 5.6 mm aggregates as wearing course on a previously prepared base as per drawing and SECTION VI-C: WORKS REQUIREMENTS Clause 2.11 .	sq.m.	6060			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
67	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement Works Gravel Road: Supplying and laying of well-graded gravel mix of crushed gravel, sand and fines with sufficient compaction, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.1.5.14, drawings and instruction of the Engineer, with all lead and lift	cum	3851			
68	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement WorksPCC/RCC Concrete Road (except reinforcement): Dismantling of existing PCC/ RCC surface and Supply of required materials (except reinforcement), mixing, placing, compaction and complete PCC/RCC concrete not less than M20 works of thickness as per site condition with proper vibration and curing of the work, removal of any debris as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.17, drawings and instruction of the Engineer, with all lead and lift	cum	816			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
69	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement Works Interlocking Concrete Block Pavement: Dismantling of Concrete Block Pavement for pipe works and further reinstatement of the same with use of dismantled blocks of good condition and if required, replacement by new blocks for damaged and broken ones with approximately 15 % provision. The replaced blocks should be of minimum 50 mm thickness and of concrete M30 grade. The reinstatement shall be done in original pattern and the blocks should be laid in the firm bedding as illustrated in the drawing and in accordance with SECTION VI-C: WORKS REQUIREMENTS Clause 2.15 and as instructed by the Engineer, with all lead and lift	sq.m.	2768			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
70	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement WorksBrick Pavement: Dismantling of brick pavement for pipe works and reinstatement of the same using dismantled bricks in good condition and, if required, replacement with new bricks for damaged or broken ones with an approximate provision of 70%. The quality of bricks and laying procedures shall be in accordance with Section VI-C: Works Requirements, Clause 2.18. The reinstatement work shall be carried out in the original pattern, as shown in the drawings and as instructed by the Engineer, including all lead and lift.	sq.m.	10400			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
71	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement Works Stone Pavement: Dismantling of Flagstone Paved Roads for pipe works and further reinstatement of the same with use of dismantled Flagstones of good condition, and if required, replacement by new Flagstones for damaged and broken ones with approximately 15 % provision. The replaced Flagstones should be of minimum 100 mm thickness. The reinstatement shall be done in existing pattern and the Flagstones should be laid in the firm bedding as illustrated in the drawing and in accordance with SECTION VI-C: WORKS REQUIREMENTS Clause 2.14 and as instructed by the Engineer, with all lead and lift	sq.m.	19469			
72	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement WorksSupply of materials at site and complete the Flat Brick Soling Work on top of compacted earthen foundation for PCC/ RCC Road reinstatement and Stone pavement foundation preparation as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 1.4.4.8, drawings and to the satisfaction of the Engineer including filling of minor depression and void by sand with all lead and lift all complete	sq.m.	4709			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
73	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement Works Kerb Stone : Dismantling of Kerb Stones for pipe works and further reinstatement of the same with use of dismantled Kerb Stones of good condition and if required, replacement by new precast Kerb Stones for damaged and broken ones with approximately 15 % provision. The replaced Kerb Stones should be of 38 cm * 20 cm * 25 cm size and of concrete M20 grade. The reinstatement shall be done in existing pattern and the stones should be laid in the firm bedding as illustrated in the drawing and in accordance with SECTION VI-C: WORKS REQUIREMENTS Clause 2.16 and as instructed by the Engineer, with all lead and lift	m	1400			
74	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement WorksSurface Drain: Execute complete M20 concrete surface drain (Tick type), including excavation in all types of soil/rock, dewatering, backfilling in layers, brick flat soling, concreting etc., as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.12, drawings and instruction of the Engineer, with safe disposal of excess soil, all lead and lift	m	1559			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
75	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement Works Catch Pit: Execute complete Catch pit including excavation in all types of soil/rock, dewatering, backfilling in layers, brick flat soling, brick wall construction in 1:6 cement sand mortar, 1:4 plaster works with cement punning, concrete topping including fixing of CI gratings (compliant with IS: 5961) including supply and laying of 160mm dia HDPE pipe (minimum length: 1.5m) etc., as per SECTION VI-C: WORKS REQUIREMENTS Clause 2.13, drawings and instruction of the Engineer, with safe disposal of excess soil, all lead and lift	Nos.	294			
76	Work No. B5: Surface Reinstatement	Other Pavement Reinstatement Works Raising of existing (circular/square/rectangular) manhole covers and frames in all sizes. It should be leveled with finishing road surface and shall be carried out as per instruction of the Engineer. The type and material for works may vary to suit the existing condition and shall generally consist of PCC or brickwork. The works should be carried out in accordance with the relevant clause in SECTION VI-C: WORKS REQUIREMENTS	Nos.	153			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
77	Work No. B6: Metal Related Works	Supply and installation of Circular manhole covers and frames with Heavy duty (HD-20) type, 28" diameter dimension, complying with IS: 1726 on main roads, leveled with surrounding area, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.8, drawings and instruction of the Engineer, with safe disposal of excess soil, all lead and lift	Nos.	70			
78	Work No. B6: Metal Related Works	Supply and installation of Circular SMC manhole covers with Frame size 880 mm dia. and cover size 700 mm dia. of capacity 50 Ton, on main roads, leveled with surrounding area, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.8, drawings and instruction of the Engineer, with safe disposal of excess soil, all lead and lift	Nos.	26			
79	Work No. B6: Metal Related Works	Replacement of broken manhole covers and frames Medium Duty (MD-10) type 24" diameter manhole cover dimension, complying with IS: 1726 on carriage way, shoulder and or in footpaths, leveled with surrounding area, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.8 , drawings and instruction of the Engineer, with safe disposal of excess soil, all lead and lift	Nos.	23			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
80	Work No. B6: Metal Related Works	Supply and installation of Circular SMC manhole covers with Frame size 725 mm dia. and cover size 600 mm dia. of capacity 40 Ton, on main roads, leveled with surrounding area, all complete as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.8, drawings and instruction of the Engineer, with safe disposal of excess soil, all lead and lift	Nos.	9			
81	Work No. B6: Metal Related Works	Supply and Installation of Circular Surface Box Cover, 150mm diameter, EN-124 Class D400, made polymer composite including M15 concrete pad and flat brick soling, completely installed as per document SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.8, completely installed to the final approval of the Engineer	Nos.	239			
82	Work No. B6: Metal Related Works	Supply and Installation of Circular Surface Box Cover, 250mm diameter, EN-124 Class D400, made of polymer composite including M15 concrete pad and flat brick soling, completely installed as per document SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.8, completely installed to the final approval of the Engineer	Nos.	24			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
83	Work No. B6: Metal Related Works	Supply and Installation of Square Manhole Cover and frame, clear opening 400 mm x 400mm, for underground hydrant chambers, IS 1726 Heavy Duty class HD-20, as per document SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.8, completely installed to the final approval of the Engineer	Nos.	12			
84	Work No. B6: Metal Related Works	Supply and complete installation of Manhole Safety Steps in chambers, steel reinforced rod minimum diameter 12mm injection molded of tough copolymer polypropylene or similar cover, as per document SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.9, completely installed to the final approval of the Engineer	Nos.	565			
85	Work No. B6: Metal Related Works	Supply, fabrication and Installation of Metallic Staircase inside overhead tank, with ISMC steel profile for column, ISLC steel profile for Beam, bracing steel profiles, bracing plate, base plate, shoe plate, J-hook, all necessary bolts and other fittings, all complete, including structure steel paint coating for corrosion protection, as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and by instruction of the Engineer, including all lead and lift	Kg	44226			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
86	Work No. B6: Metal Related Works	Supply Fabrication and Installation of Following size and shape different Iron Section as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and by instruction of the Engineer, including all lead and lift. MS Square Section medium duty 200 mm Tube with minimum thickness 7.01 mm thickness as per IS : 4923-1997 per meter weight 36.76 kg/ m.	Kg	11141			
87	Work No. B6: Metal Related Works	Supply Fabrication and Installation of Following size and shape different Iron Section as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and by instruction of the Engineer, including all lead and lift. MS Square Section medium duty 125 mm Tube with minimum thickness 5.0 mm thickness as per IS : 4923-1997 per meter weight 18.33 kg.	Kg	11402			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
88	Work No. B6: Metal Related Works	Supply Fabrication and Installation of Following size and shape different Iron Section as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and by instruction of the Engineer, including all lead and lift.MS Square Section medium duty 50 mm Tube with minimum thickness 3.6 mm thickness as per IS : 4923-1997 per meter weight 4.93 kg.	Kg	2994			
89	Work No. B6: Metal Related Works	Supply Fabrication and Installation of Following size and shape different Iron Section as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and by instruction of the Engineer, including all lead and lift. MS Square Section medium duty 40 mm Tube with minimum thickness 2.6 mm thickness as per IS : 4923-1997 per meter weight 2.92 kg.	Kg	1431			
90	Work No. B6: Metal Related Works	Supply and complete installation of Rolling Shutter for Generator Room as per drawing and specification SECTION VI: WORKS REQUIREMENTS, completely installed to the final approval of the Engineer	sq.m.	10			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
91	Work No. B6: Metal Related Works	Supply, fabrication and installation of metallic lid cover for maintenance works on Kirtipur Pumping Station and Kwacho SRT including perimeter steel frame profiles (L100*8), metallic sheet steel of 3 mm thick with paint coating for corrosion protection as specified in document SECTION VI: WORKS REQUIREMENTS and Drawings, and by instruction of the Engineer, including all lead and lift.	sq.m.	19			
92	Work No. B7: Other Miscellaneous Works	Supply of materials Installation of 50 mm & 30 mm dia. Medium class Steel Pipe Railing as per document SECTION VI-C: WORKS REQUIREMENTS, completely installed to the final approval of the Engineer	m	423			
93	Work No. B7: Other Miscellaneous Works	Supply and Installation of 240 mm PVC water Stopper as per document SECTION VI-C: WORKS REQUIREMENTS, completely installed to the final approval of the Engineer	m	3164			
94	Work No. B7: Other Miscellaneous Works	Supply and Installation of complete set of Lighting Arrestor as per document SECTION VI-C: WORKS REQUIREMENTS	set	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
95	Work No. B7: Other Miscellaneous Works	Providing and fixing Metallic cover opening 3 mm thick with natural or color anodized/ powder coated color section size (102x45x1.5 mm) for Pumping Station and Kwacho SRT Chamber as per document SECTION VI-C: WORKS REQUIREMENTS	sq.m.	31			
96	Work No. B7: Other Miscellaneous Works	Supply and installation of Aluminum Louver for SRT Ventilation as per document SECTION VI-C: WORKS REQUIREMENTS	sq.m.	10			
97	Work No. B7: Other Miscellaneous Works	Supply of Polythene Water Proof membrane (GB18173.1-2012 Standard) for water proofing Treatment on SRT/ PS Roof slab with providing mortar for minimum 1% of slope and placing membrane in the position as per drawing and as directed by the Engineer including all lead and lift.	sq.m.	350			
98	Work No. B7: Other Miscellaneous Works	Supply and Installation of CGI sheet {0.37 mm (26 gauge medium duty) CGI Sheet for roof, width of 1.11 m and length 9 ft.} and necessary nutbolt and other fitting accessories	sq.m.	826			
99	Work No. B7: Other Miscellaneous Works	Providing and fixing CGI Sheet barricades with Box Section iron posts 40 mm Horizontal section at c/c distance of 1.6 m with necessary fixing to iron posts by bolt ,complete as per Drawing and Technical Specifications.	sq.m.	618			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
100	Work No. B7: Other Miscellaneous Works	Manufacture and Installation of rolling Compound gate with 16gauge plate and SMS of 50x50x5 mm frame.	sq.m.	23			
101	Work No. B7: Other Miscellaneous Works	Providing and fixing heavy Zinc Coated GI. Wire of 12gauge welded with the SMS 40x40 mm frame as ventilation above the CGI barricade.	sq.m.	95			
102	Work No. B7: Other Miscellaneous Works	Construction of Gutter with 140 mm pipe for proper arrangement of Rain water collection with necessary fittings	Rm	114			
103	Work No. B7: Other Miscellaneous Works	providing and fixing 2 or 3 Panel sliding Window of aluminum section in naturally anodized or black anodized powder coated color, section size (87x56x1.50 mm) fitted with 5 mm clear glass with out fly mesh shutter.	sq.m.	3			
104	Work No. B7: Other Miscellaneous Works	providing and fixing single panel Swing Door of aluminum section in naturally anodized or black anodized powder coated color section size (102x45x1.50mm) fitted with 5 mm clear glass or 9 mm both side laminated board.	sq.m.	6			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
105	Work No. B7: Other Miscellaneous Works	Providing and fixing full height partition of aluminum section in naturally anodized or black anodized powder coated color section size (102x45x1.50mm) fitted with 5 mm clear glass or 9 mm both side laminated board.	sq.m.	35			
106	Work No. B7: Other Miscellaneous Works	providing and Fixing mineral fiber false ceiling Scala Board, size 600 x 600 mm & 12 mm Thickness of approved texture, design and Pattern.	sq.m.	9			
107	Work No. B7: Other Miscellaneous Works	Supply and Installation of 2000 lit. capacity Plastic Water Tank made of high-quality, food-grade polyethylene or other plastic materials and designed to be corrosion-resistant, UV-resistant, and capable of withstanding varying weather condition.	Nos.	2			
108	Work No. B7: Other Miscellaneous Works	580 mm size Porcelain clay white glazed Orissa pan with low level glazed cistern complete set with additional S trap, 10.0 liter PVC low level flushing cistern complete accessories	set	1			
109	Work No. B7: Other Miscellaneous Works	(50x40)cm Porcelain clay white glaze Oval Wash basin with Tap complete set.	set	1			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
110	Work No. B7: Other Miscellaneous Works	Supply and installation of 1/2" PPR Pipe and fitting complete Plumbing works .	Rm	25			
111	Work No. B7: Other Miscellaneous Works	Supply and Installation of Gate Valve, Tap, Check valve, Soap dish, Towel rod, as per requirement	set	1			
112	Work No. B7: Other Miscellaneous Works	0.5 H P Electric motor pump with base plate nuts, bolts etc.	set	1			
113	Work No. B7: Other Miscellaneous Works	Supply and installation of 200mm dia DWC HDPE pipe (NP class nonpressure pipe SN8)with couplers at one end to be filled with Rubber Gasket for the washout of OMU chamber with joints in perfect line and level all complete along with backfilling by crushed base material compaction properly and parent excavated material as shown in drawing, as per document SECTION VI-C: WORKS REQUIREMENTS, completely installed to the final approval of the Engineer.	m	1000			

114	Work No. B8: Horizontal Directional Drilling Works	Horizontal Directional Drilling (HDD) Work: Horizontal trenchless borehole for HDPE pipes PE 100 PN10 of different sizes (excluding the supply and installation of pipes), but including all other operations and supplies, as follow:a) Mobilizations and demobilizations,b) Site investigation & utility surveys (e.g. test pit underground utilities and Ground Penetration Radar (GPR) surveys), detailed engineering & boring profiles submittal for the approval of the Engineer before starting any stretch,c) Location and Relocation of all the equipment, material and labor in each stretch,d) Tracking electronics and location system, truck trailer with mixing system, drilling fluid activities and vacuum system,e) Pilot Bore Drilling, Reaming, Hole Conditioning, pipeline pullback, installation and grouting, including all ancillary works needed and disposal to approved site of all excavated materials, bentonite muds and waste materials, including all services, equipment, materials, and labor for the complete and proper final installation and testing of underground pipelines, as specified in SECTION VI-C-WORKS REQUIREMENTS Clause 3.2.7, drawings and as instructed by the Engineer for 140 mm to 180 mm	m	1577			

115	Work No. B8: Horizontal Directional Drilling Works	Horizontal Directional Drilling (HDD) Work: Horizontal trenchless borehole for HDPE pipes PE 100 PN10 of different sizes (excluding the supply and installation of pipes), but including all other operations and supplies, as follow:a) Mobilizations and demobilizations,b) Site investigation & utility surveys (e.g. test pit underground utilities and Ground Penetration Radar (GPR) surveys), detailed engineering & boring profiles submittal for the approval of the Engineer before starting any stretch,c) Location and Relocation of all the equipment, material and labor in each stretch,d) Tracking electronics and location system, truck trailer with mixing system, drilling fluid activities and vacuum system,e) Pilot Bore Drilling, Reaming, Hole Conditioning, pipeline pullback, installation and grouting, including all ancillary works needed and disposal to approved site of all excavated materials, bentonite muds and waste materials, including all services, equipment, materials, and labor for the complete and proper final installation and testing of underground pipelines, as specified in SECTION VI-C-WORKS REQUIREMENTS Clause 3.2.7, drawings and as instructed by the Engineer for 200 mm to 250 mm	m	308			

116	Work No. B8: Horizontal Directional Drilling Works	Horizontal Directional Drilling (HDD) Work: Horizontal trenchless borehole for HDPE pipes PE 100 PN10 of different sizes (excluding the supply and installation of pipes), but including all other operations and supplies, as follow:a) Mobilizations and demobilizations,b) Site investigation & utility surveys (e.g. test pit underground utilities and Ground Penetration Radar (GPR) surveys), detailed engineering & boring profiles submittal for the approval of the Engineer before starting any stretch,c) Location and Relocation of all the equipment, material and labor in each stretch,d) Tracking electronics and location system, truck trailer with mixing system, drilling fluid activities and vacuum system,e) Pilot Bore Drilling, Reaming, Hole Conditioning, pipeline pullback, installation and grouting, including all ancillary works needed and disposal to approved site of all excavated materials, bentonite muds and waste materials, including all services, equipment, materials, and labor for the complete and proper final installation and testing of underground pipelines, as specified in SECTION VI-C-WORKS REQUIREMENTS Clause 3.2.7, drawings and as instructed by the Engineer for 280 mm to 315 mm	m	165			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
117	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of DI Primary Spigot and Socket Straight Pipes Restrained Joint, restrained joint with double chamber and weld bead at the spigot (anchorage chamber independent of the sealing chamber), including necessary accessories, joint rings (10% extra), lock rings, lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, including restrained double spigot pieces to adjust length on bends (weld bead factory-welded in one end , the other end to be cut and field-welded, or else both ends factory-welded and cut in the center joining both sides using mechanical self-anchored/restrained coupling for DI pipes), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 400mm Class C30	m	491			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
118	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of DI Primary Spigot and Socket Straight Pipes Restrained Joint, restrained joint with double chamber and weld bead at the spigot (anchorage chamber independent of the sealing chamber), including necessary accessories, joint rings (10% extra), lock rings, lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, including restrained double spigot pieces to adjust length on bends (weld bead factory-welded in one end , the other end to be cut and field-welded, or else both ends factory-welded and cut in the center joining both sides using mechanical self-anchored/restrained coupling for DI pipes), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 350mm Class C30	m	121			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
119	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of DI Primary Spigot and Socket Straight Pipes Non-Restrained joint, including necessary accessories, joint rings (10% extra) and lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends (including length wastage), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 400mm Class C30	m	1671			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
120	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of DI Primary Spigot and Socket Straight Pipes Non-Restrained joint, including necessary accessories, joint rings (10% extra) and lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends (including length wastage), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 350mm Class C30	m	510			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
121	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of DI Double Flanged Pipe for OHT, SRT , including necessary accessories, joint rings (10% extra) and lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends (including length wastage), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 700mm	m	42.35			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
122	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of DI Double Flanged Pipe for OHT, SRT , including necessary accessories, joint rings (10% extra) and lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends (including length wastage), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 400mm	m	33			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
123	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of DI Double Flanged Pipe for OHT, SRT , including necessary accessories, joint rings (10% extra) and lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends (including length wastage), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 350mm	m	36.3			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
124	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of DI Double Flanged Pipe for OHT, SRT , including necessary accessories, joint rings (10% extra) and lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends (including length wastage), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 300mm	m	78.65			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
125	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of DI Double Flanged Pipe for OHT, SRT , including necessary accessories, joint rings (10% extra) and lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends (including length wastage), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 200mm	m	169.4			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
126	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of Stainless Steel 316-L Flanged Pipe for OHT, SRT , including necessary accessories, joint rings (10% extra) and lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends (including length wastage), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 300mm	m	5.5			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
127	Work No. C1: Supply and Installation of Pipes	Supply of all materials and laying/installation of Stainless Steel 316-L Flanged Pipe for OHT, SRT , including necessary accessories, joint rings (10% extra) and lubricant, minimum length 5.5 m, outside coating and inside lining as per technical specifications, including storing properly, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends (including length wastage), jointing, dewatering, supply and installation of PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 350mm	m	5.5			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
128	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 315mm	m	977			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
129	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 280mm	m	645			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
130	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 250mm	m	1991			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
131	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 200mm	m	837			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
132	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 180mm	m	1039			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
133	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 160mm	m	2068			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
134	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 140mm	m	12603			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
135	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 125mm	m	7254			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
136	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 110mm	m	7594			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
137	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 90mm	m	29436			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
138	Work No. C1: Supply and Installation of Pipes	Supply and laying/installation of Distribution Network HDPE pipe PE 100 PN 10 in open-cut trenches (including in measurement the interconnection with HDPE laid by HDD method) with Electro Fusion fitting joints, including all needed EF couplers and bends, also including storing in proper location, loading the pipes & fittings at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, fusion jointing, dewatering, supply and installation of detectable warning tape at specified level, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 75mm	m	6328			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
139	Work No. C1: Supply and Installation of Pipes	Supply and installation of Distribution Network HDPE pipe PE 100 PN 10 in Horizontal Directional Drilling installation with butt fusion joints and embedded tracer wire, including storing in proper location, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, butt fusion jointing, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C : WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 315mm	m	99			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
140	Work No. C1: Supply and Installation of Pipes	Supply and installation of Distribution Network HDPE pipe PE 100 PN 10 in Horizontal Directional Drilling installation with butt fusion joints and embedded tracer wire, including storing in proper location, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, butt fusion jointing, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C : WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 280mm	m	66			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
141	Work No. C1: Supply and Installation of Pipes	Supply and installation of Distribution Network HDPE pipe PE 100 PN 10 in Horizontal Directional Drilling installation with butt fusion joints and embedded tracer wire, including storing in proper location, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, butt fusion jointing, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C : WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 250mm	m	203			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
142	Work No. C1: Supply and Installation of Pipes	Supply and installation of Distribution Network HDPE pipe PE 100 PN 10 in Horizontal Directional Drilling installation with butt fusion joints and embedded tracer wire, including storing in proper location, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, butt fusion jointing, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C : WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 225mm	m	19			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
143	Work No. C1: Supply and Installation of Pipes	Supply and installation of Distribution Network HDPE pipe PE 100 PN 10 in Horizontal Directional Drilling installation with butt fusion joints and embedded tracer wire, including storing in proper location, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, butt fusion jointing, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C : WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 200mm	m	86			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
144	Work No. C1: Supply and Installation of Pipes	Supply and installation of Distribution Network HDPE pipe PE 100 PN 10 in Horizontal Directional Drilling installation with butt fusion joints and embedded tracer wire, including storing in proper location, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, butt fusion jointing, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C : WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 180mm	m	105			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
145	Work No. C1: Supply and Installation of Pipes	Supply and installation of Distribution Network HDPE pipe PE 100 PN 10 in Horizontal Directional Drilling installation with butt fusion joints and embedded tracer wire, including storing in proper location, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, butt fusion jointing, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C : WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 160mm	m	209			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
146	Work No. C1: Supply and Installation of Pipes	Supply and installation of Distribution Network HDPE pipe PE 100 PN 10 in Horizontal Directional Drilling installation with butt fusion joints and embedded tracer wire, including storing in proper location, loading the pipes at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, butt fusion jointing, successful sectional pressure and leakage testing, including cost of water and cost of all testing arrangements/equipments, all complete as specified in document SECTION VI-C : WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. OD 140mm	m	1263			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
147	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Socket Restrained Bend of 90 deg. DN 350	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
148	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 90 deg. DN 400	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
149	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Socket Restrained Bend of 45 deg. DN 350	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
150	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 45 deg. DN 400	Nos.	11			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
151	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 22.5 deg. DN 350	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
152	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 22.5 deg. DN 400	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
153	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 11.25 deg. DN 350	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
154	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 11.25 deg. DN 400	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
155	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Socket Restrained Equal Tee (ET) DN 350	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
156	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Socket Restrained Equal Tee (ET) DN 400	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
157	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Flange Equal Tee (ET) DN 400	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
158	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Socket Restrained Concentric Taper 400mm x 250mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
159	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Socket Restrained Concentric Taper 400mm x 280mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
160	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Single Flanged Piece (Tail with weld bead) DN 350	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
161	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Single Flanged Piece (Tail with weld bead) DN 400	Nos.	9			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
162	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Flanged and Socket (FS) Restrained (socket with double chamber) DN 350	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
163	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	DI PIPELINES FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Flanged and Socket (FS) Restrained (socket with double chamber) DN 400	Nos.	27			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
164	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 75	Nos.	55			
165	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 90	Nos.	50			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
166	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 110	Nos.	49			
167	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 125	Nos.	60			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
168	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 140	Nos.	98			
169	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 160	Nos.	21			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
170	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 180	Nos.	21			
171	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 200	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
172	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 225	Nos.	8			
173	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 250	Nos.	23			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
174	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 280	Nos.	13			
175	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 315	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
176	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 75	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
177	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 90	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
178	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 110	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
179	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 125	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
180	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 140	Nos.	23			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
181	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 160	Nos.	13			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
182	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 180	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
183	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 200	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
184	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 250	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
185	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 280	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
186	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 315	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
187	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 90mmX75mm	Nos.	46			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
188	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 110mm x 90mm	Nos.	59			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
189	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 125mm x 110mm	Nos.	21			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
190	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 125mm x 90mm	Nos.	35			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
191	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 140mm x 110mm	Nos.	35			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
192	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 140mm x 125mm	Nos.	27			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
193	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 140mm x 90mm	Nos.	60			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
194	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 160mm x 110mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
195	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 160mm x 125mm	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
196	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 160mm x 140mm	Nos.	20			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
197	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 160mm x 90mm	Nos.	29			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
198	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 180mm x 110mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
199	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 180mm x 125mm	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
200	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 180mm x 140mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
201	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 180mm x 160mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
202	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 180mm x 90mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
203	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 200mm x 110mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
204	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 200mm x 125mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
205	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 200mm x 140mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
206	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 200mm x 160mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
207	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 200mm x 90mm	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
208	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 225mm x 125mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
209	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 225mm x 140mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
210	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 225mm x 160mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
211	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 225mm x 90mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
212	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 110mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
213	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 125mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
214	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 140mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
215	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 160mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
216	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 180mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
217	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 200mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
218	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 225mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
219	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 90mm	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
220	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 280mm x 160mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
221	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 280mm x 200mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
222	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 280mm x 90mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
223	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 300mm x 250mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
224	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 315mm x 160mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
225	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 315mm x 200mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
226	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 315mm x 225mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
227	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 315mm x 250mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
228	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 315mm x 90mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
229	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion End Stops OD 75	Nos.	42			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
230	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion End Stops OD 90	Nos.	135			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
231	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion End Stops OD 110	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
232	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion End Stops OD 125	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
233	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion End StopsOD 140	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
234	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion End Stops OD 160	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
235	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.Supply and laying/installation of HDPE Pipe PE100 PN 10 for washout, ARV and hydrant.OD 50	m	346			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
236	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGS Supply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. Supply and laying/installation of HDPE Pipe PE100 PN 10 for washout, ARV and hydrant. OD 90	m	149			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
237	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	HDPE PIPELINES FITTINGSSupply and Installation of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.Supply and laying/installation of HDPE Pipe PE100 PN 10 for washout, ARV and hydrant.OD 110	m	68			
238	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Dismantling Joint, self restraining, flanged ends PN16, for easy installation / dismantling, with adaptor sleeve, EPDM seals, epoxy coated, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. Self Restraining dismantling Joint of size 350 mm dia	Nos.	2			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
239	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and Installation of DI Dismantling Joint, self restraining, flanged ends PN16, for easy installation / dismantling, with adaptor sleeve, EPDM seals, epoxy coated, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.Self Restraining dismantling Joint of size 400 mm dia	Nos.	2			
240	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 50mm	Nos.	174			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
241	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 75mm	Nos.	41			
242	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.80mm	Nos.	7			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
243	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 90mm	Nos.	146			
244	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 100mm	Nos.	46			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
245	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.110mm	Nos.	75			
246	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 140mm	Nos.	142			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
247	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 150mm	Nos.	7			
248	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.160mm	Nos.	22			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
249	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 200mm	Nos.	11			
250	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 250mm	Nos.	4			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
251	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and installation of DI Flange Adaptors PN16, for connection DI pipe/fitting, with all necessary gaskets, nuts & bolts, fasteners, sealing Rings and required accessories etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Flange Adaptors of size 50 mm dia	Nos.	28			
252	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of DI Flange Adaptors PN16, for connection DI pipe/fitting, with all necessary gaskets, nuts & bolts, fasteners, sealing Rings and required accessories etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Flange Adaptors of size 80 mm dia	Nos.	26			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
253	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of DI Flange Adaptors PN16, for connection DI pipe/fitting, with all necessary gaskets, nuts & bolts, fasteners, sealing Rings and required accessories etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Flange Adaptors of size 100 mm dia	Nos.	12			
254	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and installation of DI Flange Adaptors PN16, for connection DI pipe/fitting, with all necessary gaskets, nuts & bolts, fasteners, sealing Rings and required accessories etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Flange Adaptors of size 350 mm dia	Nos.	3			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
255	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of DI Flange Adaptors PN16, for connection DI pipe/fitting, with all necessary gaskets, nuts & bolts, fasteners, sealing Rings and required accessories etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Flange Adaptors of size 400 mm dia	Nos.	5			
256	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Electro-fusion Tapping Saddle Clamp with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE Electrofusion Saddle Clamp of mains x 25 mm dia	Nos.	30			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
257	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.90mmx50mm	Nos.	11			
258	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 110mmx50mm	Nos.	10			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
259	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 125mmx50mm	Nos.	14			
260	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.140mm*50 mm	Nos.	2			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
261	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 140mmx90mm	Nos.	19			
262	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 160mm*50 mm	Nos.	2			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
263	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.160mmx90mm	Nos.	2			
264	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 180mmx50mm	Nos.	2			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
265	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 200 mm*50 mm	Nos.	2			
266	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.200mmx90mm	Nos.	3			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
267	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 180 mm*90 mm	Nos.	2			
268	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 250 mm*90 mm	Nos.	4			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
269	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.315mmx50mm	Nos.	3			
270	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and installation of HDPE PE100 PN10 Tee with all needed electrofusion couplers to be connected to the pipelines, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 315 mm*90 mm	Nos.	2			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
271	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) DI Tangential/Invert with all flanged Tee as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 350x100mm	Nos.	2			
272	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)DI Tangential/Invert with all flanged Tee as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.400x100mm	Nos.	3			
273	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) DI flanged pipe as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 150 mm	m	61			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
274	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Double Flanged Pipe Piece with Puddle PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 100 mm	Nos.	3			
275	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Double Flanged Pipe Piece with Puddle PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 200mm	Nos.	48			
276	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and Installation of DI Double Flanged Pipe Piece with Puddle PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.250mm	Nos.	5			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
277	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Double Flanged Pipe Piece with Puddle PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 300mm	Nos.	9			
278	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Double Flanged Pipe Piece with Puddle PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 350mm	Nos.	3			
279	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and Installation of DI Double Flanged Pipe Piece with Puddle PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.400mm	Nos.	5			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
280	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flanged Duck Foot 90 deg Bend for Hydrants PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 50mm	Nos.	59			
281	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Flanged Duck Foot 90 deg Bend for Hydrants PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 80mm	Nos.	26			
282	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and Installation of DI Flanged Duck Foot 90 deg Bend for Hydrants PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.100mm	Nos.	12			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
283	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Double Flanged Pipe Piece PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 150 mm dia. 1000 mm length	Nos.	11			
284	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Double Flanged Pipe Piece PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 150 mm dia. 500 mm length	Nos.	11			
285	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)Supply and Installation of DI Single Flanged Pipe Piece PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.50mm	Nos.	28			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
286	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Single Flanged Pipe Piece PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 80mm	Nos.	13			
287	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) Supply and Installation of DI Single Flanged Pipe Piece PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 100mm	Nos.	11			
288	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)DI Flanged socket pipe piece as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.350mm	Nos.	3			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
289	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) DI Flanged socket pipe piece as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 400mm	Nos.	3			
290	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) DI Flanged Unequal TEE as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 350mmx100mm	Nos.	3			
291	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) DI Flanged Unequal TEE as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 400mmx100mm	Nos.	4			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
292	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs)DI Flanged 90 deg. Bend as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.80mm	Nos.	4			
293	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) DI Flanged 90 deg. Bend as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 150mm	Nos.	21			
294	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) DI Flanged Socket Ewstrainedas specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 350 mm	Nos.	3			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
295	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	CHAMBERS FITTINGS (EXCEPT OMUs) DI Flanged Socket Ewstrainedas specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 400 mm	Nos.	5			
296	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	RIVER CROSSING DI Flanged 45 deg. Bend as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.150mm	Nos.	5			
297	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	RIVER CROSSING Supply and Installation of DI Single Flanged Pipe Piece PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 150mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
298	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	RIVER CROSSING Supply and Installation of DI Double Flanged Pipe Piece PN16, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 150 mm dia. 1000 mm length	Nos.	6			
299	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	RIVER CROSSING DI flanged pipe as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 150 mm	m	8			
300	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	RIVER CROSSING Supply and installation of DI Flange Adaptors PN16, for connection DI pipe/fitting, with all necessary gaskets, nuts & bolts, fasteners, sealing Rings and required accessories etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Flange Adaptors of size 150 mm dia	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
301	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	RIVER CROSSING DI All Flange Equal Tee (ET) DN 150	Nos.	2			
302	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	RIVER CROSSING Supply and Installation of DI Flange Adaptor PN16 for connection to HDPE pipe, with all necessary gasket, nut bolt, etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. 50mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
303	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.SINGLE FLANGED PIPE-DIDN 300	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
304	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. SINGLE FLANGED PIPE-DI DN 250	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
305	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.SINGLE FLANGED PIPE-DIDN 200	Nos.	21			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
306	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. SINGLE FLANGED PIPE-DI DN 150	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
307	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED ADAPTOR UNRESTRAINEDDN 400	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
308	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED ADAPTOR UNRESTRAINED DN 350	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
309	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED ADAPTOR UNRESTRAINEDDN 300	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
310	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED ADAPTOR UNRESTRAINED DN 250	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
311	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED ADAPTOR UNRESTRAINEDDN 200	Nos.	15			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
312	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED ADAPTOR UNRESTRAINED DN150	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
313	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED ADAPTOR RESTRAINEDDN250	Nos.	9			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
314	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED ADAPTOR RESTRAINED DN200	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
315	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED ADAPTOR RESTRAINEDDN150	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
316	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED EQUAL TEE-DI DN 300	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
317	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED EQUAL TEE-DIDN 250	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
318	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED EQUAL TEE-DI DN 200	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
319	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED EQUAL TEE-DIDN150	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
320	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED 90º BEND-DI DN 300	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
321	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED 90º BEND-DIDN 250	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
322	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED 90º BEND-DI DN 200	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
323	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED 90º BEND-DIDN 150	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
324	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED REDUCER-DI DN 400/300	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
325	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED REDUCER-DIDN 400/250	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
326	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED REDUCER-DI DN 350/250	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
327	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED REDUCER-DIDN 300/200	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
328	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. FLANGED REDUCER-DI DN 250/200	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
329	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.FLANGED REDUCER-DIDN 250/150	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
330	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH DN 300	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
331	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTHDN 250	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
332	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH DN 200	Nos.	14			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
333	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTHDN 150	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
334	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. GATE VALVE-DI DN 300	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
335	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.GATE VALVE-DIDN 250	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
336	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. GATE VALVE-DI DN 200	Nos.	16			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
337	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.GATE VALVE-DIDN 150	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
338	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. SELF RESTRAINING DISMANTLING JOINT-DI DN 300	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
339	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.SELF RESTRAINING DISMANTLING JOINT-DIDN 250	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
340	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. SELF RESTRAINING DISMANTLING JOINT-DI DN 200	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
341	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.SELF RESTRAINING DISMANTLING JOINT-DIDN 150	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
342	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DOUBLE FLANGED PIPE DN 300	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
343	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DOUBLE FLANGED PIPE DN 250	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
344	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DOUBLE FLANGED PIPE DN 200	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
345	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DOUBLE FLANGED PIPE DN 150	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
346	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DUCTILE IRON BACKING RING DN 200	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
347	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DUCTILE IRON BACKING RINGDN 250	Nos.	10			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
348	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DUCTILE IRON BACKING RING DN 300	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
349	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DOUBLE FLANGED UNEQUAL TEE -DI1000X400	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
350	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. Supply and Installation of HDPE PE100 PN10 Electrofusion Stub End DN 200	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
351	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.Supply and Installation of HDPE PE100 PN10 Electrofusion Stub EndDN 250	Nos.	10			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
352	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OMU CHAMBERS FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. Supply and Installation of HDPE PE100 PN10 Electrofusion Stub End DN 300	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
353	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Bend of 90 deg.DN 150	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
354	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Bend of 90 deg. DN 200	Nos.	18			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
355	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Bend of 90 deg.DN 300	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
356	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Bend of 90 deg. DN 350	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
357	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Bend of 90 deg.DN 700	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
358	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Bend of 90 deg. DN 900	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
359	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Bend of 45 deg.DN 300	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
360	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Bend of 45 deg. DN 350	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
361	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Bend of 22.5 deg.DN 300	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
362	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Bend of 22.5 deg. DN 350	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
363	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Flanged Equal Tee (ET)DN 150	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
364	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Flanged Equal Tee (ET) DN 200	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
365	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Flanged Equal Tee (ET)DN 350	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
366	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Flanged Equal Tee (ET) DN 700	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
367	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Flange Unequal Tee (UET)DN 300 mm x 200 mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
368	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Flange Unequal Tee (UET) DN 400 mm x 200 mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
369	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Flange Unequal Tee (UET)DN 700 mm x 300 mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
370	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Flange Unequal Tee (UET) DN 700 mm x 200 mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
371	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Flange Reducer (CT)DN 700X 400 mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
372	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Flange Reducer (CT) DN 700X 200 mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
373	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Flange Reducer (CT)DN 400X 250 mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
374	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Flange Reducer (CT) DN 300X 250 mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
375	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Flange Reducer (CT)DN 200 X 150mm	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
376	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Flanged Equal Cross Tee (CET) DN 150	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
377	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Flanged Equal Cross Tee (CET)DN 200	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
378	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Self Restrained Dismantling Joint DN 150	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
379	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Self Restrained Dismantling Joint DN 200	Nos.	9			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
380	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Self Restrained Dismantling Joint DN 250	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
381	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Self Restrained Dismantling Joint DN 300	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
382	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Self Restrained Dismantling Joint DN 350	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
383	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Self Restrained Dismantling Joint DN 400	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
384	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Self Restrained Dismantling Joint DN 700	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
385	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Flanged Adopter Unrestrained DN 150	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
386	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Flanged Adopter Unrestrained DN 200	Nos.	27			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
387	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Flanged Adopter Unrestrained DN 250	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
388	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Flanged Adopter Unrestrained DN 300	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
389	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Flanged Adopter Unrestrained DN 350	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
390	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Flanged Adopter Unrestrained DN 700	Nos.	9			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
391	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Pipe with Puddle flangeDN 150	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
392	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Pipe with Puddle flange DN 200	Nos.	22			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
393	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Pipe with Puddle flangeDN 250	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
394	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Pipe with Puddle flange DN 300	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
395	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Pipe with Puddle flangeDN 350	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
396	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Pipe with Puddle flange DN 400	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
397	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Pipe with Puddle flangeDN 700	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
398	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. Stainless Steel Double Flanged Pipe with Puddle flange DN 300	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
399	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.Stainless Steel Double Flanged Pipe with Puddle flange DN 350	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
400	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Pipe Piece (DFTP) DN 150	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
401	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Flanged Pipe Piece (DFTP) DN 200	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
402	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Flanged Pipe Piece (DFTP) DN 700	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
403	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Single Flanged Pipe Piece (SFTP) DN 150	Nos.	11			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
404	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Single Flanged Pipe Piece (SFTP) DN 200	Nos.	20			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
405	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Single Flanged Pipe Piece (SFTP) DN 250	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
406	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Single Flanged Pipe Piece (SFTP) DN 300	Nos.	8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
407	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.DI Single Flanged Pipe Piece (SFTP) DN 350	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
408	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGS Supply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift. DI Single Flanged Pipe Piece (SFTP) DN 700	Nos.	9			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
409	Work No. C2: Supply and Installation of Pipe and Chamber Fittings	OHT, SRT & PUMPING STATION DI FITTINGSSupply and Installation of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift.Puddle Flange 90 deg. BendDN 200 with Stainless Steel 316-I	Nos.	2			
410	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged, double eccentric Butterfly Valves PN16 with manual gear, but compatible to be supported by SCADA system in remote command in the future if needed, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.4 and Drawings, and as instructed by the Engineer, with all lead and lift DN 350mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
411	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged, double eccentric Butterfly Valves PN16 with manual gear, but compatible to be supported by SCADA system in remote command in the future if needed, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.4 and Drawings, and as instructed by the Engineer, with all lead and liftDN 400mm	Nos.	2			
412	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged, double eccentric Butterfly Valves PN16 with manual gear, but compatible to be supported by SCADA system in remote command in the future if needed, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.4 and Drawings, and as instructed by the Engineer, with all lead and lift DN 700mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
413	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged Gate Valves PN16, including extension spindle and operating nut with protection HDPE pipeline when buried or handwheel when installed in chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.3 and Drawings, and as instructed by the Engineer, with all lead and liftDN 50mm (included Flange Adaptors DI/HDPE and EF Couplers)	Nos.	54			
414	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged Gate Valves PN16, including extension spindle and operating nut with protection HDPE pipeline when buried or handwheel when installed in chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.3 and Drawings, and as instructed by the Engineer, with all lead and lift DN 65mm (included Flange Adaptors DI/HDPE and EF Couplers)	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
415	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged Gate Valves PN16, including extension spindle and operating nut with protection HDPE pipeline when buried or handwheel when installed in chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.3 and Drawings, and as instructed by the Engineer, with all lead and liftDN 80mm (included Flange Adaptors DI/HDPE and EF Couplers)	Nos.	75			
416	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged Gate Valves PN16, including extension spindle and operating nut with protection HDPE pipeline when buried or handwheel when installed in chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.3 and Drawings, and as instructed by the Engineer, with all lead and lift DN 100mm (included Flange Adaptors DI/HDPE and EF Couplers)	Nos.	46			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
417	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged Gate Valves PN16, including extension spindle and operating nut with protection HDPE pipeline when buried or handwheel when installed in chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.3 and Drawings, and as instructed by the Engineer, with all lead and liftDN 125mm (included Flange Adaptors DI/HDPE and EF Couplers)	Nos.	42			
418	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged Gate Valves PN16, including extension spindle and operating nut with protection HDPE pipeline when buried or handwheel when installed in chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.3 and Drawings, and as instructed by the Engineer, with all lead and lift DN 150mm (included Flange Adaptors DI/HDPE and EF Couplers)	Nos.	12			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
419	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged Gate Valves PN16, including extension spindle and operating nut with protection HDPE pipeline when buried or handwheel when installed in chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.3 and Drawings, and as instructed by the Engineer, with all lead and liftDN 200mm	Nos.	12			
420	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged Gate Valves PN16, including extension spindle and operating nut with protection HDPE pipeline when buried or handwheel when installed in chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.3 and Drawings, and as instructed by the Engineer, with all lead and lift DN 250mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
421	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged Gate Valves PN16, including extension spindle and operating nut with protection HDPE pipeline when buried or handwheel when installed in chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.3 and Drawings, and as instructed by the Engineer, with all lead and liftDN 300 mm	Nos.	1			
422	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of flanged Double Orifice Air Valves PN16, with a large orifice which allows large volumes of air to be exhausted from or admitted into a system as it is filled or drained, and a smaller orifice which automatically vent small pockets of air as they accumulate at points in a system while is operating and pressurized, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.2 and Drawings, and as instructed by the Engineer, with all lead and lift DN 50mm	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
423	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of flanged Double Orifice Air Valves PN16, with a large orifice which allows large volumes of air to be exhausted from or admitted into asystem as it is filled or drained, and a smaller orifice which automatically vent small pockets of air as they accumulate at points in a system while is operating and pressurized, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.2 and Drawings, and as instructed by the Engineer, with all lead and liftDN 80mm	Nos.	5			
424	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of flanged Double Orifice Air Valves PN16, with a large orifice which allows large volumes of air to be exhausted from or admitted into a system as it is filled or drained, and a smaller orifice which automatically vent small pockets of air as they accumulate at points in a system while is operating and pressurized, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.2 and Drawings, and as instructed by the Engineer, with all lead and lift DN 150mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
425	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of DI Flap Valve Flange mounted PN16 for Wash-outs,circular aperture, single door and double hinges, hinge pins SS 316, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.10 and Drawings, and as instructed by the Engineer, with all lead and liftDN 50mm	Nos.	12			
426	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of DI Flap Valve Flange mounted PN16 for Wash-outs,circular aperture, single door and double hinges, hinge pins SS 316, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7.10 and Drawings, and as instructed by the Engineer, with all lead and lift DN 100mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
427	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of Fire Hydrant stand post (column) type with all necessary accessories (nozzles, caps, erc.), all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.13 and Drawings, and as instructed by the Engineer, with all lead and lift DN 80mm	Nos.	24			
428	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of Hydrant Underground type, with all necessary accessories (nozzles, caps, erc.), all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.13 and Drawings, and as instructed by the Engineer, with all lead and liftDN 100mm	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
429	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of Hydrant Underground type, with all necessary accessories (nozzles, caps, erc.), all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.13 and Drawings, and as instructed by the Engineer, with all lead and lift DN 50mm	Nos.	52			
430	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of double flanged DI Strainer basket type PN16, installed in OMUs and DMAs Bulk Flow meters chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 6.2 and Drawings, and as instructed by the Engineer, with all lead and lift DN 250	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
431	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and installation of double flanged DI Strainer basket type PN16, installed in OMUs and DMAs Bulk Flow meters chambers, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 6.2 and Drawings, and as instructed by the Engineer, with all lead and liftDN 300	Nos.	1			
432	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Valves and Appurtenances Supply and Installation of following size DI double flanged, Floating Valve, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.7 and Drawings, and as instructed by the Engineer, with all lead and lift DN 200	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
433	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	InstrumentationSupply and installation of double flanged Control Valve PN16 in OMUs, with hydraulic two pilots (pressure sustaining upstream and pressure reducing downstream), commanded by actuators compatible with the SCADA System, including inlet and outlet pressure sensors, V-Port Throttling Plug for low flow stability, conduits, mechanisms and accessories, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 6.1 and Drawings, and as instructed by the Engineer, with all lead and liftDN 300	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
434	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Instrumentation Supply and installation of double flanged Control Valve PN16 in OMUs, with hydraulic two pilots (pressure sustaining upstream and pressure reducing downstream), commanded by actuators compatible with the SCADA System, including inlet and outlet pressure sensors, V-Port Throttling Plug for low flow stability, conduits, mechanisms and accessories, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 6.1 and Drawings, and as instructed by the Engineer, with all lead and lift DN 250	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
435	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	InstrumentationSupply and installation of double flanged Control Valve PN16 in OMUs, with hydraulic two pilots (pressure sustaining upstream and pressure reducing downstream), commanded by actuators compatible with the SCADA System, including inlet and outlet pressure sensors, V-Port Throttling Plug for low flow stability, conduits, mechanisms and accessories, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 6.1 and Drawings, and as instructed by the Engineer, with all lead and liftDN 200	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
436	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Instrumentation Supply and installation of double flanged Control Valve PN16 in OMUs, with hydraulic two pilots (pressure sustaining upstream and pressure reducing downstream), commanded by actuators compatible with the SCADA System, including inlet and outlet pressure sensors, V-Port Throttling Plug for low flow stability, conduits, mechanisms and accessories, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 6.1 and Drawings, and as instructed by the Engineer, with all lead and lift DN 150	Nos.	1			
437	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	InstrumentationSupply and installation of double flanged Electro-magnetic DMA bulk flow meters PN16 complying with ISO 4064 and OIML R49 Class 1, including IP68 transmitter with cable for remote wall mounting installation in OMU chamber, communication module, 5-year battery, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.11 and 6.4 and Drawings, and as instructed by the Engineer, with all lead and liftDN 250mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
438	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Instrumentation Supply and installation of double flanged Electro-magnetic DMA bulk flow meters PN16 complying with ISO 4064 and OIML R49 Class 1, including IP68 transmitter with cable for remote wall mounting installation in OMU chamber, communication module, 5-year battery, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.11 and 6.4 and Drawings, and as instructed by the Engineer, with all lead and lift DN 200mm	Nos.	5			
439	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	InstrumentationSupply and installation of double flanged Electro-magnetic DMA bulk flow meters PN16 complying with ISO 4064 and OIML R49 Class 1, including IP68 transmitter with cable for remote wall mounting installation in OMU chamber, communication module, 5-year battery, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.11 and 6.4 and Drawings, and as instructed by the Engineer, with all lead and liftDN 150mm	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
440	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Instrumentation Supply and Installation of Ultrasonic water level indicator (Kwacho, Lyaku and existing Kirtipur SRTs) of 24/v; D=0.46 m; H= 5m to 10 m with water level transmitter including minimum 80 m length of wire as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift	set	5			
441	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	InstrumentationSupply and installation of Datalogger with built-in Pressure Sensor/Transducer, including wireless communication with SCADA System, for pressure test points in all DMAs, located at the inlet point and also at critical pressure points (highest elevation, lowest elevation, furthest from inlet), including all necessary accessories and auxiliary pipe from water pipeline to the location of the device at high section of the chamber, all complete, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.14.1 and Drawings, and as instructed by the Engineer, with all lead and lift	Nos.	31			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
442	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Instrumentation Supply and installation of Datalogger for Electro-magnetic DMA bulk flow meters, located at the DMA inlet, including wireless communication with SCADA System, all necessary accessories and auxiliary connection to the location of the device at high section of the chamber, all complete, as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.14.2 and Drawings, and as instructed by the Engineer, with all lead and lift	Nos.	6			
443	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	InstrumentationSupply and Installation of Autonomous Power Supply System for OMUs and Lyaku and Kwacho tank, including Solar Photovoltaic Modules, Charge Controller, Inverter, Batteries, Mounting Frame, Earthing and Grounding, Interconnection of PV to Control Panel, and Electrical Enclosure, Civil, Mechanical and Electrical Works needed, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 6.5 and Drawings, and as instructed by the Engineer, with all lead and lift	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
444	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Instrumentation Supply and Installation of OMU Control System including Remote Terminal Unit RTU, Modular Distributed Input-Output, Radio and Wireless Network Modem Communications, Control Panel and connections, Civil, Mechanical and Electrical Works needed, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 6.6 and Drawings, and as instructed by the Engineer, with all lead and lift	Nos.	4			
445	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	InstrumentationSupply and Installation of communication switch set to communicate Level Control System at Kwacho and Lyaku SRT with Scada and Kirtipur Pumping Station, Modular Distributed Input-Output, Radio and Wireless Network Modem Communications, Control Panel and connections, Civil, Mechanical and Electrical Works needed, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS 6 and Drawings, and as instructed by the Engineer, with all lead and lift	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
446	Work No. C3: Supply and Installation of Valves, Appurtenances and Instrumentation	Instrumentation Integration of SCADA system to existing system for all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 6.6.4 and 7.4, and Drawings, and as instructed by the Engineer.	LS	1			
447	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift.DN 75/90/110 mm to 15 mm	Nos.	5929			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
448	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 75/90/110 mm to 20 mm	Nos.	334			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
449	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift.DN 75/90/110 mm to 25 mm	Nos.	200			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
450	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 75/90/110 mm to 32 mm	Nos.	102			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
451	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift.DN 75/90/110 mm to 40 mm	Nos.	35			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
452	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 125/140/160 mm to 15 mm	Nos.	1485			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
453	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift.DN 125/140/160 mm to 20 mm	Nos.	86			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
454	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 125/140/160 mm to 25 mm	Nos.	53			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
455	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift.DN 125/140/160 mm to 32 mm	Nos.	28			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
456	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of HDPE PE100 PN16 Electro-fusion Tapping Saddle Tee with Under-clamp with all needed electrofusion couplers to be connected to the pipelines, for connect service connections to distribution pipelines (first diameter pipeline to connect, second diameter offtake connection), including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift. DN 125/140/160 mm to 40 mm	Nos.	11			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
457	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of all HDPE PE100 PN16 pipes, fittings, specials and accessories Service Connection Section from Tapping Saddle to Property Boundary, including, Earthwork excavation, Backfilling with compaction, shoring, Dewatering temporary end cap, all civil works except reinstatement all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift, for the following water meter diameters:15mm dia	Nos.	7408			
458	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of all HDPE PE100 PN16 pipes, fittings, specials and accessories Service Connection Section from Tapping Saddle to Property Boundary, including, Earthwork excavation, Backfilling with compaction, shoring, Dewatering temporary end cap, all civil works except reinstatement all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift, for the following water meter diameters: 20mm dia	Nos.	413			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
459	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of all HDPE PE100 PN16 pipes, fittings, specials and accessories Service Connection Section from Tapping Saddle to Property Boundary, including, Earthwork excavation, Backfilling with compaction, shoring, Dewatering temporary end cap, all civil works except reinstatement all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift, for the following water meter diameters:25mm dia	Nos.	246			
460	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of all HDPE PE100 PN16 pipes, fittings, specials and accessories Service Connection Section from Tapping Saddle to Property Boundary, including, Earthwork excavation, Backfilling with compaction, shoring, Dewatering temporary end cap, all civil works except reinstatement all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift, for the following water meter diameters: 32mm dia	Nos.	125			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
461	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of all HDPE PE100 PN16 pipes, fittings, specials and accessories Service Connection Section from Tapping Saddle to Property Boundary, including, Earthwork excavation, Backfilling with compaction, shoring, Dewatering temporary end cap, all civil works except reinstatement all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.9 and Drawings, and as instructed by the Engineer, with all lead and lift, for the following water meter diameters:40mm dia	Nos.	41			
462	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of water supply Consumer Connections sections from property boundary to water meter set, all complete; as specified in Section VI-C Technical Specification Clause 4.9 and as shown on Drawings Nos. TP-2-1 and TP-2-2, and collection of consumer details and load the data onto the database of Employer's Server as instructed by the Engineer, with all lead and lift. 15mm dia	Nos.	7408			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
463	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of water supply Consumer Connections sections from property boundary to water meter set, all complete; as specified in Section VI-C Technical Specification Clause 4.9 and as shown on Drawings Nos. TP-2-1 and TP-2-2, and collection of consumer details and load the data onto the database of Employer's Server as instructed by the Engineer, with all lead and lift.20mm dia	Nos.	413			
464	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of water supply Consumer Connections sections from property boundary to water meter set, all complete; as specified in Section VI-C Technical Specification Clause 4.9 and as shown on Drawings Nos. TP-2-1 and TP-2-2, and collection of consumer details and load the data onto the database of Employer's Server as instructed by the Engineer, with all lead and lift. 25mm dia	Nos.	246			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
465	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of water supply Consumer Connections sections from property boundary to water meter set, all complete; as specified in Section VI-C Technical Specification Clause 4.9 and as shown on Drawings Nos. TP-2-1 and TP-2-2, and collection of consumer details and load the data onto the database of Employer's Server as instructed by the Engineer, with all lead and lift. 32mm dia	Nos.	125			
466	Work No. C4: Supply and Installation of Service Connections	Supply and Installation of water supply Consumer Connections sections from property boundary to water meter set, all complete; as specified in Section VI-C Technical Specification Clause 4.9 and as shown on Drawings Nos. TP-2-1 and TP-2-2, and collection of consumer details and load the data onto the database of Employer's Server as instructed by the Engineer, with all lead and lift.40mm dia	Nos.	41			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
467	Work No. C5: Testing and Disinfection Work	Successful Hydraulic Sectional Pressure and/or Leakage Test of Primary Pipelines, in completed installed stretches, including supply of potable water, all labor, materials and equipment, safe disposal of water and sealing the pipe ends after the test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.3 and engineer's instructions, of following Pipe Size: DN 400mm	m	2162			
468	Work No. C5: Testing and Disinfection Work	Successful Hydraulic Sectional Pressure and/or Leakage Test of Primary Pipelines, in completed installed stretches, including supply of potable water, all labor, materials and equipment, safe disposal of water and sealing the pipe ends after the test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.3 and engineer's instructions, of following Pipe Size: DN 350mm	m	631			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
469	Work No. C5: Testing and Disinfection Work	Cleaning, Flushing and Disinfection of completed installed stretches of Primary Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.13 and engineer's instructions, of following Pipe Size:DN 400mm	m	2162			
470	Work No. C5: Testing and Disinfection Work	Cleaning, Flushing and Disinfection of completed installed stretches of Primary Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.2.5.13 and engineer's instructions, of following Pipe Size: DN 350mm	m	631			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
471	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size: DN 315mm	m	1076			
472	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size: DN 280mm	m	704			
473	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size: DN 250mm	m	2116			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
474	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size: DN 200mm	m	923			
475	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size:DN 180mm	m	1100			
476	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size: DN 160mm	m	2068			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
477	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size: DN 140 mm	m	12603			
478	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size:DN 125mm	m	7254			
479	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size: DN 110mm	m	7594			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
480	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size: DN 90mm	m	29436			
481	Work No. C5: Testing and Disinfection Work	Cleaning and Flushing of completed installed stretches of Distribution Pipelines, including supply of potable water, all labor, materials and equipment, and safe disposal of water after test, all complete work, as per SECTION VI-C: WORKS REQUIREMENTS Clause 3.4 and engineer's instructions, of following Pipe Size:DN 75mm	m	6328			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
482	Work No. C5: Testing and Disinfection Work	Successful Functional Guarantee Tests of each DMA Distribution Network for final taking-over, with DMA Full Hydraulic Leakage and Disinfection Test for 24 hours and 7 days trail run period, including all labor, supply of water, materials and equipment, customer communication campaign, disinfection procedure with chlorine and disinfection equipment, leakage testing with installed pressure points and inlet flow meter with dataloggers, safe disposal of water, testing and final reporting, as specified in SECTION VI-C: WORKS REQUIRMENTS Clause 3.5 and as instructed by the Engineer DMA 1	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
483	Work No. C5: Testing and Disinfection Work	Successful Functional Guarantee Tests of each DMA Distribution Network for final taking-over, with DMA Full Hydraulic Leakage and Disinfection Test for 24 hours and 7 days trail run period, including all labor, supply of water, materials and equipment, customer communication campaign, disinfection procedure with chlorine and disinfection equipment, leakage testing with installed pressure points and inlet flow meter with dataloggers, safe disposal of water, testing and final reporting, as specified in SECTION VI-C: WORKS REQUIRMENTS Clause 3.5 and as instructed by the EngineerDMA 2	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
484	Work No. C5: Testing and Disinfection Work	Successful Functional Guarantee Tests of each DMA Distribution Network for final taking-over, with DMA Full Hydraulic Leakage and Disinfection Test for 24 hours and 7 days trail run period, including all labor, supply of water, materials and equipment, customer communication campaign, disinfection procedure with chlorine and disinfection equipment, leakage testing with installed pressure points and inlet flow meter with dataloggers, safe disposal of water, testing and final reporting, as specified in SECTION VI-C: WORKS REQUIRMENTS Clause 3.5 and as instructed by the Engineer DMA 3	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
485	Work No. C5: Testing and Disinfection Work	Successful Functional Guarantee Tests of each DMA Distribution Network for final taking-over, with DMA Full Hydraulic Leakage and Disinfection Test for 24 hours and 7 days trail run period, including all labor, supply of water, materials and equipment, customer communication campaign, disinfection procedure with chlorine and disinfection equipment, leakage testing with installed pressure points and inlet flow meter with dataloggers, safe disposal of water, testing and final reporting, as specified in SECTION VI-C: WORKS REQUIRMENTS Clause 3.5 and as instructed by the EngineerDMA 4	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
486	Work No. C5: Testing and Disinfection Work	Successful Functional Guarantee Tests of each DMA Distribution Network for final taking-over, with DMA Full Hydraulic Leakage and Disinfection Test for 24 hours and 7 days trail run period, including all labor, supply of water, materials and equipment, customer communication campaign, disinfection procedure with chlorine and disinfection equipment, leakage testing with installed pressure points and inlet flow meter with dataloggers, safe disposal of water, testing and final reporting, as specified in SECTION VI-C: WORKS REQUIRMENTS Clause 3.5 and as instructed by the Engineer DMA 5	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
487	Work No. C5: Testing and Disinfection Work	Successful Functional Guarantee Tests of each DMA Distribution Network for final taking-over, with DMA Full Hydraulic Leakage and Disinfection Test for 24 hours and 7 days trail run period, including all labor, supply of water, materials and equipment, customer communication campaign, disinfection procedure with chlorine and disinfection equipment, leakage testing with installed pressure points and inlet flow meter with dataloggers, safe disposal of water, testing and final reporting, as specified in SECTION VI-C: WORKS REQUIRMENTS Clause 3.5 and as instructed by the EngineerDMA 6	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
488	Work No. C5: Testing and Disinfection Work	Successful Functional Guarantee Tests of each DMA Distribution Network for final taking-over, with DMA Full Hydraulic Leakage and Disinfection Test for 24 hours and 7 days trail run period, including all labor, supply of water, materials and equipment, customer communication campaign, disinfection procedure with chlorine and disinfection equipment, leakage testing with installed pressure points and inlet flow meter with dataloggers, safe disposal of water, testing and final reporting, as specified in SECTION VI-C: WORKS REQUIRMENTS Clause 3.5 and as instructed by the Engineer Kumari club Area	LS	1			
489	Work No. C5: Testing and Disinfection Work	Successful water tightness test of completed SRT with supply of potable water, necessary equipment and safe disposal of water after testing all complete work as per specification and engineer's instruction SECTION VI-C: WORKS REQUIREMENTS and engineer's instructions, of following tank Size:Overhead Tank (1500 cum.)	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
490	Work No. C5: Testing and Disinfection Work	Successful water tightness test of completed SRT with supply of potable water, necessary equipment and safe disposal of water after testing all complete work as per specification and engineer's instruction SECTION VI-C: WORKS REQUIREMENTS and engineer's instructions, of following tank Size: Kwacho SRT (400 cum.)	LS	1			
491	Work No. C5: Testing and Disinfection Work	Disinfection and sterilizing of completed SRT with supply of potable water, necessary disinfection equipment and chemicals, water quality tests and safe disposal of water after disinfection, all complete SECTION VI-C: WORKS REQUIREMENTS and engineer's instructions Overhead Tank (1500 cum.)	LS	1			
492	Work No. C5: Testing and Disinfection Work	Disinfection and sterilizing of completed SRT with supply of potable water, necessary disinfection equipment and chemicals, water quality tests and safe disposal of water after disinfection, all complete SECTION VI-C: WORKS REQUIREMENTS and engineer's instructionsKwacho SRT (400 cum.)	LS	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
493	Work No. C6:Chlorination Unit Work	Design review, Supply, Installation, Testing and Commissioning of 2 KPH continuous Electro chlorinator for the design flow rate of 0.23 m3/s (828 m3/hr.) at Kirtipur Service Reservoir Tank Including all Civil Works, Electro Mechanical Works reception and commissioning at site all complete works, as per SECTION VI-C: WORKS REQUIREMENTS Clause 8 and engineer's instructions.	LS	1			
494	Work No. C6:Chlorination Unit Work	Design, Supply, Fabrication , Installation and total finishing of Pre-fab building for chlorination system including storage of required chemical all complete works, as per SECTION VI-C: WORKS REQUIREMENTS Clause 8.3 and engineer's instruction.	sq.ft.	800			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
495	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGSSupply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Socket Restrained Bend of 90 deg.DN 350	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
496	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGS Supply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 90 deg. DN 400	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
497	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGSSupply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Socket Restrained Bend of 45 deg.DN 350	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
498	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGS Supply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 45 deg. DN 400	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
499	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGSSupply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Socket Restrained Bend of 22.5 deg.DN 350	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
500	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGS Supply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 22.5 deg. DN 400	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
501	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGSSupply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI Double Socket Restrained Bend of 11.25 deg.DN 350	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
502	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGS Supply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Double Socket Restrained Bend of 11.25 deg. DN 400	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
503	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGSSupply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Socket Restrained Equal Tee (ET)DN 350	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
504	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGS Supply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Socket Restrained Equal Tee (ET) DN 400	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
505	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGSSupply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Flange Equal Tee (ET)DN 400	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
506	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGS Supply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI All Socket Restrained Concentric Taper 400mm x 250mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
507	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGSSupply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI All Socket Restrained Concentric Taper400mm x 280mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
508	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGS Supply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Single Flanged Piece (Tail with weld bead) DN 350	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
509	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGSSupply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI Single Flanged Piece (Tail with weld bead)DN 400	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
510	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGS Supply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift. DI Flanged and Socket (FS) Restrained (socket with double chamber) DN 350	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
511	Work No. D1: Fittings Dayworks for System Stabilization Period	DI PIPELINES FITTINGSSupply and Delivery of DI Fittings (PN16), including all accessories, outside coating and inside lining as per technical specifications, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, cutting and preparing ends, jointing, PE sleeving with seal tape, non detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.4 and Drawings, and as instructed by the Engineer, with all lead and lift.DI Flanged and Socket (FS) Restrained (socket with double chamber)DN 400	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
512	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 75	Nos.	6			
513	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion TeesOD 90	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
514	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 110	Nos.	6			
515	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion TeesOD 125	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
516	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 140	Nos.	7			
517	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion TeesOD 160	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
518	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 180	Nos.	4			
519	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion TeesOD 200	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
520	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 225	Nos.	2			
521	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion TeesOD 250	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
522	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Tees OD 280	Nos.	3			
523	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion TeesOD 315	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
524	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 75	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
525	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Cross TeesOD 90	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
526	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 110	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
527	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Cross TeesOD 125	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
528	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 140	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
529	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Cross TeesOD 160	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
530	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 180	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
531	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Cross TeesOD 200	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
532	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Cross Tees OD 250	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
533	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Cross TeesOD 315	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
534	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 90mmX75mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
535	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers110mm x 90mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
536	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 125mm x 110mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
537	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers125mm x 90mm	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
538	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 140mm x 110mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
539	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers140mm x 125mm	Nos.	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
540	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 140mm x 90mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
541	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers160mm x 110mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
542	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 160mm x 125mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
543	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers160mm x 140mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
544	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 160mm x 90mm	Nos.	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
545	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers180mm x 110mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
546	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 180mm x 125mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
547	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers180mm x 140mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
548	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 180mm x 160mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
549	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers180mm x 90mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
550	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 200mm x 110mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
551	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers200mm x 125mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
552	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 200mm x 140mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
553	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers200mm x 160mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
554	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 200mm x 90mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
555	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers225mm x 125mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
556	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 225mm x 140mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
557	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers225mm x 160mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
558	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 225mm x 90mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
559	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers250mm x 110mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
560	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 125mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
561	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers250mm x 140mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
562	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 160mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
563	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers250mm x 180mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
564	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 200mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
565	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers250mm x 225mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
566	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 250mm x 90mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
567	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers280mm x 160mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
568	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 280mm x 200mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
569	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers280mm x 90mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
570	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 300mm x 250mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
571	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers315mm x 160mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
572	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 315mm x 200mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
573	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers315mm x 225mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
574	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion Reducers 315mm x 250mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
575	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion Reducers315mm x 90mm	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
576	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion End Stops OD 75	Nos.	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
577	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion End StopsOD 90	Nos.	9			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
578	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion End Stops OD 110	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
579	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion End StopsOD 125	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
580	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE PE100 PN16 Electrofusion End Stops OD 140	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
581	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE PE100 PN16 Electrofusion End StopsOD 160	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
582	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE Pipe PE100 PN 10 of 50 mm dia. For washout, ARV and hydrant OD 50	m	18			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
583	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGSSupply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift.HDPE Pipe PE100 PN 10 of 50 mm dia. For washout, ARV and hydrantOD 90	m	11			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
584	Work No. D1: Fittings Dayworks for System Stabilization Period	HDPE PIPELINES FITTINGS Supply and Delivery of HDPE PE100 PN16 Electrofusion Fittings with all needed electrofusion couplers to be connected to the pipelines, including storing properly, loading at store, delivery to site, unload, distribute, multiple handling, jointing, detectable warning tape at specified levels, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 4.5 and Drawings, and as instructed by the Engineer, with all lead and lift. HDPE Pipe PE100 PN 10 of 50 mm dia. For washout, ARV and hydrant OD 110	m	6			
585	WORK No. - D2: Dayworks	Labour Unskilled Labour	md	500			
586	WORK No. - D2: Dayworks	LabourSemi Skilled Labour	md	400			
587	WORK No. - D2: Dayworks	Labour Skilled Labour	md	300			
588	WORK No. - D2: Dayworks	Labour Engineer/Supervisor	md	300			
589	WORK No. - D2: Dayworks	Labour Surveyor	md	500			
590	WORK No. - D2: Dayworks	Labour Staff man	md	500			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
591	WORK No. - D2: Dayworks	Materials Sand	cum	250			
592	WORK No. - D2: Dayworks	Materials Crushed gravel	cum	250			
593	WORK No. - D2: Dayworks	Materials Natural gravel	cum	250			
594	WORK No. - D2: Dayworks	Materials Portland cement	bags	500			
595	WORK No. - D2: Dayworks	Materials First class Brick	Nos.	5000			
596	WORK No. - D2: Dayworks	Materials 150 mm dia DI Surface Valve Box Cover	Nos.	10			
597	WORK No. - D2: Dayworks	Materials 250 mm dia DI Surface Valve Box Cover	Nos.	6			
598	WORK No. - D2: Dayworks	Materials 15 mm dia water meter with Composite Body and other specification remain same as per specification of Water meter.	Nos.	45			
599	WORK No. - D2: Dayworks	MaterialsProviding MID approved with minimum Dynamic ratio (Q3/Q1) of 500:1, Electromagnetic AMI Smart Water Meters of dia 15 mm having no moving part in contact with water, with fully body made up of composite material, conforming to ISO 4064	Nos.	25			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
600	WORK No. - D2: Dayworks	Materials Hexagonal Interlocking Block with compressive strength M30 or above, thickness 50 mm, Dimension 200x165x50	Nos.	3300			
601	WORK No. - D2: Dayworks	Materials Providing required material and Painting lines,dashes,arrowsetc.on roads in two coats on network with ready mixed road marking paint conforming to NS408/IS 164 on bituminous surface, including cleaning the surface of all dirt, dust and other foreign matter, demarcation at site and traffic control as per Drawing and Technical Specifications up to 10 cm width.	sq.m.	625			
602	WORK No. - D2: Dayworks	Materials Bituminous Penetration Macadam, 50 mm thickness	sq.m.	600			
603	WORK No. - D2: Dayworks	Materials PVCO pipe dia. 160 mm class 500 PN 12.5	m	150			
604	WORK No. - D2: Dayworks	Materials PVCO pipe dia. 200 mm class 500 PN 12.5	m	120			
605	WORK No. - D2: Dayworks	Materials PVCO pipe dia. 250 mm class 500 PN 12.5	m	90			
606	WORK No. - D2: Dayworks	Materials PVCO pipe dia. 315 mm class 500 PN 12.5	m	75			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
607	WORK No. - D2: Dayworks	MaterialsPVCO pipe dia. 355 mm class 500 PN 12.5	m	60			
608	WORK No. - D2: Dayworks	Materials PVCO pipe dia. 400 mm class 500 PN 12.5	m	45			
609	WORK No. - D2: Dayworks	Equipment Back Hoe Loader (> 90Hp)	Hr.	170			
610	WORK No. - D2: Dayworks	Equipment Steel Vibrator Roller (up to 12 ton)	Hr.	170			
611	WORK No. - D2: Dayworks	Equipment Truck/Tipper (up to 150 Hp)	Hr.	500			
612	WORK No. - D2: Dayworks	Equipment Air compressor incl. hoses, hammers, chisels (7 m^3/min)	Hr.	100			
613	WORK No. - D2: Dayworks	Equipment Jack hammer	Hr.	100			
614	WORK No. - D2: Dayworks	Equipment Crane lifting capacity 10 t	Hr.	100			
615	WORK No. - D2: Dayworks	Equipment Crane lifting capacity over 10 t	Hr.	100			
616	WORK No. - D2: Dayworks	Equipment Rammer	Hr.	100			
617	WORK No. - D2: Dayworks	Equipment Drainage Pump, 10 l/s	Hr.	100			
618	WORK No. - D2: Dayworks	Equipment Complete Survey instrument	Hr.	180			
619	WORK No. - D2: Dayworks	Equipment Concrete Pumping Machine	Hr.	55			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
620	WORK No. - D2: Dayworks	Equipment Mobile Generator 50 kVA	Hr.	100			
621	WORK No. - E1. Electrical works	Distribution Transformer :Supply of 250 KVA Three phase ,11/0.415 KV. 50 Hz ,Dyn-11, Oil type Distribution Transformer as per Single Line Diagram, all complete as specified in document SECTION VI: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift and applicable Standards(ISO certified company and IEC Standard) all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift	Set	1			

622	WORK No. - E1. Electrical works	Motor Control Panel :Supply ,Installation and testing of Three phase four wire 400 Volt.Motor Control Panel with Auto transfer switch as per Single Line Diagram, applicable Standards (ISO certified company & IEC Standard), Erection of MCC Panel charge, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following components.1.600 AF/ 500 AT, Four pole MCCB for incoming line 1 set.2. Potential transformers 400/110V 1 set.3. 500/5A Current transformers with Digital multi function meter 1 set.4. R-Y-B Indication lamp and Fuses 1set.5. 500A Four pole Auto- transfer Switch 1 set.6. Outgoings as below:a. 225 AF/150 AT, Three pole MCCB , 37 KW V.V.V.F Drive , Power Contractor , Digital motor protection relay,CTs, PF Capacitor and Magnetic Contractor for pump motor circuit 4 set with static condenser to correct power factor above 95%.b.100 AF/100 AT, Three pole MCCB , 25 KW V.V.V.F Drive , Power Contractor , Digital motor protection relay,CTs, PF Capacitor and Magnetic Contractor for pump motor circuit 3 set t with static condenser to correct power factor above 95%.c. 100 AF/100 AT, Three pole	Set	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
		MCCB , 25 KW V.V.V.F Drive , Power Contractor , Digital motor protection relay,CTs, PF Capacitor and Magnetic Contractor for pump motor circuit 3 set t with static condenser to correct power factor above 95%.d. 50 AF/15 AT,Four pole MCCB for Discharge valves 7set e. 50 AF/15 AT,Two pole MCCB for water hammer control system 1 set.f. 50 AF/15 AT,Three pole MCCB, 0.75 KW DOL starter,Digital motor protection relay and CTs for Sump pump 2 set.g. 50 AF/15 AT,Double pole MCCB for Lighting Panel 1 set.h. 50 AF/50 AT, Four pole MCCB for spare 2 set.J.50 AF/50 AT, Double pole MCCB for spare 2 set.J. Metal -clad enclosed type, free standing, IP 41,front door openable motor control panel with five split sections for transportation to installation site of size 3200mm (800+800+800+800) length x 600mm width x 1900mm height with three coats of paints applied on it 1set.K. 630 A, Three phase and neutral, tin-plated copper busbars with epoxy bushing, insulation sleeves and hardware 1 set.L. Electrical equipments wiring, control cables, lugs and testing of switchgears etc. complete1 set.					

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
623	WORK No. - E1. Electrical works	Diesel Generator :Supply ,Installation ,testing and commissioning of Three phase four wire,400-230 V AC, 50 Hz,0.8 PF,1500 RPM Diesel engine operated generator with Control Panel as per Single Line Diagram and all complete as specified in document SECTION VI: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Capacity : 161 KVA (Prime)In -built Fuel tank, Diesel Engine: Multi cylinder, in-line 4 stroke, radiator cooled engine, Maintenance free Lead acid batteries (24 V DC), Alternator :Phase 3 φ 4 W, 4 Pole, Insulation class H.Control Panel : Integrated with set ,Micro-processor based monitoring, metering and control system with MCCB of suitable rating, copper bus-bars with incoming and outgoing terminals, Indicating lamps for 'Load On' and 'Set Running'.	Set	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
624	WORK No. - E1. Electrical works	Cables :Supply ,laying and testing of 600/1000 AC Voltage grade, Copper conductor, XLPE Insulated , PVC sheathed Un-armored power cable via underground in HDPE pipe and on cable tray (inside building) from Transformer and Generator to MCC Panel and from MCC to Pumps, Discharge valves, Water hammer control system, Sump pumps, Lighting panels and UPS panel concealed wirings as per SLD and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following :Single core 185 sqmm. (CU / XLPE / PVC)	m	320			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
625	WORK No. - E1. Electrical works	Cables : Supply ,laying and testing of 600/1000 AC Voltage grade, Copper conductor, XLPE Insulated , PVC sheathed Un-armored power cable via underground in HDPE pipe and on cable tray (inside building) from Transformer and Generator to MCC Panel and from MCC to Pumps, Discharge valves, Water hammer control system, Sump pumps, Lighting panels and UPS panel concealed wirings as per SLD and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following : Single core 150 sqmm. (CU / XLPE / PVC)	m	124			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
626	WORK No. - E1. Electrical works	Cables :Supply ,laying and testing of 600/1000 AC Voltage grade, Copper conductor, XLPE Insulated , PVC sheathed Un-armored power cable via underground in HDPE pipe and on cable tray (inside building) from Transformer and Generator to MCC Panel and from MCC to Pumps, Discharge valves, Water hammer control system, Sump pumps, Lighting panels and UPS panel concealed wirings as per SLD and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following :Two core 4 sqmm. (CU / XLPE / PVC)	m	74			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
627	WORK No. - E1. Electrical works	Cables : Supply ,laying and testing of 600/1000 AC Voltage grade, Copper conductor, XLPE Insulated , PVC sheathed Un-armored power cable via underground in HDPE pipe and on cable tray (inside building) from Transformer and Generator to MCC Panel and from MCC to Pumps, Discharge valves, Water hammer control system, Sump pumps, Lighting panels and UPS panel concealed wirings as per SLD and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following : Two core 6 sqmm. (CU / XLPE / PVC)	m	100			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
628	WORK No. - E1. Electrical works	Cables :Supply ,laying and testing of 600/1000 AC Voltage grade, Copper conductor, XLPE Insulated , PVC sheathed Un-armored power cable via underground in HDPE pipe and on cable tray (inside building) from Transformer and Generator to MCC Panel and from MCC to Pumps, Discharge valves, Water hammer control system, Sump pumps, Lighting panels and UPS panel concealed wirings as per SLD and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following :Two core 16 sqmm. (CU / XLPE / PVC)	m	83			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
629	WORK No. - E1. Electrical works	Cables : Supply ,laying and testing of 600/1000 AC Voltage grade, Copper conductor, XLPE Insulated , PVC sheathed Un-armored power cable via underground in HDPE pipe and on cable tray (inside building) from Transformer and Generator to MCC Panel and from MCC to Pumps, Discharge valves, Water hammer control system, Sump pumps, Lighting panels and UPS panel concealed wirings as per SLD and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following : Three core 4 sqmm. (CU / XLPE / PVC)	m	64			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
630	WORK No. - E1. Electrical works	Cables :Supply ,laying and testing of 600/1000 AC Voltage grade, Copper conductor, XLPE Insulated , PVC sheathed Un-armored power cable via underground in HDPE pipe and on cable tray (inside building) from Transformer and Generator to MCC Panel and from MCC to Pumps, Discharge valves, Water hammer control system, Sump pumps, Lighting panels and UPS panel concealed wirings as per SLD and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following :Three core 16 sqmm. (CU / XLPE / PVC)	m	446			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
631	WORK No. - E1. Electrical works	Cables : Supply ,laying and testing of 600/1000 AC Voltage grade, Copper conductor, XLPE Insulated , PVC sheathed Un-armored power cable via underground in HDPE pipe and on cable tray (inside building) from Transformer and Generator to MCC Panel and from MCC to Pumps, Discharge valves, Water hammer control system, Sump pumps, Lighting panels and UPS panel concealed wirings as per SLD and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following : Three core 25 sqmm. (CU / XLPE / PVC)	m	168			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
632	WORK No. - E1. Electrical works	Cables :Supply ,laying and testing of 600/1000 AC Voltage grade, Copper conductor, XLPE Insulated , PVC sheathed Un-armored power cable via underground in HDPE pipe and on cable tray (inside building) from Transformer and Generator to MCC Panel and from MCC to Pumps, Discharge valves, Water hammer control system, Sump pumps, Lighting panels and UPS panel concealed wirings as per SLD and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following :Four core 4 sqmm. (CU / XLPE / PVC)	m	298			
633	WORK No. - E1. Electrical works	Cables : Supply and Installation of 600/1000 AC Voltage grade, Copper conductor, PVC insulated, PVC sheathed Unarmored control cable for sump pump control wiring, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. Four core 2.5 sqmm. (CU / PVC / PVC)	m	33			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
634	WORK No. - E1. Electrical works	Cables :Supply and Installation of 600/1000 AC Voltage grade, Copper conductor, PVC insulated, PVC sheathed Unarmored control cable for sump pump control wiring, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer.Fifteen core 2.5 sqmm. (CU / PVC / PVC)	m	298			
635	WORK No. - E1. Electrical works	Cables : Supply and Installation of Green/ Yellow colored ,PVC insulated, Copper conductor Grounding wire for electrical equipments safety connection to earth bar, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. 4 sqmm	m	436			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
636	WORK No. - E1. Electrical works	Cables :Supply and Installation of Green/ Yellow colored ,PVC insulated, Copper conductor Grounding wire for electrical equipments safety connection to earth bar, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer.6 sqmm	m	100			
637	WORK No. - E1. Electrical works	Cables : Supply and Installation of Green/ Yellow colored ,PVC insulated, Copper conductor Grounding wire for electrical equipments safety connection to earth bar, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. 10 sqmm.	m	76			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
638	WORK No. - E1. Electrical works	Cables : Supply and Installation of Green/ Yellow colored ,PVC insulated, Copper conductor Grounding wire for electrical equipments safety connection to earth bar, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. 16 sqmm.	m	314			
639	WORK No. - E1. Electrical works	Cables :Supply and Installation of Green/ Yellow colored ,PVC insulated, Copper conductor Grounding wire for electrical equipments safety connection to earth bar, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer.95 sqmm.	m	31			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
640	WORK No. - E1. Electrical works	Cables : Supply and Installation of Terminal lug, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 16 sqmm. Long neck copper terminal lug	Nos.	114			
641	WORK No. - E1. Electrical works	Cables : Supply and Installation of Terminal lug, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 25 sqmm. Long neck copper terminal lug	Nos.	24			
642	WORK No. - E1. Electrical works	Cables :Supply and Installation of Terminal lug, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift.95 sqmm. Long neck copper terminal lug	Nos.	2			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
643	WORK No. - E1. Electrical works	Cables : Supply and Installation of Terminal lug, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 150 sqmm. Long neck copper terminal lug	Nos.	8			
644	WORK No. - E1. Electrical works	Cables : Supply and Installation of Terminal lug, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 185 sqmm. Long neck copper terminal lug	Nos.	8			
645	WORK No. - E1. Electrical works	Cables :Supply and Installation of Cable tray, cable tray separator, fittings, miscellaneous material to complete, including labour, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift.400W x 100H , 2.5 mm thickness ,straight, Hot Dip Galvanized ladder type cable tray with cover, clamp and nutbolts	m	55			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
646	WORK No. - E1. Electrical works	Cables : Supply and Installation of Cable tray, cable tray separator, fittings, miscellaneous material to complete, including labour, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 400W x 100H , 2.5 mm thickness ,Horizontal 90 Elbow, Hot Dip Galvanized ladder type cable tray with cover, clamp and nutbolts	Nos.	1			
647	WORK No. - E1. Electrical works	Cables :Supply and Installation of Cable tray, cable tray separator, fittings, miscellaneous material to complete, including labour, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift.400W x 100H , 2.5 mm thickness ,Vertical 90 inside , Hot Dip Galvanized ladder type cable tray with cover, clamp and nutbolts	Nos.	5			
648	WORK No. - E1. Electrical works	Cables : Miscellaneous Material	LS	1			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
649	WORK No. - E1. Electrical works	Cables : Cable tray separator (100H)	m	55			
650	WORK No. - E1. Electrical works	Cables : Supply and Installation of Poly-ethylene Conduit, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 28 mm	m	26			
651	WORK No. - E1. Electrical works	Cables : Supply and Installation of Poly-ethylene Conduit, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 36 mm	m	246			
652	WORK No. - E1. Electrical works	Cables :Supply and Installation of Poly-ethylene Conduit, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift.42 mm	m	82			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
653	WORK No. - E1. Electrical works	Cables : Supply and Installation of Poly-ethylene Conduit, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 104 mm	m	108			
654	WORK No. - E1. Electrical works	Cables : Supply and Installation of Flexible Conduit with connector, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 28 mm	m	4			
655	WORK No. - E1. Electrical works	Cables : Supply and Installation of Flexible Conduit with connector, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 36 mm	m	42			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
656	WORK No. - E1. Electrical works	Cables :Supply and Installation of Flexible Conduit with connector, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift.42 mm	m	30			
657	WORK No. - E1. Electrical works	Cables : Supply and Installation of Pull Box, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. (150x150x150)mm	set	3			
658	WORK No. - E1. Electrical works	Cables : Supply and Installation of Pull Box, all complete, as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. (300x300x300)mm	set	1			
659	WORK No. - E1. Electrical works	Cables : Supply and installation of underground warning tape "Caution Buried Cable", as per Nepalese/Indian or equivalent International standards	m	150			

660	WORK No. - E1. Electrical works	Lightning protection: Supply and Installation of Lightning protection system as per drawing and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS and Drawings, and as instructed by the Engineer, with all lead and lift all complete as specified in document SECTION VI: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with following :Air Terminal with multiple points , EC grade copper (1000mm length and 3/4 " threaded diameter); Air Terminal Base ,suitable to install Air Terminal and positive continuity to earthing conductor (High grade copper alloy with stainless steel bolts, suitable for 95 sqmm. Conductor - 5 set; 3500 mm length,50 mm Dia. Hot Dip Galvanized heavy type pipe with flange on top and base plate anchoring on concrete foundation, - 5 set; Ground wire termination box with copper busbar and insulator, - 4 set; 95 sqmm. electrolytic grade copper strained bare conductor, 93m; High grade copper alloy Tee type clamp suitable for 95 sqmm. Bare conductor, 8 Nos.; 95 sqmm. Long neck copper terminal lug, 12 Nos; Concrete foundation (450mmx450mmx450mm), 0.2 Cum	set	5			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
661	WORK No. - E1. Electrical works	Earthing system :Supply and Installation common earthing system, copper plate earthing electrodes, copper strained bare conductor bonding around pumping station as per drawing and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Electrolytic grade copper plate (600x600x3.14 mm): 4 Nos; 95 sqmm. electrolytic grade copper strained bare conductor: Aprox: 181m, High grade copper alloy Tee type clamp suitable for 95 sqmm. Bare conductor: 45 Nos; 36 mm Dia HDPE pipe conduit: 118m; Earthing terminal box with copper busbar : 1 Nos; 95 sqmm. Green/ Yellow colored ,PVC insulated, Copper conductor Grounding wire for electrical equipments safety connection to earth bar.: 136m; 95 sqmm. Long neck terminal Lug: 18 Nos; Installation: 435m; Earth excavation : 90 Cum; Back filling: 90 Cum; 300 x300 mm. Cast iron cover for water pouring into pit: 4 Set; Funnel with wire mesh: 4 set; Salt: 4 Kgs; Installation all complete	LS	1			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
662	WORK No. - E1. Electrical works	Light and Power for pumping station :Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Concealed type ,10- way Single phase & neutral Distribution Board with busbar, neutral link, earth bar, Din rail,14 SWG CRCA sheet housing with double cover and cable glands all complete, as per drawing all complete as specified in document SECTION VI: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift, including in each set:1 x 16 A DP MCB ,10 KA8 x 6A / 10A SP MCB, 10 KA1 x 20 A SP MCB Tie busbar	set	1			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
663	WORK No. - E1. Electrical works	Light and Power for pumping station :Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Light / socket point wiring with 2x 2.5 sqmm. + 1x1.5 sqmm. PVC insulated copper wires through 22 mm Dia. HDPE conduit concealed from DB to various points, all complete as per drawing all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 2.5 sqmm.	m	601			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
664	WORK No. - E1. Electrical works	Light and Power for pumping station :Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Light / socket point wiring with 2x 2.5 sqmm. + 1x1.5 sqmm. PVC insulated copper wires through 22 mm Dia. HDPE conduit concealed from DB to various points, all complete as per drawing all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 1.5 sqmm.	m	319			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
665	WORK No. - E1. Electrical works	Light and Power for pumping station :Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Light / socket point wiring with 2x 2.5 sqmm. + 1x1.5 sqmm. PVC insulated copper wires through 22 mm Dia. HDPE conduit concealed from DB to various points, all complete as per drawing all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift. 22 mm Dia. HDPE pipe	m	269			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
666	WORK No. - E1. Electrical works	Light and Power for pumping station :Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Electrical mechanisms:Supply and installation of 13 A Flat pin/ 6 A Round pin Universal type Dual switch socket modular plate, unbreakable with box (C-vivace Clipsal or similar), all complete as per drawing all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift.	Nos.	4			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
667	WORK No. - E1. Electrical works	Light and Power for pumping station :Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Electrical mechanisms:Supply and installation of two-gang switch 10AX 230V, unbreakable with box (C-vivace Clipsal or similar), all complete as per drawing all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift.	Nos.	1			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
668	WORK No. - E1. Electrical works	Light and Power for pumping station : Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings : Electrical mechanisms: Supply and installation of one-gang switch 10AX 230V, unbreakable with box (C-vivace Clipsal or similar), all complete as per drawing all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift.	Nos.	3			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
669	WORK No. - E1. Electrical works	Light and Power for pumping station :Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Indoor Lighting :Supply and installation of internal lightings with 2*36 W lamp fluorescent tube including inductive ballasts filled with polyester or equivalent, complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift	Nos.	22			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
670	WORK No. - E1. Electrical works	Light and Power for pumping station :Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Outdoor Lighting :Supply and Installation of a basic solar powered LED street light system complete set as per drawing and all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings, all complete, with Mono crystalline, solar PV 200 W, Maintenance free 12V, 100AH ,Li-ion (Lithium ion) or Life PO4 (Lithium Iron Phosphate), MPPT charge controller, DC, 40 W LED street light	set	4			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
671	WORK No. - E1. Electrical works	Light and Power for pumping station :Supply and Installation of Distribution Board, Lighting Fixtures and Power Sockets in concealed HDPE conduit wiring as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift with followings :Outdoor Lighting :Hot Dip Galvanized ,7 meter long, street light pole complete with erection; Two core 4 sqmm.,0.6/1 KV power cable (CU/XLPE/PVC), (Aprox. 112m), 4 sqmm. Green / yellow color, PVC insulated copper conductor (Aprox. 112m), 28 mm Dia. HDPE pipe (97m), Earth excavation (66 Cum), Single layer brick (600 Nos.), sand (8.1 Cum), Back filling (58 Cum); Cement concrete foundation for street light (0.84 cum); Underground warning tape (60m)	Lot	2			
672	WORK No. - E1. Electrical works	Testing and Commissioning as per all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 12 and Drawings, and as instructed by the Engineer, with all lead and lift	LS	1			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
673	WORK No. - E2. Mechanical Works	Pumping EquipmentCentrifugal Pumping EquipmentSupplying, installing, aligning, testing commissioning and trial run of Centrifugal pump motor set directly coupled and mounted on base frame, with necessary foundation bolts etc. including supply and installation of all accessories such as pressure gauge mounted on the pump suction and delivery pipe in addition with connection pipe for pressure gauge, consumables for bearings, spare parts, nut bolts, necessary appurtenances etc., and issuance of warranty certificate for a least period of 3 years, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift, as per the following parameters:Discharge: 1.12 m3/min; Head: 84m (vertical multi-stage, 22 KW for Kwachho)	Set	2			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
674	WORK No. - E2. Mechanical Works	Pumping EquipmentCentrifugal Pumping EquipmentSupplying, installing, aligning, testing commissioning and trial run of Centrifugal pump motor set directly coupled and mounted on base frame, with necessary foundation bolts etc. including supply and installation of all accessories such as pressure gauge mounted on the pump suction and delivery pipe in addition with connection pipe for pressure gauge, consumables for bearings, spare parts, nut bolts, necessary appurtenances etc., and issuance of warranty certificate for a least period of 3 years, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift, as per the following parameters:Discharge: 0.86 m3/min; Head: 74m (vertical multi-stage, 15 KW for Lyaku)	Set	3			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
675	WORK No. - E2. Mechanical Works	Pumping EquipmentCentrifugal Pumping EquipmentSupplying, installing, aligning, testing commissioning and trial run of Centrifugal pump motor set directly coupled and mounted on base frame, with necessary foundation bolts etc. including supply and installation of all accessories such as pressure gauge mounted on the pump suction and delivery pipe in addition with connection pipe for pressure gauge, consumables for bearings, spare parts, nut bolts, necessary appurtenances etc., and issuance of warranty certificate for a least period of 3 years, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift, as per the following parameters:Discharge: 2.12 m3/min; Head: 30m (End suction single stage, 15 KW for Kirtipur OHT)	Set	2			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
676	WORK No. - E2. Mechanical Works	Pumping EquipmentSubmersible sump pumpSupplying, installing, aligning, testing commissioning and trial run of non-clog type, fully submersible pump coupled with a suitable direct online starter to be installed in a sump pit, with 3-Phase, 400 V +10%, 50 HZ submersible motor, including supply and installation of all accessories such as submersible cables, nut bolts, necessary appurtenances etc. and supply of spare parts and issuance of warranty certificate for a least period of 3 years, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11and Drawings, and as instructed by the Engineer, with all lead and lift, for the following parameters:Discharge: 0.1 m3/min; Head: 10 m; Power 0.75kW (For Kirtipur OHT)	Set	2			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
677	WORK No. - E2. Mechanical Works	Pumping EquipmentBooster PumpingSupplying, installing, aligning, testing commissioning and trial run of Buster pump Hydro Multi-S consists of 2 identical pumps connected in parallel and mounted on a common base frame, with a control cabinet with integrated controller and provided with all the necessary fittings. The booster set is fitted with an on/off switch for the supply voltage and issuance of warranty certificate for a least period of 3 years, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift, as per the following parameters:Discharge:7.368 m^3/h; Head:33.24 m; Power 1.703 kW (For Kwacho Tank)	set	1			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
678	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, storage, handling, cutting (if applicable) of flangeless pipes, including preparation of weld groove joints for butt welding or welding flanges at one or two ends for flanged fittings, with welds testing and commissioning, all complete with fusion bonded epoxy coating and lining as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 200mm, Carbon Steel Flangeless Pipe 4.5mm	m	11			
679	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, storage, handling, cutting (if applicable) of flangeless pipes, including preparation of weld groove joints for butt welding or welding flanges at one or two ends for flanged fittings, with welds testing and commissioning, all complete with fusion bonded epoxy coating and lining as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 150mm, Carbon Steel Flangeless Pipe 4mm	m	2.4			

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Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
680	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, storage, handling, cutting (if applicable) of flangeless pipes, including preparation of weld groove joints for butt welding or welding flanges at one or two ends for flanged fittings, with welds testing and commissioning, all complete with fusion bonded epoxy coating and lining as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 125mm, Carbon Steel Flangeless Pipe 3.6mm	m	2			
681	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, storage, handling, cutting (if applicable) of flangeless pipes, including preparation of weld groove joints for butt welding or welding flanges at one or two ends for flanged fittings, with welds testing and commissioning, all complete with fusion bonded epoxy coating and lining as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 80mm, Carbon Steel Flangeless Pipe 2.9 mm	m	0.8			

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S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
682	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, storage, handling, cutting (if applicable) of flangeless pipes, including preparation of weld groove joints for butt welding or welding flanges at one or two ends for flanged fittings, with welds testing and commissioning, all complete with fusion bonded epoxy coating and lining as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 50mm, Carbon Steel Flangeless Pipe 2.3mm	m	4.6			
683	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, storage, handling, cutting (if applicable) of flangeless pipes, including preparation of weld groove joints for butt welding or welding flanges at one or two ends for flanged fittings, with welds testing and commissioning, all complete with fusion bonded epoxy coating and lining as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 15mm, Carbon Steel Flangeless Pipe PN16	m	6.8			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
684	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 250mm x 125mm, Carbon Steel Flangeless Reducer 4.5 mm/ 3.6mm	Nos.	3			
685	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 200mm x 100mm, Carbon Steel Flangeless Reducer 4.5mm/3.2mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
686	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 80mm x 50mm, Carbon Steel Flangeless Reducer 2.9mm/2.3mm	Nos.	1			
687	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 150mm x 80mm, Carbon Steel Flangeless Reducer4mm/2.9mm	Nos.	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
688	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 125mm x 80mm, Carbon Steel Flangeless Reducer 3.6mm/2.9mm	Nos.	3			
689	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 150mm x 100mm, Carbon Steel Flangeless Reducer 4mm/3.2mm	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
690	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 125mm x 100mm, Carbon Steel Flangeless Reducer 3.6mm/3.2mm	Nos.	2			
691	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 200mm x 150mm, Carbon Steel Flangeless Unequal Tee 4.5mm/4mm	Each	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
692	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 200mm x 125mm, Carbon Steel Flangeless Unequal Tee 4.5mm/3.6mm	Each	3			
693	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 150mm x 80mm, Carbon Steel Flangeless Unequal Tee 4mm/2.9mm	Each	3			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
694	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 125mm x 80mm, Carbon Steel Flangeless Unequal Tee 3.6mm/2.9mm	Each	3			
695	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 15mm, Carbon Steel Flangeless Equal Tee Sch 20S	Each	9			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
696	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 200mm, 90o Flangeless Elbow Carbon Steel 4,5 mm	Each	9			
697	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 80mm, 90o Flangeless Elbow Carbon Steel 2.9mm	Each	6			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
698	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flangeless fitting items, preparation of weld groove joints and weld at site to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 80mm, 45o Flangeless Elbow Carbon Steel 2.9mm	Each	2			
699	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 250mm, Carbon Steel Slip-on type Flange PN10	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
700	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 200mm, Carbon Steel Slip-on type flange PN10	Nos.	14			
701	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 150mm, Carbon Steel Slip-on type flange PN10	Nos.	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
702	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 125mm, Carbon Steel Slip-on type flange PN10	Nos.	2			
703	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 100mm, Carbon Steel Slip-on type Flange PN10	Nos.	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
704	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 80mm, Carbon Steel Slip-on type flange PN10	Nos.	1			
705	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 50mm, Carbon Steel Slip-on type flange PN10	Nos.	10			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
706	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 200mm, Carbon Steel Slip-on type Flange PN16	Nos.	10			
707	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 150mm, Carbon Steel Slip-on type Flange PN16	Nos.	11			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
708	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 125mm, Carbon Steel Slip-on type Flange PN16	Nos.	30			
709	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 100mm, Carbon Steel Slip-on type Flange PN16	Nos.	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
710	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flanges, welded to the common adjacent pipe ends or fittings etc, weld testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 80mm, Carbon Steel Slip-on type Flange PN16	Nos.	10			
711	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flanged fitting items including supply of accessories and high pressure gaskets, testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 250mm, Carbon Steel Double Flanged Bellows type Flexible joint PN10	Each	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
712	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flanged fitting items including supply of accessories and high pressure gaskets, testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 200mm, Carbon Steel Double Flanged Bellows type Flexible joint PN16	Each	2			
713	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flanged fitting items including supply of accessories and high pressure gaskets, testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 200mm, Carbon Steel Double Flanged Bellows type Flexible joint PN10	Each	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
714	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flanged fitting items including supply of accessories and high pressure gaskets, testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 150mm, Carbon Steel Double Flanged Bellows type Flexible joint PN16	Each	5			
715	WORK No. - E2. Mechanical Works	Pipe and fittingsSupplying, installing, fixing, aligning in correct position for listed flanged fitting items including supply of accessories and high pressure gaskets, testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and liftDN 125mm, Carbon Steel Double Flanged Bellows type Flexible joint PN16	Each	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
716	WORK No. - E2. Mechanical Works	Pipe and fittings Supplying, installing, fixing, aligning in correct position for listed flanged fitting items including supply of accessories and high pressure gaskets, testing and commissioning all complete with fusion bonded epoxy coating and lining , all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift DN 50mm, Carbon Steel Double Flanged Bellows type Flexible joint PN16	Each	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
717	WORK No. - E2. Mechanical Works	ValveMotorized Butterfly ValveSupplying, installing, fixing, aligning, testing and trial run and commissioning of motorized butterfly valve, Ductile Iron body, End to end connection of wafer type, provided with an electrical actuator and provision of Manual Hand Wheel and Control Panel etc, including supply of accessories, spare parts, high pressure gaskets and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer.DN 125 mm, Pressure rating: PN 16	Each	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
718	WORK No. - E2. Mechanical Works	ValveMotorized Butterfly ValveSupplying, installing, fixing, aligning, testing and trial run and commissioning of motorized butterfly valve, Ductile Iron body, End to end connection of wafer type, provided with an electrical actuator and provision of Manual Hand Wheel and Control Panel etc, including supply of accessories, spare parts, high pressure gaskets and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer.DN 200mm, Pressure rating: PN10	Each	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
719	WORK No. - E2. Mechanical Works	ValveGate ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Iron Sluice Gate Valve, Outside Stem & Yoke type with bolted bonnet, and Raised Face Flanged ends with provision of hand wheel operated and body tested at pressure not less than 1.5 times the test pressure etc. including supply of accessories, spare parts, high pressure gaskets and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 200mm,PN16	Each	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
720	WORK No. - E2. Mechanical Works	ValveGate ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Iron Sluice Gate Valve, Outside Stem & Yoke type with bolted bonnet, and Raised Face Flanged ends with provision of hand wheel operated and body tested at pressure not less than 1.5 times the test pressure etc. including supply of accessories, spare parts, high pressure gaskets and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 150mm, PN16	Each	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
721	WORK No. - E2. Mechanical Works	ValveGate ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Iron Sluice Gate Valve, Outside Stem & Yoke type with bolted bonnet, and Raised Face Flanged ends with provision of hand wheel operated and body tested at pressure not less than 1.5 times the test pressure etc. including supply of accessories, spare parts, high pressure gaskets and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 125mm, PN16	Each	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
722	WORK No. - E2. Mechanical Works	ValveGate ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Iron Sluice Gate Valve, Outside Stem & Yoke type with bolted bonnet, and Raised Face Flanged ends with provision of hand wheel operated and body tested at pressure not less than 1.5 times the test pressure etc. including supply of accessories, spare parts, high pressure gaskets and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 80mm, PN16	Each	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
723	WORK No. - E2. Mechanical Works	ValveGate ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Iron Sluice Gate Valve, Outside Stem & Yoke type with bolted bonnet, and Raised Face Flanged ends with provision of hand wheel operated and body tested at pressure not less than 1.5 times the test pressure etc. including supply of accessories, spare parts, high pressure gaskets and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 200mm, PN10	Each	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
724	WORK No. - E2. Mechanical Works	ValveGate ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Iron Sluice Gate Valve, Outside Stem & Yoke type with bolted bonnet, and Raised Face Flanged ends with provision of hand wheel operated and body tested at pressure not less than 1.5 times the test pressure etc. including supply of accessories, spare parts, high pressure gaskets and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 250mm, PN10	Each	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
725	WORK No. - E2. Mechanical Works	ValveGate ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Iron Sluice Gate Valve, Outside Stem & Yoke type with bolted bonnet, and Raised Face Flanged ends with provision of hand wheel operated and body tested at pressure not less than 1.5 times the test pressure etc. including supply of accessories, spare parts, high pressure gaskets and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 50mm, PN10	Each	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
726	WORK No. - E2. Mechanical Works	ValveCheck ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Steel Non Return Valve with double flanged ends and body tested at pressure not less than 1.5 times of test pressure etc., including supply of accessories, spare parts, and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 125 mm, Non-Slam Dashpot with counter weight loaded type Check Valve, PN16	Each	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
727	WORK No. - E2. Mechanical Works	ValveCheck ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Steel Non Return Valve with double flanged ends and body tested at pressure not less than 1.5 times of test pressure etc., including supply of accessories, spare parts, and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 200 mm, Non-Slam Dashpot with counter weight loaded type Check Valve, PN10	Each	2			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
728	WORK No. - E2. Mechanical Works	ValveCheck ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Cast Steel Non Return Valve with double flanged ends and body tested at pressure not less than 1.5 times of test pressure etc., including supply of accessories, spare parts, and issuance of warranty certificate for a least period of 3 years etc., all complete as per drawing, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift and direction of the Engineer. DN 50 mm, Swing type check Valve, PN16	Each	2			
729	WORK No. - E2. Mechanical Works	Valve Ball Valve Supplying, installing, fixing, aligning, testing commissioning and trial run of Ductile Iron DN 15mm, 10K Ball Valve with threaded ends and body tested at pressure not less than 1.5 times of test pressure, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift). DN 15mm; PN 10	Each	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
730	WORK No. - E2. Mechanical Works	ValveBall ValveSupplying, installing, fixing, aligning, testing commissioning and trial run of Ductile Iron DN 15mm, 10K Ball Valve with threaded ends and body tested at pressure not less than 1.5 times of test pressure, all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift).DN 15mm; PN 16	Each	10			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
731	WORK No. - E2. Mechanical Works	Surge tank bladder Supplying, installing, fixing, aligning, testing commissioning of internally and externally coated finished vertical mounted carbon steel tank of capacity 500 liter supported by brackets embedded on the concrete structure bolted connection, initial air pressure 5.0kgf/cm2 indicated by pressure gauge mounted at the top and DN 80mm flanged outlet at the bottom for pipe connection from main pipe working system, with provision of MOP and issuance of warranty certificate for a least period of 3 years etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. (For Kwachho)	set	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
732	WORK No. - E2. Mechanical Works	Surge tank bladderSupplying, installing, fixing, aligning, testing commissioning of internally and externally coated finished vertical mounted carbon steel tank of capacity 500 liter supported by brackets embedded on the concrete structure bolted connection, initial air pressure 3.0 kgf/cm2 indicated by pressure gauge mounted at the top and DN 80mm flanged outlet at the bottom for pipe connection from main pipe working system, with provision of MOP and issuance of warranty certificate for a least period of 3 years etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. (For Lyaku)	set	1			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
733	WORK No. - E2. Mechanical Works	Hoisting system Supply, design, erection, load testing commissioning and trial run of portable gantry type with monorail trolley hoist, including supply of manual chain pulley block of capacity of 1.0 ton span (L) = 3.0m and lifting (H) = 8.0m mounted on the monorail trolley as per design drawing and including supply of spare parts, consumables required and issuance of warranty certificate for at least period of 3 years etc., all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift	set	1			
734	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. ISMC-150x75x6.5t (Channel), [1.4M, 3 sets], [3.6M, 3 sets]	kg	300			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
735	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. ISA - 50x50x6t (Angle), [0.5M, 2 sets]	kg	5			
736	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Chemical anchor bolts/nuts M12	set	5			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
737	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Chemical anchor bolts/nuts M16	set	51			
738	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. PL- 300x300x6t (Plate), [4 ea, 6 sets]	kg	56			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
739	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. PL- 300x75x6t (Plate), [16 ea, 6 sets]	kg	56			
740	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. PL-150x150x6t (Plate), [1 ea, 2 sets]	kg	4			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
741	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. U-bolt/nut, Φ50mm	set	3			
742	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. U-bolt/nut, Φ200mm	set	7			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
743	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Anticorrosive paint	sq.m.	15			
744	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply, fabrication, painting, fixing, aligning and positioning of pipe support for clamping and supporting of the pipe and its fittings all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Ready mixed paint	sq.m.	15			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
745	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Nut bolts and washer set DN 250mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M22x80mm	Nos.	108			
746	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift.Nut bolts and washer setDN 200mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M20x70mm	Nos.	348			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
747	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Nut bolts and washer set DN 150mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M20x70mm	Nos.	56			
748	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift.Nut bolts and washer setDN 125mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M20x65mm	Nos.	144			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
749	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Nut bolts and washer set DN100mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M16x60mm	Nos.	24			
750	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift.Nut bolts and washer setDN 80mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M16x60mm	Nos.	64			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
751	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Nut bolts and washer set DN 50mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M16x55mm	Nos.	48			
752	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift.Nut bolts and washer setDN 200mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M22x90mm	Nos.	96			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
753	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Nut bolts and washer set DN 150mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M22x85mm	Nos.	84			
754	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift.Nut bolts and washer setDN 125mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M22x80mm	Nos.	120			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
755	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. Nut bolts and washer set DN 100mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M20x75mm	Nos.	32			
756	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift.Nut bolts and washer setDN 80mm, Hot Dipped Galvanized Coating Nut, bolt and washer set, M20x70mm	Nos.	24			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
757	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. High Pressure Gasket for min. 20 kg/cm2 pressure rating DN 250mm, Rubber Gasket	Nos.	9			
758	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift.High Pressure Gasket for min. 20 kg/cm2 pressure ratingDN 200mm, Rubber Gasket	Nos.	37			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
759	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. High Pressure Gasket for min. 20 kg/cm2 pressure rating DN 150mm, Rubber Gasket	Nos.	14			
760	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift.High Pressure Gasket for min. 20 kg/cm2 pressure ratingDN 125mm, Rubber Gasket	Nos.	33			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
761	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. High Pressure Gasket for min. 20 kg/cm2 pressure rating DN 100mm, Rubber Gasket	Nos.	7			
762	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessoriesSupply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift.High Pressure Gasket for min. 20 kg/cm2 pressure ratingDN 80mm, Rubber Gasket	Nos.	11			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
763	WORK No. - E2. Mechanical Works	Installation, Pipe support and accessories Supply and fixing of Hot dipped Galvanized Hex bolt with single nut and single washernut for complete laying of pipe and fittings etc. all complete as specified in document SECTION VI-C: WORKS REQUIREMENTS Clause 10 & 11 and Drawings, and as instructed by the Engineer, with all lead and lift. High Pressure Gasket for min. 20 kg/cm2 pressure rating DN 50mm, Rubber Gasket	Nos.	12			
764	Work No. F: Extended Period Stabilization: 1 years	Maintenance activities for System stabilizationSystem Stabilization Services as per Section VI-D of the Employer's Requirements for all works constructed in each Section of the Works, including but not limited to: Primary Pipelines, Secondary Pipelines, House Connections and all Chambers for 12 Month starting from the commission date of each Section.SSS for Section 1 of the Works	Month	12			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
765	Work No. F: Extended Period Stabilization: 1 years	Maintenance activities for System stabilization System Stabilization Services as per Section VI-D of the Employer's Requirements for all works constructed in each Section of the Works, including but not limited to: Primary Pipelines, Secondary Pipelines, House Connections and all Chambers for 12 Month starting from the commission date of each Section. SSS for Section 2 of the Works	Month	12			
766	Work No. F: Extended Period Stabilization: 1 years	Maintenance activities for System stabilization System Stabilization Services as per Section VI-D of the Employer's Requirements for all works constructed in each Section of the Works, including but not limited to: Primary Pipelines, Secondary Pipelines, House Connections and all Chambers for 12 Month starting from the commission date of each Section. SSS for Section 3 of the Works	Month	12			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
767	Work No. F: Extended Period Stabilization: 1 years	Maintenance activities for System stabilizationSupply and Installation of new metered water supply consumer connections during the SSS period whenever specifically directed by the Employer/Engineer, from the Service Pipeline to the consumer, all complete; as specified in Works Requirements Section VI-D: Technical Specifications System Stabilization Services (SSS), Items 4.1, Works Requirements Section VI-C Technical Specification, 4.9 Service/Household Connections and as shown on Drawings Nos. TP-2-1 and TP-2-2.DN 15	Nos.	300			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
768	Work No. F: Extended Period Stabilization: 1 years	Maintenance activities for System stabilization Supply and Installation of new metered water supply consumer connections during the SSS period whenever specifically directed by the Employer/Engineer, from the Service Pipeline to the consumer, all complete; as specified in Works Requirements Section VI-D: Technical Specifications System Stabilization Services (SSS), Items 4.1, Works Requirements Section VI-C Technical Specification, 4.9 Service/Household Connections and as shown on Drawings Nos. TP-2-1 and TP-2-2. DN 20	Nos.	10			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
769	Work No. F: Extended Period Stabilization: 1 years	Maintenance activities for System stabilizationSupply and Installation of new metered water supply consumer connections during the SSS period whenever specifically directed by the Employer/Engineer, from the Service Pipeline to the consumer, all complete; as specified in Works Requirements Section VI-D: Technical Specifications System Stabilization Services (SSS), Items 4.1, Works Requirements Section VI-C Technical Specification, 4.9 Service/ Household Connections and as shown on Drawings Nos. TP-2-1 and TP-2-2.DN 25	Nos.	5			
770	Work No. F: Extended Period Stabilization: 1 years	Decommissioning of Old Networks during SSS Period. Disconnection of existing networks of following sizes including Supply of necessary fittings for cutting and plugging and all civil works with reinstatement as specified in Works requirement section VI-D: Technical Specifications System Stabilization Services (SSS). Service Connection level of size 1/2 inche to 1 inches.	Nos.	140			

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
771	Work No. F: Extended Period Stabilization: 1 years	Decommissioning of Old Networks during SSS Period. Disconnection of existing networks of following sizes including Supply of necessary fittings for cutting and plugging and all civil works with reinstatement as specified in Works requirement section VI-D: Technical Specifications System Stabilization Services (SSS). Primary, Secondary and Tertiary Pipe Level of size 1.5 incheto 4 inche.	Nos.	35			
772	Work No. F: Extended Period Stabilization: 1 years	Decommissioning of Old Networks during SSS Period. Disconnection of existing networks of following sizes including Supply of necessary fittings for cutting and plugging and all civil works with reinstatement as specified in Works requirement section VI-D: Technical Specifications System Stabilization Services (SSS). Primary, Secondary and Tertiary Pipe Level of size more than 4 inches.	Nos.	21			
I		**Total Amount excluding PS**					
II		**Total of PS**					

Bill of Quantities

Contract No.: PID/SKV/DNI2-Kirtipur

S. N.	Work No.	Item Description	Unit	Quantity	Bidder's Rate in Figure (NPR)	Bidder's Rate in Words (NPR)	Amount (NPR)
III		**Total Amount including PS (I + II)**					
IV		**VAT (13 % of III)**					
V		**Grand Total Amount (III + IV)**					

Sign and Seal:

Section 5: Eligible Countries

Eligible countries are limited to all ADB members listed at www.adb.org/about/members, other than any restrictions arising from ITB 4.8.

Section 6: Works' Requirements

This section comprising Works' Requirement contains the Specifications, Environmental, Health and Safety Management Requirement, Drawings, Supplementary Information that describe the Works to be procured, Key Personnel Requirements, and Equipment Requirements.

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Supplementary Information Regarding Works to Be Procured

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Key Personnel Requirements

Using Form PER – 1 and PER – 2 in Section 4 (Bidding Forms), the Bidder must demonstrate that it has personnel who meet the following requirements:

No.	Position	Relevant Academic Qualifications	Total Work Experience (years)	Experience in Similar Work (years)
1	Contractor's Representative	Bachelor's degree in engineering/ management or related field. A full-time Employee being continuously salaried by the Contractor (in the case of Joint Ventures, the partner who meets the compliance requirement under 'one partner' in EQC) for not less than **the immediately** preceding one year.	7	5
2	**Key Personnel**			
2.1	Contract Manager	Bachelor's degree in civil engineering/ construction management.	10	5
2.2	QAQC Engineer	Bachelor's degree in civil / mechanical / Geotechnical engineering.	5	3
2.3	Public Relation Officer	Bachelor's degree in any discipline	5	3
2.4	Civil Engineer	Bachelor's degree in civil engineering.	3	1
2.5	CAD Engineer	Bachelor's degree in civil/ geomatics engineering.	3	1
2.6	Foreman (2 Nos)	Experience in Site supervision of Water Supply Construction Project.	7	5
3	**Other Technical Personnel**			
3.1	Structural Engineer	Master's degree in civil/ Structural Engineering.	7	5
3.2	Mechanical Engineer	Bachelor's degree in mechanical engineering.	7	5
3.3	ICT Engineer (during periods of installation and testing of ICT equipment)	Bachelor's Degree in ICT field with experience/training in SCADA	5	3

No.	Position	Relevant Academic Qualifications	Total Work Experience (years)	Experience in Similar Work (years)
3.4	Water Supply Operation Engineer (during testing and commissioning)	Bachelor's degree in civil engineering with experience in water supply operation/ commissioning.	5	3

Note: Personnel requiring licensing from Nepal Engineering Council, as per the law of Nepal, must obtain a license before their mobilization.

Using Form EXP-6 in Section 4 (Bidding Forms), the Bidder must demonstrate that it has EHS personnel who meet the following requirements:

Key Personnel as determined by the EMP and other safeguard management plans

No.	Position/Specialization	Relevant Academic Qualifications	Minimum Years of Relevant Work Experience	Minimum Time On-site (%FTE)
1	Environmental, Health and Safety (EHS) Officer	Bachelor's degree in environmental science/ environmental engineering or related field	3	60
2	Occupational Safety Assistant	Experience in Occupational Safety related field.	1	

Note:

i. The Contractor's Representative shall be a full-time Employee being continuously salaried by the Contractor (in the case of Joint Ventures, the partner who meets the compliance requirement under 'one partner' in EQC) for not less than the immediately preceding one year.

ii. The Contractor's Representative shall be at the site location during the implementation of the Works. If the personnel is to be temporarily absent during the period, a suitable replacement shall be temporarily appointed, subject to the Engineer's prior consent. However, the temporary appointment shall not be valid if absent period exceeds 42 days.

Equipment Requirements

Using Form EQU in Section 4 (Bidding Forms), the Bidder must demonstrate that it has the key equipment listed below:

No.	Equipment Type and Characteristics	Minimum Number Required
1.	Excavator Min. 15 Tons	2
2.	Concrete Mixer (RMC) or Modern Batching plant	1
3.	Concrete pump	1
4.	Truck Mounted Crane or hydra >10t (Pipe storage area & pipe and fittings laying)	1
5.	Vibrator	4
6.	Complete Scaffolding set	2
7.	Mobile Generator (min. 50 kVA)	2
8.	Dewatering System: Submersible high flow pumps. Min 100m3/h	3 pumps
9.	Water Tanker (15-20 Tons) for sprinkling water	3
10.	Vibrating Roller (Min. 5 Ton)	1
11.	Mechanical Hand Compactors: Vibratory Plate Rammer Type	 2 2
12.	HDD Machine and supporting accessories minimum 15 Ton	1

Section 7: General Conditions of Contract

The Conditions of Contract consists of two parts, this Section 7 (General Conditions of Contract) and the following Section 8 (Particular Conditions of Contract).

Red Book:

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The Conditions of Contract are the "General Conditions" which form part of the "Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer ("Red book") Second edition 2017" published by the Federation Internationale Des Ingenieurs – Conseils (FIDIC) and the following Section 8 "Particular Conditions of Contract."

An original copy of the above FIDIC publication i.e. "Conditions of Contract for Building and Engineering Works Designed by the Employer" must be obtained from FIDIC.

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Section 8: Particular Conditions of Contract

Part A – Contract Data

Ref. Sub-Clause (Col 1)	Conditions (Col 2)	Data (Col 3)
1.1.20 Percentage of Profit	Where the Contract allows for Cost Plus Profit, percentage profit to be added to the Cost	5 % (Five Percent)
1.1.27	Defects Notification Period	365 days after Date of Completion of the Works or Section or Part.
1.1.31	Employer's name and address	**Project Implementation Directorate, Kathmandu Upatyaka Khanepani Limited (PID/KUKL), Anamnagar, Kathmandu, Nepal**
1.1.35	Engineer's name and address	Design, Supervision and Project Management Consultant Contract Identification No: DSC/SKV-01
1.1.73	Sections	Refer to Table: Summary of Sections below
1.1.84	Time for Completion	The Intended Completion Date for the whole of the Works shall be Section I- 427 calendar days from the commencement date Section II - 583 calendar days from the commencement date Section III - 913 calendar days from the commencement date **Stage – 1 Completion of all DMAs:** As per the completion schedule mentioned above and **913** calendar days in total from the commencement date **Stage – 2:** 365 days for stabilization period after taking over of respective sections
1.1.89	Bank's name	Asian Development Bank
1.1.90	Borrower's name	Nepal
1.3 (a) (ii)	Electronic transmission system	Email will be an acceptable form of electronic transmission, provided that signed written communication in hard copy is also received within ten (10) days of the transmission of an email.
1.3(d)	Address of Employer for communications:	Project Implementation Directorate, Kathmandu Upatyaka Khanepani Limited (PID/KUKL), Anamnagar, Kathmandu, Nepal Electronic mail address: pidmail@kuklpid.org.np
1.3(d)	Address of Engineer for communications:	TBN

Ref. Sub-Clause (Col 1)	Conditions (Col 2)	Data (Col 3)
1.3(d)	Address of Contractor for communications:	[Insert electronic transmission systems]
1.4	Governing Law	Law of Nepal
1.4	Ruling language	English
1.4	Language for communications	English
1.8	Number of additional paper copies of Contractor's Documents	One
1.15	Total liability of the Contractor to the Employer under or in connection with the Contract	The product of 1.1 times the Accepted Contract Amount
2.1	Time for access to the Site	14 days after Commencement Date, however the Employer may give the contractor right to access to, and possession of the site within such times as required to enable the Contractor to proceed without disruptions in accordance with the Program submitted under Sub-Clause 8.3 (Program).
2.4	Employer's Financial Arrangements	Loan Financing from Asian Development Bank
3.2	Engineer's Duties and Authority	Any Variation resulting in change in the Accepted Contract Amount shall require prior consent of the Employer.
4.2	Performance Security	The performance security will be in the form of an unconditional bank guarantee in the amount of ten (10) percent of the Accepted Contract Amount. Bank Guarantee issued by a bank outside Nepal must be counter guaranteed by a Commercial Bank in Nepal. The Employer, at its discretion, may increase the Performance Security to a level sufficient to protect it against financial loss, if it determines that the lowest evaluated bid is seriously unbalanced or front loaded. The Contractor shall extend the validity of the Performance Security at his own cost, if the Performance Certificate has not been issued by that time, for any reasons.
4.7.2 (a)	Period for notification of errors in the items of reference	28 days
4.19	Period of payment for temporary utilities	28 days
4.20	Number of additional paper copies of progress reports	Two Nos.
5.1(a)	Maximum allowable accumulated value of work subcontracted (as a percentage of the Accepted Contract Amount)	20% (Twenty Percent) only
5.1(b)	Parts of the Works for which subcontracting is not permitted	Pipe laying and House Service Connection works.

Ref. Sub-Clause (Col 1)	Conditions (Col 2)	Data (Col 3)
6.5	Normal working hours	Normal hours during which work will be permitted to be carried out at the site will be between 08:00 hours to 17:00 hours on all days of the week except the works specified in the BOQ under the item “Working at Night”. The Contractor shall be responsible to obtain the written consent of the Engineer if he desires to work outside of these times. No separate/additional payment shall be made for operations beyond the normal working hours except the works specified in the BOQ under the item “Working at Night”.
8.3	Number of additional paper copies of program	2 (Two) Nos.
8.8	Delay damages payable for each day of delay	Refer to Table: Summary of Sections below
8.8	Maximum amount of delay damages	10 % (Ten Percent) of the Accepted Contract Amount.
12.2	Method of measurement	As stated in the technical specifications and BOQ
12.3	Percentage profit	5 % (five percent)
13.3	Variation procedure	Add the following at the end of subclause 13.3 Variations including determining new rate or price for an item of work in accordance with subclause 12.3 will be based on total quantity under the contract. Excess quantity required for any section can be adjusted from any other section if required.
13.4 (b)(ii)	Percentage rate to be applied to Provisional Sums for overhead charges and profit	7.5 % (Seven-point five percent)
13.7	Adjustment in changes of cost	Add the following at the end of sub clause 13.7; The Contract is subject to price adjustment; however, cost indices shall be frozen at the end of original completion period.

Ref. Sub-Clause (Col 1)	Conditions (Col 2)	Data (Col 3)
14.2	Total Advance Payment	The Advance Payments shall be 15% (fifteen percent) of the Accepted Contract Amount payable in the currencies and proportions in which the Accepted Contract Amount is payable excluding provisional sums, Value Added Tax and contingencies and shall be paid to the Contractor in two instalments of 10% and 5% after receipt of acceptable required advance payment security. The Engineer shall issue Advance Payment Certificate in accordance with GCC Sub-clause 14.2.2. and the advance payment shall be paid as mentioned below in two instalments: - 1st instalment: 10% shall be paid after signing the Contract Agreement within 56 days from the receipt of Letter of Acceptance upon submission of separate bank guarantees issued by Class A commercial bank for each currency. If the bank guarantees are issued by a bank located outside of Nepal, the guarantees shall be counter-guaranteed by Class A commercial bank located in Nepal. - 2nd instalment: 5% shall be paid after the Contractor's mobilization at the site as mentioned below and by submission of separate bank guarantees issued by Class A commercial bank for each currency. If the bank guarantees are issued by a bank located outside of Nepal, the guarantees shall be counter-guaranteed by Class A commercial bank located in Nepal: i. Establishment/Arrangement of Engineer's site office, Contractor's site office, site laboratory, Labour Camp and Stockyard, as defined under Section VI. ii. Engineer's approval for proposed individual to meet Personnel Requirements, as defined under Section VI-B Appendix H, along with the individual's confirmation of commitment to being available for the performance of the Contract. iii. Mobilization of Equipment, as defined under Section VI-B, Appendix I : Equipment Requirements, required as per approved work program. iv. Commencement of pre-construction surveys and setting out, as defined under Section VI-A,9. SUBMISSION BY THE CONTRACTOR.

Ref. Sub-Clause (Col 1)	Conditions (Col 2)	Data (Col 3)
14.2.3	Repayment of Advance payment	Deductions will commence from the first Interim payment certificate. Deduction will be at the rate of **18.75%** of the respective Monthly Interim Payment Certificate until such time as the advance payment has been fully repaid; provided that the advance payment shall be completely repaid prior to the end of **80%** of the approved contract price. The total repayment of advance payment shall be made within the originally stipulated contract period. In case of the non-compliance of this provision, remaining advance payment shall be repaid from any due amount to the contractor.
14.3	Period of payment	Monthly payment
14.3(b)	Number of additional paper copies of Statements	2 Nos. (Two Nos.)
14.3(c)	Supporting Documents	**Add the following at the end of 14.3 (c):** GIS data as defined in Employer's Requirement or as directed by the Engineer shall be submitted along with each IPC which includes pipelaying and associated works.
14.3(iii)	Percentage of retention	Retention money at the rate of 5% (Five percent) from each interim payment certificate shall be deducted and in total 5% of the final contract price.
14.5(b)(i)	Plant and Materials	Not applicable
14.5(c)(i) and (ii)	Plant and Materials	Plant and Materials for payment when delivered to the Site are Pipes, Pipe Fittings and Valves. The amount to be certified shall be as stipulated in sub-clause 14.5(c) (i) and (ii) of **Part B – Special Provisions**.
14.6.2	Minimum Amount of Interim Payment Certificates	1% (One percent) of the Accepted Contract Amount.
14.7(a)	Period of payment of Advance Payment to the Contractor	As mentioned in sub-clause 14.2 above
14.7b(i)	Period for the Employer to make interim payments to the Contractor under Sub-Clause 14.6 (interim Payment)	56 days
14.7b(ii)	Period for the Employer to make the Final Payment to the Contractor under Sub-Clause 14.13	28 days
14.7(c)	Period for the Employer to make final payment to the Contractor	56 days

Ref. Sub-Clause (Col 1)	Conditions (Col 2)	Data (Col 3)
14.8	Financing charges for delayed payment (percentage points above the average bank short-term lending rate as referred to under sub-paragraph (a))	2% for foreign-Currency 3% for Nepalese Currency
14.9	The relevant percentage for each Section	Refer to Part B – Special Provisions sub-clause 14.9
14.11.1(b)	Number of additional paper copies of draft Final Statement	2 (Two Nos.)
17.2(d)	Forces of nature, the risks of which are allocated to the Contractor	*None*
19.2	Insurance to be provided by the Contractor	The contractor shall provide all the necessary insurance in accordance with the contract, and it is the sole responsibility of the contractor, and no separate payment shall be made against the insurance. The Insurance for the extended contract period if any for whatever reasons shall be the responsibility of the contractor on his own cost.
19.2.1	Insurance to be provided by the Contractor for the Works	The minimum insurance amounts and deductibles shall be: 1. The minimum cover for loss of or damage to the Works, Plant and Materials is: **115%** of the Contract Amount. The maximum deductible for insurance of the Works and of Plant and Materials is: ***0.50% of sum insured*** 2. The minimum cover for loss or damage to **immovable** Equipment/plants is: ***100 % (i. e. Replacement Cost)*** The maximum deductible for insurance of Equipment/plant is:***1 % of sum insured.***
19.2.2	Extent of insurance required for Goods	To be covered under GCC sub clause 19.2.1 above.
19.2.3	Period of insurance required for liability for breach of professional duty	Until the date of issuance of Performance Certificate

Ref. Sub-Clause (Col 1)	Conditions (Col 2)	Data (Col 3)
19.2.4	Amount of insurance required for injury to persons and damage to property	The minimum **cover for loss of or damage to** other property is **NRs. 10,000,000.00** with unlimited number of occurrences. The maximum deductible for insurance of other property is: ***None*** The minimum cover for personal injury or death insurance i. for other people is***: NRs. 1,000,000.00*** with an unlimited number of occurrences
19.2.5	Amount of insurance required for injury to employees	The minimum cover for personal injury or death insurance i. for the Contractor's employees is that specified in the Labor act of Nepal and ii. The Employer and the Engineer is***: NRs. 1,000,000.00*** with an unlimited number of occurrences ***The Insurance for the extended contract period if any for whatever reasons shall be the responsibility of the contractor on his own cost.***
21.1	Time for appointment of Dispute Avoidance/Adjudication Board (DAAB) member (s)	28 days after the Commencement Date
21.1	The DAAB shall comprise	One sole Member
21.1	Proposed members of DAAB	Proposed by Employer
21.2	Appointment (if not agreed) to be made by	Executive Committee of FIDIC (International Federation of Consulting Engineers)
21.6 (a)	Rules of arbitration and administration of arbitration proceedings	**Replace 21.6 (a) as following:** Arbitration shall be: i. Conducted in accordance with the rules of SIAC ii. Singapore International Arbitration Centre (SIAC) shall be the institution to administer the arbitration. iii. The place of arbitration shall be Singapore.
21.6 (b)	Number of arbitrators	Three (3)

Table: Summary of Sections

Description of parts of the Works that shall be designated a Section for the purposes of the Contract (Sub-Clause 1.1.73)	**Value: Percentage* of Accepted Contract Amount (Sub-Clause 14.9)**	**Time for Completion (Sub-Clause 1.1.84)**	**Delay Damages (Sub-Clause 8.8)**
Section I - All works necessary permanent and temporary works for complete installation, testing and commissioning of: • Primary Pipeline Alignments complete for all DMA • Secondary Pipelines in DMAs nos. 3, 4 & Kumariclub • Consumer Connections in DMAs nos. 3,4 & Kumariclub (approx. 3447 nos.). • corresponding reinstatement of Road & Structures. • Hydraulic testing and Disinfection of Pipe line.	…	427 calendar days	0.05% of the Accepted Contract Amount for Section I
Section II - All works necessary permanent and temporary works for complete installation, testing and commissioning of: • Construction of 400 Cum SRT at Kwachow, Sundarighat Shade • Secondary Pipelines in DMAs nos. 5 & 6 • Consumer Connections in DMAs nos. 5 & 6 (approx. 2436 nos.) • corresponding reinstatement of Road & Structures. • Hydraulic testing and Disinfection of Pipe line	…	583 calendar days	0.05% of the Accepted Contract Amount for Section II
Section III - All works necessary permanent and temporary works for complete installation, testing and commissioning of: • Construction of 1500 cum Overhead Tank, Pumping Station. • Secondary Pipelines in DMAs nos. 1 & 2 • Consumer Connections in DMAs nos. 1 & 2 (approx. 2350 no.). • corresponding reinstatement of Road & Structures. • Hydraulic testing and Disinfection of Pipe line	…	913 calendar days	0.05% of the Accepted Contract Amount for Section III

*These percentages shall also be applied to each half of the Retention Money under Sub-Clause 14.9.
*The Percentage of Accepted Contract Amount of each Section shall be determined before awarding of Contract.
*These percentages shall also be applied to the Accepted Contract Amount for computing the contract amount for each Section.

Part B – Special Provisions

Clause/Sub-Clause	Special Provisions
Sub-Clause 1.1.10 Contract	"the Contractor's Proposal" is deleted
Sub-Clause 1.1.16 Contractor's Equipment	The following is added at the end of the definition. The Contractor's Equipment include, but not limited to the equipment stated in the Specification.
Sub-Clause 1.1.74 Site	The Sub-Clause is replaced with: "Site" means the places where the Permanent Works are to be executed, including storage and working area, and to which Plant and Materials are to be delivered, and any other places specified in the Contract as forming part of the Site."
Sub-Clause 1.1.76 Specification	The following is added to the definition. The Specification includes Environment, Health and Safety Management Plan; Key Personnel requirement; and Equipment requirements.
Sub-Clause 1.1.77 Statement	On the second line after "Payment Certificate under…", add "Sub-Clause 14.2.1 [Advance Payment Guarantee] (if applicable),".
Sub-Clause 1.1.81 Tender	"the Contractor's Proposal" is deleted.
New Sub-Clause 1.1.89 Bank	"Bank" means the financing institution (if any) named in the Contract Data
New Sub-Clause 1.1.90 Borrower	"Borrower" means the person (if any) named as the borrower in the Contract Data
Sub-Clause 1.2 Interpretation	Sub-paragraph (a) is replaced with the following: "Words indicating one gender include all genders; "he/she" is replaced with: "it"; "him/her" is replaced with "it"; "his" and "his/her" are replaced with: "its"; "himself/herself" are replaced with: "itself"." Further, "and" is deleted from the end of sub-paragraph (i) and added at the end of sub-paragraph (j). sub-paragraph (k) is added: (k) "The word "tender" is synonymous with "bid" or "proposal", the word tenderer with "bidder" or "proposer" and the words "tender documents" with "request for bids documents" or "request for proposal documents", as applicable."
Sub-Clause 1.5 Priority of Documents	Delete sub-paragraphs from (a) to (k) and replace with the following; (a) the Contract Agreement; (b) the Letter of Acceptance;

Clause/Sub-Clause	Special Provisions
	(c) the Letter of Bid; (d) the Particular Conditions Part A – Contract Data; (e) the Particular Conditions Part B – Special Provisions; (f) the Particular Conditions Part C – Corrupt and Fraudulent Practices; (g) the Particular Conditions Part D - Environmental, Health, and Safety (EHS) Metrics for Progress Reports; (h) List of Eligible Countries as defined by the Bank; (i) these General Conditions; (j) the Specification including EMP, EHS, personnel and equipment requirements; (k) the Drawings; (l) the Bill of Quantities; (m) Environment, Health and Safety Code of Conduct for Contractor's Personnel; (n) Environment, Health and Safety Management Plan (EHSMP); (o) the Joint Venture Undertaking (if the Contractor is a Joint Venture); and (p) any other documents forming part of the Contract
Sub-Clause 1.6 Contract Agreement	The last paragraph is replaced with: "If the Contractor comprises a Joint Venture, the authorized representative of the Joint Venture shall sign the Contract Agreement in accordance with Sub-Clause 1.14 [Joint and Several Liability]."
Sub-Clause 1.12 Confidentiality	The following is added at the end of the second paragraph: "The Contractor shall however be permitted to disclose such particulars if required to establish its qualifications to compete for other projects." "or" at the end of (b) is deleted. "or" at the end of (c) is added. The following is then added as (d): "is required to be provided to the Bank."
New Sub-Clause 1.17 Inspections & Audit by the Bank	The following Sub-Clause is added after Sub-Clause 1.16: "Pursuant to paragraph 2.1(e) of Particular Conditions - Part C- [Corrupt and Fraudulent Practices], the Contractor shall permit and shall cause its agents (whether declared or not), Subcontractors, subconsultants, service providers, suppliers, and personnel, to permit the Bank and/or persons appointed by the Bank to inspect the Site, assets and/or the accounts, records and other documents relating to the procurement process, selection and/or Contract execution/performance, and to have such accounts, records, and other documents audited by auditors appointed by the Bank. The Contractor's and its Subcontractors' and subconsultants' attention is drawn to Part C [Corrupt and Fraudulent Practices] which provides, inter alia, that obstructive practice constitutes an integrity violation subject to Contract termination (as well as to a determination of ineligibility pursuant to the Bank's Anticorruption Policy and Integrity Principles and Guidelines, both as amended from time to time)." The Bank's right to inspect the Site, assets and/or the Contractor's accounts, records and other documents relating to the procurement and performance of the Contract stated in Sub-Clause 1.17 and Part C shall survive termination and/ or expiration of this Contract.

Clause/Sub-Clause	Special Provisions
Sub-Clause 2.1 Right of Access to the Site	Add after the first sentence of the first paragraph: "For any part of the Site (or the whole Site as the case may be) for which the Contractor is to be given access to, and possession of, there shall be no physical works at the Site or any part thereof (as the case may be) unless the Employer shall give a Notice to the Contractor stating that all relevant provisions of the applicable Resettlement Plan (RP) were complied with and confirming that all compensation to the affected persons have been duly paid as per the RP. This Notice shall specify the date on which access to, and possession of the part of the Site (or the whole Site as the case may be) shall be given to the Contractor."
Sub-Clause 2.4 Employer's Financial Arrangements	The first paragraph is replaced with: "The Employer shall submit, before the Commencement Date, reasonable evidence that financial arrangements have been made for financing the Employer's obligations under the Contract." The following sub-paragraph is added at the end of Sub-Clause 2.4: "In addition, if the Bank has notified to the Borrower that the Bank has suspended disbursements under its loan, which finances in whole or in part the execution of the Works, the Employer shall give notice of such suspension to the Contractor with detailed particulars, including the date of such notification, with a copy to the Engineer, within 7 days of the Borrower having received the suspension notification from the Bank. If alternative funds will be available in appropriate currencies to the Employer to continue making payments to the Contractor beyond 60 days after the date of Bank notification of the suspension, the Employer shall provide reasonable evidence in its notice of the extent to which such funds will be available."
Sub-Clause 3.1 The Engineer	Add the following at the end of first paragraph "The Engineer shall be a third party capable of acting neutrally between the Parties".
Sub-Clause 3.2 Engineer's Duties and Authority	Add the following at the end of the third paragraph: The Engineer shall obtain the consent in writing of the Employer before acting under the following Sub-Clauses of these Conditions: a) Sub-Clause 13.2 [Value Engineering]: stating consent or otherwise to a value engineering proposal submitted by the Contractor in accordance with Sub-Clause 13.2; or b) Sub-Clause 13.3 [Variation Procedure]: instructing a Variation, except: (i) if, in the opinion of the Engineer, an emergency situation occurs that may affect the safety of life or of the Works or of adjoining property. In such a situation, the Engineer may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work, or to do all such things, as may, in the opinion of the Engineer, be necessary to abate or reduce the risk and the Contractor shall forthwith comply with such instruction.
Sub-Clause 3.3 Engineer's Representative	Add the following third paragraph after paragraph 2. "The Engineer shall obtain the consent of the Employer before appointing or replacing an Engineer's Representative."
Sub-Clause 3.4	The following is added at the end of the second paragraph:

Clause/Sub-Clause	Special Provisions
Delegation by the Engineer	"If any assistants are not fluent in this language, the Engineer shall make competent interpreters available during all working hours, in a number sufficient for those assistants to properly perform their assigned duties and/or exercise their delegated authority."
Sub-Clause 4.1 Contractor's General Obligations	Replace the first paragraph with the following: "The Contractor shall execute the Works in accordance with the Contract. All Contractor's Equipment, Material, and services to be incorporated in or required for the Works shall have their origin in any Eligible Country as defined by the Bank. The Contractor undertakes that the execution of the Works and the completed Works will be in accordance with the documents forming the Contract, as altered or modified by Variations, *and* with the Site-Specific Environment Management Plan (as per Sub-Clause 4.18) and Site-Specific Health and Safety Management Plan (as per Sub-Clause 4.8)." The following is inserted after the fourth paragraph: "The Contractor has the obligation to notify the Employer of any changes in connection with the representations made in the Letter of Bid. If the Contractor is debarred or temporarily suspended by ADB, it shall inform the Employer of such debarment or suspension. The following is added as (g); and the current (g) and (h) of the Sub-Clause are then renumbered as (h) and (i) respectively. (g) "if so stated in the Specification, the Contractor shall: (i) design structural elements of the Works considering climate change considerations; (ii) apply the concept of universal access (the concept of universal access means unimpeded access for people of all ages and abilities in different situations and under various circumstances); (iii) consider the incremental risks of the public's potential exposure to operational accidents or natural hazards, including extreme weather events; and (iv) any other requirement stated in the Specification."
Sub-Clause 4.2.1 Contractor's obligations	The first paragraph is replaced with: "The Contractor shall deliver the Performance Security to the Employer within 28 days after receiving the Letter of Acceptance and shall send a copy to the Engineer. The Performance Security shall be issued by a reputable bank or financial institution selected by the Contractor and shall be in the form annexed to the Particular Conditions, as stipulated by the Employer in the Contract Data, or in another form approved by the Employer."
Sub-Clause 4.2.2 Claims under the Performance Security	In the first paragraph after the words "is entitled under the Contract", replace "in the event of" with "including in, but not limited to, the event of:".
Sub-Clause 4.2.3 Return of Performance Security	In sub-paragraph (a) "21 days" is replaced with: "28 days"
Sub-Clause 4.3 Contractor's Representative	*Add the following at the end of first paragraph:* The Contractor's Representative shall be a full-time Employee being continuously salaried by the Contractor (in the case of Joint Ventures, the partner who meets the

Clause/Sub-Clause	Special Provisions
	compliance requirement under 'one partner' in EQC) for not less than the immediately preceding one year. Add the following at the end of sixth paragraph: However, the temporary appointment shall not be valid if the absent period exceeds continuously 42 days. The following is added at the end of the last paragraph: "If any of these persons is not fluent in this language, the Contractor shall make competent interpreters available during all working hours in a number that the Engineer considers to be sufficient for those persons to properly perform their delegated powers, function, and/or authority."
Sub-Clause 4.4.1 Preparation and Review	In the first paragraph, delete the word "and" at the end of sub-paragraph (c), at the end of sub-paragraph (d) replace "." with "; and" and add sub-paragraph(e) as follows: "(e) described in Sub-Clause 4.4.4 [Site-Specific Health and Safety Management Plan] and Sub-Clause 4.4.5 [Site-Specific Environment Management Plan]; and"
Sub-Clause 4.4.4 Site-Specific Health and Safety Management Plan	Add the following Sub-Clause: "The Contractor shall prepare, and keep up-to-date, the Site-Specific Health and Safety Management Plan (SSHSMP) as per Sub-Clause 4.8 [Health and Safety Obligations] showing how the Contractor will manage the health and safety risks related to the Works. The initial SSHSMP shall be submitted to the Engineer for Review, and no physical Works shall commence on Site until the Engineer has given (or is deemed to have given) a Notice of No-objection under sub-paragraph (i) of Sub-Clause 4.4.1 [Preparation and Review]. Thereafter, the Contractor shall update the SSHSMP at the request of the Engineer but at not less than 6- month intervals to ensure that it contains measures appropriate to the Works. The updated SSHSMP shall be submitted to the Engineer for Review as per the process outlined in Sub-Clause 4.4.1 [Preparation and Review]."
Sub-Clause 4.4.5 Site-Specific Environment Management Plan	Add the following Sub-Clause: "The Contractor shall prepare, and keep up-to-date, the Site-Specific Environment Management Plan (SSEMP) as per Sub-Clause 4.18 [Protection of the Environment] showing how the Contractor will manage the environment risks and impacts related to the Works (e.g., excavation, earth works, bridge and structure works, stream and road diversions, quarrying or extraction of materials, concrete batching, and asphalt manufacture). The initial SSEMP shall be submitted to the Engineer for Review, and no works shall commence on Site until the Engineer has given (or is deemed to have given) a Notice of No-objection under sub-paragraph (i) of Sub-Clause 4.4.1 [Preparation and Review]. Thereafter, the Contractor shall update the SSEMP at the request of the Engineer but at not less than 6-month intervals to ensure that it contains measures

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	appropriate to the Works. The updated SSEMP shall be submitted to the Engineer for Review as per the process outlined in Sub-Clause 4.4.1 [Preparation and Review]."
Sub-Clause 4.6 Co-operation	On the penultimate line of the first paragraph before "Contractor's," add "of the." The following is added after the first paragraph: "The Contractor shall also, as stated in the Specification or as instructed by the Engineer, cooperate with and allow appropriate opportunities for the Employer's Personnel to conduct any environmental and social assessment."
Sub-Clause 4.7 Setting out	In the second bullet-point of sub-paragraph (b) of Sub-Clause 4.7.3: Before "if the items of reference", the following is added: "when examining the items of reference within the period stated in sub-paragraph (a) of Sub-Clause 4.7.2,". On the second and third lines, the following is deleted "and the contractor's Notice is given after the period stated in sub-paragraph (a) of Sub-Clause 4.7.2".
Sub-Clause 4.8 Health and Safety Obligations	The following is included after deleting "and" at the end of (f) and replacing "." with ";" at the end of (g): (h) "provide health and safety induction training of Contractor's Personnel as appropriate and maintain training records; (i) actively engage the Contractor's Personnel in promoting understanding, and methods for, the implementation of health and safety requirements, as well as in providing information to the Contractor's Personnel, and provision of personal protective equipment without expense to the Contractor's Personnel; (j) put in place workplace processes for Contractor's Personnel to report work situations that they believe are not safe or healthy, and to remove themselves from a work situation that they have reasonable justification to believe presents an imminent and serious danger to their life or health; (k) ensure that Contractor's Personnel who remove themselves from such work situations shall not be required to return to work until necessary remedial action to correct the situation has been taken and Contractor's Personnel shall not be retaliated against or otherwise subject to reprisal or negative action for such reporting or removal; (l) subject to Sub-Clause 4.6 [Co-Operation], collaborate with the entities and Personnel under paragraph (a), (b), and (c) of Sub-Clause 4.6 [Co-Operation], in applying the health and safety requirements without prejudice to the responsibility of the relevant entities for the health and safety of their own personnel; (m) establish and implement a system for regular (not less than every 6th month) review of health and safety performance and the working environment and related reporting on incidents and accidents as per Sub-Clause 4.20 [Progress Reports]; (n) establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks of the construction site work to the health and safety of local communities; and (o) conduct an awareness program concerning the risk of sexually transmitted infections (STIs) and sexually transmitted diseases (STDs) including

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	HIV/AIDS via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of HIV between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals. Delete all the paragraphs after the first paragraph and replace with the following: As soon as practicable after the Contractor has been given access to, and possession of, the first part of the Site (or the whole Site, as the case may be), the Contractor shall submit to the Engineer for Review a detailed SSHSMP showing how the Contractor intends to comply with health and safety requirements prescribed in the Contract. The SSHSMP shall include measures the Contractor proposes to manage the health and safety risks and impacts related to the Works, provide site workers with safe and healthy working conditions and establish an operating system to prevent accidents, injuries, and disease. At a minimum, it shall be based on the Environment, Health, and Safety Management Plan (EHSMP) and Environment, Health, and Safety (EHS) Code of Conduct for Contractor's Personnel submitted as part of the Contractor's Tender and agreed as part of the Contract, and address requirements in the Environmental Management Plan (EMP) of the project. The procedures for Review of the SSHSMP and its updates shall be as described in Sub-Clause 4.4.1 [Preparation and Review]. The Contractor shall, as stated in the Specification and as the Engineer may reasonably require, maintain records and make reports (in compliance with the applicable health and safety regulations and Laws) concerning the health and safety of persons and any damage to property.
Sub-Clause 4.13 Rights of Way and Facilities	Add the following at the end of the second paragraph: "For any such additional facilities that the Contractor may need to obtain, the Contractor shall comply with: (a) the measures and requirements relevant to the Contractor, which are set forth in the Resettlement Plan ("RP") attached hereto as Annex to the Particular Conditions of Contract, to the extent it concerns impacts on affected people during construction; and (b) any corrective or preventive actions set out in safeguards monitoring reports that the Employer will prepare from time to time to monitor implementation of the Resettlement Plan. The Accepted Contract Amount is deemed to include all expenses to ensure compliance with these measures, requirements, and actions."
Sub-Clause 4.15 Access Route	The following is added at the end of Sub-Clause 4.15: "The Contractor shall take all necessary safety measures to avoid the occurrence of incidents and injuries to any third party, associated with the use of, if any, the Contractor's Equipment on access routes and other public roads or other infrastructure.

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	The Contractor shall monitor road safety incidents and accidents to identify safety issues and establish and implement necessary measures to resolve them. The Contractor shall adequately record the condition of roads, agricultural land adjacent to access route and other infrastructure prior to the start of transporting Goods. The Contractor shall be liable for the reinstatement of all such access routes, agricultural land, and other public roads and infrastructure to the extent any such damages were caused by the Contractor. The Contractor shall fully reinstate pathways, other local infrastructure, and agricultural land too at least their pre-project condition upon completion of construction
Sub-Clause 4.18 Protection of the Environment	Sub-Clause 4.18 [Protection of the Environment] is replaced with: "The Contractor shall take all necessary measures to fulfill the following obligations under the Contract to protect the environment, including (but not limited to): (a) protect the environment (both on and off the Site); and (b) limit damage and nuisance to people, property, and protected areas and habitat of threatened species (if any) resulting from pollution, noise, and other results of the Contractor's operations and/or activities. The Contractor shall ensure that emissions, surface discharges, effluent, and any other pollutants from the Contractor's activities shall exceed neither the values indicated in the Specification, nor those prescribed by applicable Laws. In the event of damage to the environment, property, and/or nuisance to people, on or off Site as a result of the Contractor's operations, the Contractor shall agree with the Engineer the appropriate actions and time scale to remedy, as practicable, the damaged environment to its former condition. The Contractor shall implement such remedies at its cost to the satisfaction of the Engineer. As soon as practicable after the Contractor has been given access to, and possession of, the first part of the Site (or the whole Site, as the case may be), the Contractor shall submit to the Engineer for Review a detailed Site-Specific Environment Management Plan (SSEMP) which has been specifically prepared for the Works, the Site and other places (if any) where the Contractor intends to execute the Works. The SSEMP shall include measures the Contractor proposes to manage the environmental risks and impacts of the Works. At a minimum, it shall be based on the EHSMP and EHS Code of Conduct for Contractor's Personnel submitted as part of the Contractor's Tender and agreed as part of the Contract, and address requirements in the EMP of the project. The SSEMP shall be in addition to any other similar document required under applicable environmental regulations and Laws, and shall set out all the requirements for the protection of the environment that: (i) are stated in the Specification; and

Clause/Sub-Clause	Special Provisions
	(ii) comply with all the Contractor's environmental obligations under the Contract. The procedures for Review of the SSEMP shall be as described in Sub-Clause 4.4.1 [Preparation and Review]. The Contractor shall (a) comply with the measures relevant to the Contractor set forth in the Initial Environmental Examination (IEE), the Environmental Management Plan (EMP) (SECTION VI-B: Works Requirements, Particular Requirements, Appendix D), and the Resettlement Plan (RP) (to the extent they concern impacts on affected people during construction), and any corrective or preventative actions set forth in a safeguards monitoring report; (b) make available a budget for all such environmental and social measures; (c) provide the Employer with a written notice of any unanticipated environmental, resettlement or indigenous peoples risks or impacts that arise during construction, implementation or operation of the Works that were not considered in the IEE, the EMP, and the RP; (d) adequately record the condition of roads, agricultural land and other infrastructure prior to starting to transport materials and construction; and (e) reinstate roads, pathways, other local infrastructure, and agricultural land to at least their pre-project condition upon the completion of construction. Following matters shall be considered in the EMP: a. All associated soil is to be removed offsite temporarily and stored properly until it is needed for backfilling. The following associated works shall also be undertaken; - Contractor is reminded that the Employer/ Engineer can engage others at cost to undertake any non-compliance of the above said. Further, the Contractor agrees that a notice by way of a phone SMS to engage others shall be considered as contractually binding and that no other formal notices shall be required to be issued. Contractor shall be given the authorized numbers that will apply in the above case. (Any decision taken through SMS shall be recorded in written within 3 days.) b. For trenches deeper than 1.5 m or as directed by the Engineer, shoring is to be installed in order to stabilize the slope/cut. c. **1 % of respective IPC amount (not reimbursable) will be deducted for non-compliance of any environmental safeguard requirements as mentioned in EMP and this sub-clause.** Damaged Utility Repair: The Contractor shall take special attention for management/taking care of the utilities and the associated responsibilities as follows; - Relocation of Utilities: at cost to the Employer - Repair of Damaged water and sewer pipes of any diameter shall be undertaken within 2 days of the damage depending upon circumstances and at cost to the Contractor. - Repair of Damage to all other utility: at cost to the Contractor - Relocation and repair of damage to the utility is the responsibility of the Contractor to coordinate the relocation and repair with the concerned Authority. The Employer/ Engineer can engage others at cost to undertake any non-compliance of the above said works. **Compliance with the Environmental, Social and Safety Requirements**

Clause/Sub-Clause	Special Provisions
	The Contractor shall comply with the requirements of Safety, Security and Protection of Environment. A compliance monitoring and evaluation mechanism has been developed for this provision as per SECTION VI: Works Requirements. Regular monitoring in site and evaluation will be carried out in daily/weekly basis, reported on a monthly basis, and a score will be determined for compliances as defined in the Monitoring Checklist. **In case that the Contractor achieves less than 70% of score in the monthly monitoring, one (1) percent amount will be deducted (not reimbursable) for non-compliance of Safety, Security and/or Protection of Environment from respective IPC.** The Contractor shall comply with the measures relevant to the Contractor set forth in the relevant Initial Environmental Examination (IEE), Environmental Management Plan (EMP), Resettlement Plan (RP) and Indigenous Peoples Plan (IPP) (to the extent they concern impacts on affected people during construction), and any corrective or preventative actions set forth in the Safeguards Monitoring Report. The Contractor shall make available a budget for all such environmental and social measures.
Sub-Clause 4.20 Progress Reports	Replace 4.20 (g) with: "the Environmental, Health and Safety (EHS) Metrics for Progress Reports set out in Particular Conditions - Part D" The following is added at the end of the Sub-Clause: "In addition to the reporting requirement of this sub-paragraph (g) of Sub-Clause 4.20 [Progress Reports] upon becoming aware of its occurrence, the Contractor shall inform the Engineer within 24 hours of any allegation, incident or accident, which has or is likely to have a significant adverse effect on the environment, the affected communities, the public, Employer's Personnel or Contractor's Personnel. This includes, but is not limited to, any incident or accident-causing fatality or serious injury; significant adverse effects or damage to private property or to the natural environment, including protected areas and habitat of threatened species. The Contractor, upon becoming aware of the incident or accident, shall also inform the Engineer within 24 hours of any such incident or accident on the Subcontractors' or suppliers' premises relating to the Works that has or is likely to have a significant adverse effect on the environment, the affected communities, the public, Employer's Personnel or Contractor's, its Subcontractors' and suppliers' personnel. The notification shall provide sufficient detail regarding such incidents or accidents. The Contractor shall provide full details of such incidents or accidents to the Engineer within the timeframe outlined in the SSEMP and SSHSMP or as agreed with the Engineer. The Contractor shall require its Subcontractors and suppliers to notify the Contractor of any incidents or accidents referred to in this Sub-Clause within the timeframe outlined in the SSEMP and SSHSMP or as agreed with the Engineer." The Contractor shall provide the Employer with a written notice of any unanticipated environmental, resettlement, or indigenous peoples risks or impacts that arise during construction, implementation or operation of the Project that were not considered in the relevant IEE, EMP, RP or IPP.
Sub-Clause 4.21	At the end of Sub-Clause 4.21 the following paragraphs are added:

Clause/Sub-Clause	Special Provisions
Security of the Site	"If required in the Specification, further to conducting a site security risk assessment, the Contractor shall submit for the Engineer's No-objection a security management plan that sets out the security arrangements for the Site. The Contractor shall (i) conduct appropriate background checks on any personnel retained to provide security; (ii) train the security personnel adequately (or determine that they are properly trained) in the use of force (and where applicable, firearms), and appropriate conduct towards Contractor's Personnel, Employer's Personnel and affected communities; and (iii) require the security personnel to act within the applicable Laws and any requirements set out in the Specification. The Contractor shall not permit any use of force by security personnel in providing security except when used for preventive and defensive purposes in proportion to the nature and extent of the threat. In making security arrangements, the Contractor shall also comply with any additional requirements stated in the Specification."
Sub-Clause 4.22 Contractor's Operations on Site	On the third line of the second paragraph before "4.17", "Sub- Clause" is added.
Sub-Clause 4.23 Archaeological and Geological Findings	The first paragraph is replaced with the following: "All fossils, coins, articles of value or antiquity, structures, groups of structures, and other remains or items of geological, archaeological, paleontological, historical, architectural, or religious interest found on the Site shall be placed under the care and custody of the Employer. The Contractor shall: a. take all reasonable precautions, including fencing-off the area or site of the finding, to avoid further disturbance and prevent Contractor's Personnel or other persons from removing or damaging any of these findings; b. train relevant Contractor's Personnel on appropriate actions to be taken in the event of such findings; and c. implement any other action consistent with the requirements of the Specification and relevant Laws."
Sub-Clause 4.24 Environment, Health, and Safety Code of Conduct	New Sub-Clause 4.24 is added as following: "The Contractor shall adhere to the EHS Code of Conduct for the Contractor's Personnel submitted as part of the Contractor's Tender. The Contractor shall take all necessary measures to ensure that each Contractor's Personnel is made aware of the of EHS Code of Conduct including specific behaviors that are prohibited and understands the consequences of engaging in such prohibited behaviors. These measures include providing instructions and documentation that can be understood by the Contractor's Personnel and seeking to obtain, as part of the site induction training, that person's signature acknowledging receipt of such instructions and/or documentation, as appropriate. The Contractor shall keep record of such acknowledgement of receipt.

Clause/Sub-Clause	Special Provisions
	The Contractor shall also ensure that the EHS Code of Conduct is visibly displayed in multiple locations on the Site and any other place where the Works will be carried out, as well as in areas outside the Site accessible to the local community and project affected people. The posted EHS Code of Conduct shall be provided in languages comprehensible to Contractor's Personnel, Employer's Personnel, and the local community. The Contractor's SSEMP (as per Sub-Clause 4.8 [Health and Safety Obligations] and SSHSMP (as per Sub-Clause 4.18 [Protection of the Environment] shall include appropriate processes for the Contractor to verify compliance with these obligations."
Sub-Clause 5.1 Subcontractors	The following is added at the end of the third paragraph of Sub-Clause 5.1: "When requesting such a prior consent, the Contractor shall submit, in addition to any other required document, an undertaking from each proposed Subcontractor to confirm that they have read, understand and shall comply with the EHS obligations set out in Sub-Clause 4.24 and EHS Code of Conduct. The following is added at the end of the last paragraph of Sub-Clause 5.1: The Contractor shall ensure that the requirements imposed on the Contractor by Sub-Clause 1.12 [Confidentiality] apply equally to each Subcontractor. Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors. All subcontracts relating to the Works shall include provisions which entitle the Employer to require the subcontract to be assigned to the Employer under sub-paragraph (a) of Sub-Clause 15.2.3 [After Termination]."
Sub-Clause 5.2.2 Objection to Nomination	In sub-paragraph (a), on the first line before "Subcontractor", "nominated" is added. In sub-paragraph (c): "and" is deleted from the end of (i); "." at the end of (ii) is replaced with: ", and". The following is then added as (iii): "(iii) be paid only if and when the Contractor has received from the Employer payments for sums due under the Subcontract referred to under Sub-Clause 5.2.3 [Payment to nominated Subcontractors]."
Sub-Clause 6.1 Engagement of Staff and Labor	The following paragraphs are added at the end of the Sub-Clause: "The Contractor shall provide the Contractor's Personnel information and documentation that are clear and understandable regarding their terms and conditions of employment. The information and documentation shall set out their rights under relevant labor Laws applicable to the Contractor's Personnel (which will include any applicable collective agreements), including their rights related to hours of work, wages, overtime, compensation and benefits, as well as those arising from any requirements in the Specification. The Contractor's Personnel shall

Clause/Sub-Clause	Special Provisions
	be informed when any material changes to their terms or conditions of employment occur. The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labor with appropriate qualifications and experience from sources within the Country."
Sub-Clause 6.2 Rates of Wages and Conditions of Labor	The following paragraphs are added: "The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, allowances, and any benefits as are subject to tax under the Laws of the Country for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws. The Contractor shall have paid its staff and labor all due wages and entitlements on or before the end of their engagement or employment."
Sub-Clause 6.5 Working Hours	The following is inserted at the end of the Sub-Clause: "The Contractor shall provide the Contractor's Personnel annual holiday and sick, maternity, and family leave, as required by applicable Laws or as stated in the Specification."
Sub-Clause 6.6 Facilities for Staff and Labor	The following is added as the last paragraph: "If stated in the Specification, the Contractor shall give access to or provide services that accommodate the physical, social, and cultural needs of the Contractor's Personnel. The Contractor shall also provide similar facilities for the Employer's Personnel as stated in the Specification."
Sub-Clause 6.7 Health and Safety of Personnel	In the second paragraph, "The Contractor" is replaced with: "Except as otherwise stated in the Specification, the Contractor…" The following is added after the third paragraph: **HIV/AIDS Prevention**. The Contractor shall conduct an HIV/AIDS awareness program via an approved service provider and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals. The Contractor shall conduct health and safety programs for workers employed under the project and shall include information on the trafficking of workers and the risk of sexually transmitted diseases, including HIV/AIDS, in such programs. The Contractor shall, throughout the contract (including the Defects Notification Period): (i) conduct information, education, and communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labor (including all the Contractor's employees, all Subcontractors, and any other Contractor's or Employer's personnel, and all truck drivers and crew making deliveries to the Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to, sexually transmitted diseases (STDs) or sexually transmitted infections (STIs) in

Clause/Sub-Clause	Special Provisions
	general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labor as appropriate; and (iii) provide for STIs and HIV/AIDS screening, diagnosis, counselling, and referral to a dedicated national STIs and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labor. The Contractor shall include in the program to be submitted for the execution of the Works under Sub-Clause 8.3 an alleviation program for Site staff and labor and their families in respect of STIs and STDs including HIV/AIDS. The STIs, STDs, and HIV/AIDS alleviation program shall indicate when, how, and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related subcontracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this program shall not exceed the Provisional Sum dedicated for this purpose.
Sub-Clause 6.9 Contractor's Personnel	The Sub-Clause is replaced with: "The Contractor's Personnel (including Key Personnel, if any) shall be appropriately qualified, skilled, experienced, and competent in their respective trades or occupations. The Engineer may require the Contractor to remove (or cause to be removed) any person employed on the Site or Works, including the Contractor's Representative and Key Personnel (if any), who: a) persists in any misconduct or lack of care; b) carries out duties incompetently or negligently; c) fails to comply with any provision of the Contract; d) persists in any conduct which is prejudicial to safety, health, or the protection of the environment; e) based on reasonable evidence, is determined to have engaged in any of the conducts defined in 2.1 (a) of Particular Conditions Part C (Corrupt and Fraudulent Practices) during the execution of the Works; f) has been recruited from the Employer's Personnel in breach of Sub-Clause 6.3 [Recruitment of Persons]; and g) undertakes behavior that breaches the EHS Code of Conduct for Contractor's Personnel as stated in Sub-Clause 4.24 [EHS Code of Conduct]. If appropriate, the Contractor shall then promptly appoint (or cause to be appointed) a suitable replacement with equivalent skills and experience. In the case of replacement of the Contractor's Representative, Sub-Clause 4.3 [Contractor's Representative] shall apply. In the case of replacement of Key Personnel (if any), Sub-Clause 6.12 [Key Personnel] shall apply. Subject to the requirements in Sub-Clause 4.3 [Contractor's Representative] and 6.12 [Key Personnel], and notwithstanding any requirement from the Engineer to remove or cause to remove any person, the Contractor shall take immediate action as appropriate in response to any violation of (a) through (g) above. Such immediate action shall include removing (or causing to be removed) from the Site or other places where the Works are being carried out, any Contractor's Personnel who engages in (a), (b), (c), (d), (e), or (g) above or has been recruited as stated in (f) above."
Sub-Clause 6.12	The following is inserted at the end of the last paragraph:

Clause/Sub-Clause	Special Provisions
Key Personnel	"If any of the Key Personnel are not fluent in this language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer."
	The following Sub-Clauses 6.13 to 6.28 are added after Sub-Clause 6.12
Sub-Clause 6.13 Foreign Personnel	The Contractor may bring into the Country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer will, if requested by the Contractor, use its best endeavors in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel. The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial.
Sub-Clause 6.14 Supply of Foodstuffs	The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.
Sub-Clause 6.15 Supply of Water	The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.
Sub-Clause 6.16 Measures against Insect and Pest Nuisance	The Contractor shall, at all times, take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce the danger to their health. The Contractor shall comply with all the regulations of the local health authorities, including on the use of appropriate insecticide.
Sub-Clause 6.17 Alcoholic Liquor or Drugs	The Contractor shall not, otherwise in accordance with the Laws of the Country, import, sell, give, barter, or dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift, barter, or disposal thereto by the Contractor's Personnel.
Sub-Clause 6.18 Arms and Ammunition	The Contractor shall not give, barter, or dispose of, to any person, any arms or ammunition of any kind, or allow the Contractor's Personnel to do so.
Sub-Clause 6.19 Festivals and Religious Customs	The Contractor shall respect the Country's recognized festivals, days of rest, and religious or other customs including those practiced by communities adjacent to the Site.
Sub-Clause 6.20 Funeral Arrangements	The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of its local employees who may die while engaged upon the Works.
Sub-Clause 6.21 Forced Labor	The Contractor shall not employ or engage forced labor. Forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty. The Contractor shall not employ persons who have been subject to trafficking. Trafficking in persons is defined as the recruitment, transportation, transfer, harboring, or receipt of persons by means of the threat or use of force or other forms of coercion, abduction, fraud, deception, abuse of power, or of a position of vulnerability, or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purposes of exploitation.

Clause/Sub-Clause	Special Provisions
	The Contractor shall ensure that its Subcontractors and suppliers comply with all the obligations under this Sub-Clause.
Sub-Clause 6.22 Child Labor	The Contractor shall not employ or engage a child whose age is below the Country's statutory minimum age of employment or a child in contravention of International Labour Organization, Convention no. 138 (Minimum Age Convention). The Contractor shall not employ or engage a child between the minimum age and the age of 18 in a manner that is likely to be hazardous, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. The Contractor shall only employ or engage children between the minimum age and the age of 18 after an appropriate risk assessment has been conducted by the Contractor with the Engineer's consent. The Contractor shall be subject to regular monitoring by the Engineer that includes monitoring of health, working conditions, and hours of work. Work considered hazardous for children is work that, by its nature or the circumstances in which it is carried out, is likely to jeopardize the health, safety, or morals of children. Such work activities prohibited for children include work (a) with exposure to physical, psychological, or sexual abuse; (b) underground, underwater, or working at heights or in confined spaces; (c) with dangerous machinery, equipment, or tools, or involving handling or transport of heavy loads; (d) in unhealthy environments exposing them to hazardous substances, agents, or processes, or to temperatures, noise, or vibration damaging to their health; or (e) under difficult conditions such as working for long hours, during the night, or in confinement on the premises of the employer. The Contractor shall ensure that its Subcontractors and suppliers comply with all the obligations under this Sub-Clause.
Sub-Clause 6.23 Employment Records of Workers	The Contractor shall keep complete and accurate records of the employment of labor at the Site. The records shall include the names, ages, genders, hours worked, and wages paid to all workers. These records shall be summarized on a monthly basis and submitted to the Engineer. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 [Contractor's Records].
Sub-Clause 6.24 Workers' Organizations	In countries where the relevant labor laws recognize workers' rights to form and join workers' organizations of their choosing and to bargain collectively without interference, the Contractor shall comply with such laws. In such circumstances, the role of legally established workers' organizations and legitimate workers' representatives will be respected, and they will be provided with information needed for meaningful negotiation in a timely manner. Where the relevant labor laws substantially restrict workers' organizations, the Contractor shall enable alternative means for the Contractor's Personnel to express their grievances and protect their rights regarding working conditions and terms of employment. The Contractor shall not seek to influence or control these alternative means. The Contractor shall not

Clause/Sub-Clause	Special Provisions
	discriminate or retaliate against the Contractor's Personnel who participate, or seek to participate, in such organizations and collective bargaining or alternative mechanisms. Workers' organizations are expected to fairly represent the workers in the workforce.
Sub-Clause 6.25 Non-Discrimination and Equal Opportunity	The Contractor shall not make decisions relating to the employment or treatment of Contractor's Personnel on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment of the Contractor's Personnel on the principle of equal opportunity and fair treatment and shall not discriminate with respect to any aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination. The Contractor shall provide protection and assistance as necessary to ensure non-discrimination and equal opportunity, including for specific groups such as women, people with disabilities, indigenous peoples and/or ethnic minorities, migrant workers and children (of working age in accordance with Sub-Clause 6.22).
Sub-Clause 6.26 Contractor's Personnel Grievance Mechanism	The Contractor shall have a grievance mechanism for Contractor's Personnel, and where relevant, the workers' organizations stated in Sub-Clause 6.24 [Workers' Organizations], to raise workplace concerns. The grievance mechanism shall be proportionate to the nature, scale, risks, and impacts of the Contract. The mechanism shall address concerns promptly, using an understandable and transparent process that provides timely feedback to those concerned in a language they understand, without any retribution, and shall operate in an independent and objective manner. The Contractor's Personnel shall be informed of the grievance mechanism at the time of engagement for the Contract, and the measures put in place to protect them against any reprisal for its use. Measures will be put in place to make the grievance mechanism easily accessible to all Contractor's Personnel. The grievance mechanism shall not impede access to other judicial or administrative remedies that might be available or substitute for grievance mechanisms provided through collective agreements. The grievance mechanism may utilize existing grievance mechanisms, providing that they are properly designed and implemented, address concerns promptly, and are readily accessible to Contractor's Personnel. Existing grievance mechanisms may be supplemented as needed with Contract-specific arrangements.
Sub-Clause 6.27 Training of Contractor's Personnel	The Contractor shall provide appropriate training to relevant Contractor's Personnel on obligations set out in Sub-Clause 4.8 [Health and Safety Obligations], 4.18 [Protection of the Environment] and Sub-Clause 6.28 [Respectful Work Environment] respectively.
Sub-Clause 6.28 Respectful Work Environment	The following sentence shall apply: The Contractor shall ensure that its employees and Subcontractors observe the highest ethical standards and refrain from any form of bullying, discrimination, misconduct and harassment, including sexual harassment; and shall, at all times, behave in a manner that creates an environment free of unethical behavior, bullying, misconduct, and harassment, including sexual harassment. The

Clause/Sub-Clause	Special Provisions
	Contractor shall take appropriate action against any employees or subcontractors, including suspension or termination of employment or subcontract, if any form of unethical or inappropriate behavior is identified. The Contractor shall conduct training programs for its employees and Subcontractors to raise awareness on and prevent any form of bullying, discrimination, misconduct, and harassment including sexual harassment, and to promote a respectful work environment. The Contractor shall keep an up-to-date record of its employees and Subcontractors who have attended and completed such training programs and provide such records to the Employer or the Engineer at their first written request.
Sub-Clause 7.7 Ownership of Plant and Materials	The following is added before the first paragraph: "Except as otherwise provided in the Contract,"
Sub-Clause 8.1 Commencement of Work	The first paragraph is replaced with the following: "The Engineer shall give a Notice to the Contractor stating the Commencement Date, not less than 14 days before the Commencement Date. This Notice shall be issued promptly after the Engineer determines the fulfillment of the following conditions: (a) signature of the Contract Agreement by both Parties; (b) delivery to the Contractor of reasonable evidence of the Employer's financial arrangements under Sub-Clause 2.4 [Employer's Financial Arrangements]; (c) except if otherwise specified in Sub-Clause 2.1 in the Contract Data, effective access to and possession of the Site given to the Contractor together with such permission(s) under (a) of Sub-Clause 1.13 [Compliance with Laws] as required for the commencement of the Works; (d) receipt by the Contractor of the Advance Payment (1st instalment) under Sub-Clause 14.2 [Advance Payment] provided that the conditions set out under Sub-Clause 14.2.2(a) and (b) have been fulfilled by the Contractor within 28 days from the receipt of the Letter of Acceptance. Otherwise, this sub-paragraph (d) shall not apply.
Sub-Clause 8.3 Programme	Add the following at the end of sub-paragraph (b): ", it being understood that the sequence of construction activities should take into account, to the extent possible, the constraints due to land acquisition as set out in the resettlement plan."
Add the following sub-clauses Sub-Clause 10A.1 to 10A.8	
Sub-Clause 10A.1 General Requirements for Operation Service	The Contractor shall comply with the operation management requirements during system stabilization period as provided for in the Contract, and any Variation thereof. Prior to the commencement of the system stabilization Service, the Contractor shall have submitted for the Engineer's (or Employer's) prior approval, and obtained the Engineer's (or Employer's) prior approval, an Operation and Maintenance Plan as per the requirements set out in the Specification.

Clause/Sub-Clause	Special Provisions
	During the whole system stabilization period, the Contractor shall follow the requirements of the Specification, the Operation and Maintenance Plan and any operation and maintenance manual. No significant alteration to such arrangements and methods shall be made without the prior approval of the Engineer. The operators and maintenance personnel for the Works, including operators, shall have the appropriate experience and qualifications to perform the Operation Service. The names, with details of their qualifications and experience, of all operation and maintenance personnel shall be submitted to the Engineer (or Employer) for approval, and no such personnel shall be engaged prior to receiving such approval.
Sub-Clause 10A.2 Commencement of Operation Service	The commencement of the system stabilization service shall be from the date stated in the Taking over Certificate issued under Sub-Clause 10.1 [*Taking over of the Works*]. The Contractor shall thereafter, over the whole system stabilization period, provide the Operation Service with the reasonable skill, care and diligence expected from an operator experienced in the operation and maintenance of Works of similar nature, size and complexity. However, and additionally, for any part of the Permanent Works designed by the Contractor, the Contractor shall be responsible to ensure that this part is fit for such purposes for which the part is intended as are specified in the Contract. For the avoidance of doubt, the Contractor shall not be under any fitness for purpose obligation for a part of the Works which has not been designed by him but by (or on behalf of) the Employer.
Sub-Clause 10A.5 Delays and Interruptions during the System Stabilization **Service**	Delays and interruptions during the system Stabilization Service shall be agreed and determined as follows: (a) delays or interruptions caused by the Contractor If there are any delays or interruptions during the **S**ystem Stabilization Service which are caused by the Contractor, or by a cause for which the Contractor is responsible, the Contractor shall compensate the Employer for any losses including loss of revenue, loss of profit and overhead losses. The amount of compensation due shall be agreed or determined according to Sub-Clause 3.7 [Agreement or Determination], and the Employer shall be entitled to recover the amount due by making a corresponding deduction from the next payment due to the Contractor. However, the total amount of compensation payable by the Contractor to the Employer shall not exceed 10 % of the **S**ystem Stabilization Services amount. (b) delays or interruptions caused by the Employer If there are any delays or interruptions during the **S**ystem Stabilization Service which are caused by the Employer, or by a cause for which the Employer is responsible, the Employer shall compensate the Contractor for any cost and losses including loss of revenue and loss of profit. The amount of compensation due shall be agreed or determined according to Sub-Clause 3.7 [Agreement or Determination] and the Employer shall pay the amount due by making a corresponding adjustment to the next payment due to the Contractor. In any event other than in the case of election by the Employer to terminate for his convenience pursuant to Sub-Clause 15.5 [*Termination for Employer's Convenience*], the total amount of compensation payable by the Employer to the Contractor shall not exceed 10 % of the System Stabilization Services amount. There will be no extension of the period of the **S**ystem Stabilization Service as a result of any such delay or interruption.

Clause/Sub-Clause	Special Provisions
	(c) Suspension by the Employer The Employer (or the Engineer) may at any time during the **S**ystem Stabilization Service instruct the Contractor to suspend progress of the **S**ystem Stabilization Service. During such suspension, the Contractor shall protect, store, secure and maintain the Plant against any deterioration, loss or damage. If the need to suspend the **S**ystem Stabilization Service by the Employer is due to any failure of the Contractor or circumstances for which the Contractor is responsible under the Contract, the provisions of paragraph (a) of this Sub-Clause shall apply. If the need to suspend the **S**ystem Stabilization Service is a result neither of any failure by the Contractor nor of circumstances for which the Contractor is responsible under the Contract, the provisions of paragraph (b) of this Sub-Clause shall apply. After the permission or instruction to resume the **S**ystem Stabilization Service is given by (or on behalf of) the Employer, the Contractor and the Employer (or the Engineer) shall jointly examine the Works. The Contractor shall make good any deterioration or defect in the Plant and the Employer (or the Engineer) shall make a written record of all making good required to be carried out by the Contractor. If the suspension is due neither to any failure by the Contractor nor to circumstances for which the Contractor is responsible under the Contract, the Contractor shall be entitled to be paid the Cost plus profit of making good the Works prior to re-commencing the **S**ystem Stabilization Service.
Sub-Clause 10A.6 Failure to Reach Production Outputs	In the event that the Contractor fails to achieve the KPIs Output required under the Contract, the Parties shall jointly establish the cause of such failure. (a) If the cause of the failure lies with the Employer or the Employer's Personnel, then, after consultation with the Contractor, the Employer (or the Engineer) shall give written instruction to the Contractor of the measures which the Employer requires the Contractor to take. If the Contractor suffers any additional cost as a result of the failure or the measures instructed by the Employer (or the Engineer), the Employer, subject to Sub-Clause 3.7 [Agreement or Determination] and Sub-Clause 20.1 [*Claims*], shall pay the Contractor his Cost plus profit. (b) If the cause of the failure lies with the Contractor then, after due consultation with the Employer, the Contractor shall take all steps necessary to restore the output to the levels required under the Contract. If the Employer suffers any loss as a result of the failure or the measures taken by the Contractor, the Employer shall have the same remedies as provided under Sub-Clause 10A.5(a). If the failure continues for a period of more than 84 days and the Contractor is unable to achieve the required production output, the Employer may either: (i) continue with the **S**ystem Stabilization Service at a reduced level of compensation determined in accordance with Sub-Clause 3.7 [Agreement or Determination]; or (ii) if the production outputs fail to reach the minimum values required in the Contract Data, give notice to the Contractor not less than 56 days prior to terminating the Contract, in accordance with Clause 15 [*Termination by Employer*]. In such an event, the Employer shall

Clause/Sub-Clause	Special Provisions
	be free to continue the **S**ystem Stabilization Service himself or by others.
Sub-Clause 10A.7 Completion of the Operation Service	The obligation of the Contractor to operate and maintain the Works under the **S**ystem Stabilization Service shall cease at the end of the period stated in the Contract as the Operation Service Period. Notwithstanding the foregoing, other services to be performed by the Contractor must be completed before the Contractor will be entitled to receive the Performance Certificate in accordance with Sub-Clause 11.9 [*Performance Certificate*]. Other pre-conditions which must be fulfilled by the Contractor before the Performance Certificate will be issued are: (a) Updating Operation and Maintenance Plan, and operation and maintenance manuals providing performance records and data; (b) Supply of all Contractor's Documents; and (c) Completion and testing of all of the Works, including remedying any defects,
Sub-Clause 10A.8 Ownership of Output and Revenue	During the System Stabilization Service, any production output and revenue shall be the exclusive property of the Employer.
Sub-Clause 11.7 Right of Access after Taking Over	In the second paragraph, "Whenever the Contractor intends to access any part of the Works during the relevant DNP:" is replaced with: "Whenever, until the date 28 days after issue of the Performance Certificate, the Contractor intends to access any part of the Works:"
Sub-Clause 12.3 Valuation of the Works	Replace Clause 12.3 (b) (i) and (ii) with the following i. the measured quantity of the item is changed by more than 25% from the quantity of this item in the Bill of Quantities or other schedule, ii. this change in quantity multiplied by the rate or price specified in the Bill of Quantities or other Schedule for this item exceeds 1% of the Accepted Contract Amount, Sub-paragraph (b)(iii) is deleted in its entirety. The requirement to demonstrate a change in the Cost per unit quantity shall not apply. The following is added at the end of the fourth paragraph: "For any item of work where a new rate or price is determined under sub-paragraph (b), such new rate or price shall apply only to the measured quantity of that item which is in excess of 125% of the quantity specified in the Bill of Quantities or other Schedule. The quantity up to and including 125% shall be valued at the rate or price specified in the Bill of Quantities or other Schedule." The following is added at the end of the Sub-Clause: "Any new rate or price determined under this Sub-Clause shall be considered a 'current price' for the purpose of Sub-Clause 13.7 [Adjustments for Changes in Cost]. Accordingly, no price adjustment shall apply to the portion of work valued at such new rate."
Sub-Clause 13.3.1	Sub-paragraph 13.3.1 (a) is replaced with: "a description of the varied work performed or to be performed, including details of the resources and methods

Clause/Sub-Clause	Special Provisions
Variation by Instruction	adopted or to be adopted by the Contractor, and sufficient information to enable an evaluation of environment, health, and safety risks and impacts;"
Sub-Clause 13.4 Provisional Sums	The following is inserted as the penultimate paragraph: "A specific Provisional Sum for the work of the DAAB shall be used to cover the Employer's share of the DAAB members' fees and expenses, in accordance with Clause 21 [Dispute and Arbitration]. Notwithstanding the foregoing, no prior instruction of the Engineer shall be required for use of this specific Provisional Sum. The Contractor shall submit the DAAB members' invoices and satisfactory evidence of having paid 100% of such invoices as part of supporting documents of those Statements submitted under Sub-Clause 14.3 [Application for Interim Payment]. No overhead and profit shall be paid to the Contractor in respect of the Provisional Sum". The following is added at the end of the first paragraph: If the Bill of Quantities includes Provisional Sums for contingencies, it shall be used, in whole or part, at the discretion, and in accordance with the instructions, of the Engineer, to meet any of the Employer's payment obligations in connection with or arising out of the Contract. The following is added at the end of Sub-Clause 13.4: The Provisional Sum includes an allocation for Deposits required to obtain road cutting permissions from the Department of Roads (DOR) or other relevant authorities, if so required by such authorities. The Contractor shall deposit the required amounts to the relevant authorities on behalf of the Employer from this Provisional Sum. These payments will be reimbursed to the Contractor through the next Interim Payment Certificate (IPC). Notwithstanding any other provision in the Contract, the Contractor shall not be entitled to any overhead or profit on this specific Provisional Sum item. If any deposited amount is forfeited by the authority, or is not released to the Employer because the Contractor failed to perform the road reinstatement works to the required standard or within the specified time period, the Employer shall be entitled to recover this amount from the Contractor. The Engineer shall include such amount as a deduction in any Payment Certificate issued under Clause 14 [Contract Price and Payment].
Sub-Clause 13.6 Adjustments for Changes in Laws	The following paragraph is added at the end of the Sub-Clause: "Notwithstanding the foregoing, the Contractor shall not be entitled to an extension of time if the relevant delay has already been taken into account in the determination of a previous extension of time and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the Table of Adjustment Data in accordance with the provisions of Sub-Clause 13.7 [Adjustments for Changes in Cost]."
Sub-Clause 14.1 The Contract Price	The Contractor shall bear all the import duties and taxes upon importation of the Equipment, including essential spare parts, imported by the Contractor for executing the Contract.
Sub-Clause 14.2.1	The first paragraph is replaced with:

Clause/Sub-Clause	Special Provisions
Advance Payment Guarantee	"The Contractor shall obtain (at the Contractor's cost) an Advance Payment Guarantee in amounts and currencies equal to the advance payment and shall submit it to the Employer with a copy to the Engineer. This guarantee shall be issued by reputable bank or financial institution selected by the Contractor and shall be based on the sample form annexed to the Particular Conditions or in another form agreed by the Employer (but such agreement shall not relieve the Contractor from any obligation under this Sub-Clause)."
Sub-Clause 14.3 Application for Interim Payment	Sub-paragraph (vi) is replaced with the following; "(vi) any other additions and/or deductions that have become due under the Contract or otherwise, including those under Sub-Clause 3.7 [Agreement or Determination], any amount due to the Contractor under Sub-Clause 21.4.3 (i) and any reimbursement due to the Contractor under Sub-Clause 9.5 of the General Conditions of the DAAB Agreement."
Sub Clause 14.5(c) (i) and (ii) Plants and Materials intended for the Works	This sub-clause shall apply if, the Contractor submits the specific procurement plan of each lot of Materials procurement to the engineer and obtain no-objection prior to placing any orders with the Manufacturer / Supplier, then following installment of payment shall apply to the Materials as listed under. **a. Primary Lines (Including fittings):** (i) 45% of the Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid upon delivery of procured pipes and necessary fittings for the said procured length of pipe. (ii) 35% of the Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid after laying jointing of the pipes and fittings, its sectional pressure test, and reinstatement of respective road sections. (iii) 20% of Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid upon completion of testing and disinfection as per Technical Specifications as well as completion of any pending reinstatement works. **b. Secondary and Tertiary Pipeline (Including fittings):** (i) 45% of the Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid upon delivery of procured pipes and necessary fittings for the said procured length of pipe. (ii) 35% of the Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid after laying jointing of the pipes and fittings, its sectional pressure test, and reinstatement of respective road sections. (iii) 20% of Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid upon completion of full DMA testing and disinfection as per Technical Specifications as well as completion of any pending reinstatement works. **c. Valve, Meters, fire hydrants, Specials and Instruments (Including Electro-chlorinator)** (i) 45% of the Contractor's quoted item rate for supply and installation shall be paid upon delivery at the site. (ii) 35% of the Contractor's quoted item rate for supply and installation shall be paid upon completion of installation.

Clause/Sub-Clause	Special Provisions
	(iii) 20% of Contractor's quoted item rate for supply and installation shall be paid upon completion of full DMA testing including disinfection works as per Technical Specifications and completion of customer data survey for respective DMA's as per the format provided in the Technical Specification. For Electro-chlorinator, the mandatory trial run and commissioning shall be established as per Technical Specifications.
Sub-Clause 14.9 Release of Retention Money	The following is added at the end of Sub-Clause 14.9: "Unless otherwise stated in the Contract, when the Taking-Over Certificate has been issued for the Works or section as applicable and the first half of the Retention Money has been certified for payment by the Engineer, the Contractor shall be entitled to substitute a guarantee, in the form annexed to the Particular Conditions or in another form approved by the Employer and issued by a reputable bank or financial institution selected by the Contractor, for the second half of the Retention Money. The Contractor shall ensure that the guarantee is in the amounts and currencies of the second half of the Retention Money and is valid and enforceable until the Contractor has executed and completed the Works and remedied any defects, as specified for the Performance Security under Sub-Clause 4.2. On receipt by the Employer of the required guarantee, the Engineer shall certify and pay the second half of the Retention Money. The release of the second half of the Retention Money against a guarantee shall then be in lieu of the release after the latest of the expiry dates of the Defects Notification Periods. The Employer shall return the guarantee to the Contractor within 21 days after receiving a copy of the Performance Certificate."
Sub-Clause 14.12 Discharge	On the seventh line of the first paragraph, "Sub-Clause 21.6 [Arbitration]" is replaced with: "Clause 21 [Disputes and Arbitration]"
Sub-Clause 14.15 Currencies of Payment	Throughout Sub-Clause 14.15, "Contract Data" is replaced with: "Schedule of Payment Currencies or the Bill of Quantities (in case the use of various currencies is stated in the Bill of Quantities itself), as applicable".
Sub-Clause 15.1 Notice to Correct	"and" is deleted at the end of (b) and "." is replaced by: "; and" in (c). The following is then added as (d): "(d) specify the time within which the Contractor shall respond to the Notice to Correct." In the third paragraph, "shall immediately respond" is replaced with: "shall respond within the time specified in (d)". Further, at the end of the third paragraph, "to comply with the time specified in the Notice to Correct." is replaced with: "to comply with the time specified in (c)."
Sub-Clause 15.2.1 Notice	Sub-paragraph (h) is replaced with: "is found, based on reasonable evidence, to have engaged in Corrupt and Fraudulent Practices as defined in Paragraph 2.1 (a) of Part C of the Particular Conditions [Corrupt and Fraudulent Practices], in competing for or in executing the Contract."
Sub-Clause 15.8 Fraud and Corruption	The following new Sub-Clause is added:

Clause/Sub-Clause	Special Provisions
	"15.8.1 The Bank requires compliance with the Bank's Anticorruption Policy and Integrity Principles and Guidelines (both as amended from time to time), as set forth in Particular Conditions - Part C- Corrupt and Fraudulent Practices. 15.8.2 The Employer requires the Contractor to disclose any commissions, gratuities, or fees that may have been paid or are intended to be paid to agents or any other party with respect to the bidding process or execution of the Contract. The information disclosed must include at least the name and address of the agent or other party, the amount and currency, and the purpose of the commission, gratuity, or fee."
Sub-Clause 16.2.1 Notice	At the end of sub-paragraph (i): "; or" is replaced with: "." sub-paragraph (f) is replaced with: "(f) the Contractor does not receive a Notice of the Commencement Date under Sub-Clause 8.1 [Commencement of Works] within 182 days after receiving the Letter of Acceptance, for reasons not attributable to the Contractor;" Sub-paragraph (j) is replaced with: "the Employer is found, based on reasonable evidence, in accordance with the Bank's Anticorruption Policy and Integrity Principles and Guidelines (both as amended from time to time) to have incurred in integrity violations, such as those defined in Part C [Corrupt and Fraudulent Practices] of the Particular Conditions of Contract at any time in relation to work or the Contract."
Sub-Clause 16.2.2 Termination	The following is added at the end of Sub-Clause 16.2.2: "In the event the Bank suspends the loan or grant from which part or whole of the payments to the Contractor are being made, if the Contractor has not received the sums due to him by the expiry of 14 days after the relevant time period referred to in Sub-Clause 14.7 [Payment], issuance of the Interim Payment Certificates to which they relate, the Contractor may, without prejudice to the Contractor's entitlement to financing charges under Sub-Clause 14.8 [Delayed Payment], take one of the following actions: (i) suspend work or reduce the rate of work under Sub-Clause 16.1 above, or (ii) terminate the Contract by giving Notice to the Employer, with a copy to the Engineer, such termination to take effect 14 days after giving the Notice."
Sub-Clause 17.1 Responsibility for Care of the Works	On the fourth and fifth lines of the first paragraph, replace "Date of Completion of the Works" with "issue of the Taking-Over Certificate for the Works".
Sub-Clause 17.3 Intellectual and Industrial Property Rights	On the first line of the second paragraph, replace "notice" with "a Notice".
Sub-Clause 17.7 Use of Employer's Accommodation/Facilities	The following Sub-Clause is added as 17.7: "The Contractor shall take full responsibility for the care of the Employer-provided accommodation and facilities, if any, as detailed in the Specification, from the respective dates of hand over to the Contractor until cessation of occupation (where hand over or cessation of occupation may take place after the date stated in the Taking-Over Certificate for the Works). If any loss or damage happens to any of the above items while the Contractor is responsible for their care arising from any cause whatsoever other than those for which the Employer is liable, the Contractor shall, at its own cost, rectify the loss or damage to the satisfaction of the Engineer."

Clause/Sub-Clause	Special Provisions
Sub-Clause 18.1 Exceptional Events	"Sub-paragraph (c) is substituted with (c) riot, commotion, disorder, or sabotage by persons other than the Contractor's Personnel and other employees of the Contractor and Subcontractors;"
Sub-Clause 18.4 Consequences of an Exceptional Event	The following is added at the end of sub-paragraph (b) after deleting the ".": ", including the costs of rectifying or replacing the Works and/or Goods damaged or destroyed by Exceptional Events, to the extent they are not indemnified through the insurance policy referred to in Sub-Clause 19.2 [Insurance to be provided by the Contractor]."
Sub-Clause 18.5 Optional Termination	In sub-paragraph (c), "and necessarily" is inserted after "was reasonably".
Sub-Clause 19.1 General Requirements	The following paragraphs are added after the first paragraph: "Wherever the Employer is the insuring Party, each insurance shall be effected with insurers and in terms acceptable to the Contractor. These terms shall be consistent with terms (if any) agreed by both Parties before the date of the Letter of Acceptance. This agreement of terms shall take precedence over the provisions of this Clause.
Sub-Clause 19.2 insurance to be provided by the Contractor	The following is inserted as the first sentence in Sub-Clause 19.2: "The Contractor shall be entitled to place all insurances relating to the Contract (including, but not limited to the insurance referred to in Clause 19) with insurers from the List of Eligible Countries as stated in Sub-Clause 1.5."
Sub-Clause 19.2.1 The Works	On the last line of the second paragraph, "and Clause 12 [Tests after completion]" is deleted.
Sub-Clause 19.2.5 Injury to employees	The second paragraph is replaced with: "The Employer and the Engineer shall also be indemnified under the policy of insurance, against liability for claims, damages, losses, and expenses (including legal fees and expenses) arising from injury, sickness, disease, or death of any person employed by the Contractor or any other of the Contractor's Personnel, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel."
Sub-Clause 20.1 Claims	In a): "any additional payment" is replaced with "any payment".
Sub-Clause 20.2 Claims for Payment and/or EOT	The first paragraph is replaced with: "If either Party considers that it is entitled to claim under Sub-Clause 20.1 (a) or (b), the following claim procedure shall apply:"
Sub-Clause 20.2.7 General requirements	In the first paragraph, replace "until" with "after" and delete "reasonably".
Sub-Clause 21.1 Constitution of the DAAB	First paragraph: the second sentence is replaced with: "The Parties shall jointly appoint the member(s) of the DAAB within 28 days after the Commencement Date, unless stated otherwise in the Contract Data."

Clause/Sub-Clause	Special Provisions
	In the second paragraph, at the end of the first sentence after deleting: ".", the following is added: ", each of whom shall meet the criteria set forth in Sub-Clause 3.3 of Appendix- General Conditions of Dispute Avoidance/ Adjudication Agreement." After the second paragraph insert the following paragraph: "If the Contract is with a foreign Contractor, the DAAB members shall not have the same nationality as the Employer or the Contractor."
Sub-Clause 21.4.3 The DAAB's decision	Item (i) of penultimate paragraph is deleted and replaced as follows: subject to sub-paragraph (ii) below, this amount shall be due and payable in the next Payment Certificate, for which the Engineer is obliged to certify, and the Employer is obliged to make payment; and
	APPENDIX- GENERAL CONDITIONS OF DISPUTE AVOIDANCE/ADJUDICATION AGREEMENT
Title	General Conditions of Dispute Avoidance/Adjudication Agreement" is replaced with "General Conditions of DAAB Agreement".
1. Definitions	Sub-Clause 1.2: In both the first and third lines, "DAA Agreement" is replaced with "DAAB Agreement". Sub-Clause 1.3: -In the first line, "Dispute Avoidance/Adjudication Agreement" or "DAA Agreement" means" is replaced with: "DAAB Agreement" is as defined under the Contract and is". - In the first line of sub-paragraph (c), "DAA Agreement" is replaced with "DAAB Agreement". - In sub-paragraph (c)(ii), "chairman" is replaced with "chairperson". Sub-Clause 1.7 to 12: Replace all instances of "DAA Agreement" with "DAAB Agreement". In Sub-Clause 1.7 a(i):" authorized representative of the Contractor or of the Employer" is replaced with: "Contractor's Representative or authorized representative of the Employer".
2. General Provisions	Sub-Clause 2.2 is deleted in its entirety.
7. Confidentiality	In Sub-Clause 7.3: "or" is deleted from the end of sub-paragraph (b); "." at the end of sub-paragraph (c) is replaced with: ", or". The following is then added as (d): "(d) is required by the Bank."
10. Resignation and Termination	In Sub-Clause 10.3: "the DAA Agreement" is replaced with: "a DAAB member's DAAB Agreement".
11. Challenge	In Sub-Clause 11.1: on the second line, delete the text: ", or in the case of a three-member DAAB the Other Members jointly,".

Clause/Sub-Clause	Special Provisions
	Annex- DAAB Procedural Rules
Rule 4.2	On the fourth line, “chairman” is replaced with “chairperson”.
Rules 8.3	On the sixth line, “chairman” is replaced with “chairperson”.
	Form of Dispute Avoidance/Adjudication Agreement
	All instances of “DAA Agreement” are replaced with: “DAAB Agreement”. In C (b): “chairman” is replaced with “chairperson”.

Part C – Corrupt and Fraudulent Practices

1. Purpose

1.1 ADB's Anticorruption Policy and Integrity Principles and Guidelines (both as amended from time to time) and this annex apply with respect to procurement under ADB-financed activities.

2. Requirements

2.1 ADB requires Borrowers (including beneficiaries of ADB-financed activity) and their personnel, as well as firms and individuals participating in an ADB-financed activity, including but not limited to, Bidders, Suppliers and Contractors, agents, subcontractors, subconsultants, service providers, subsuppliers, manufacturers (including their respective officers, directors, employees and personnel) under ADB-financed contracts to observe the highest standard of ethics during the procurement and execution of such contracts in accordance with ADB's Anticorruption Policy (1998, as amended from time to time). In pursuance of this policy, ADB

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;

(ii) "fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(iv) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;

(v) "abuse" means theft, waste, or improper use of assets related to ADB-related activity, either committed intentionally or through reckless disregard;

(vi) "conflict of interest" means any situation in which a party has interests that could improperly influence that party's performance of official duties or responsibilities, contractual obligations, or compliance with applicable laws and regulations;

(vii) "integrity violation" means any act, as defined under ADB's Integrity Principles and Guidelines (2015, as amended from time to time), which violates ADB's Anticorruption Policy, including (i) to (vi) above and the following: obstructive practice, violations of ADB sanctions, retaliation against whistleblowers or witnesses, and other violations of ADB's Anticorruption Policy, including failure to adhere to the highest ethical standards.

(b) will reject a proposal for award if it determines that the Bidder recommended for award or any of its officers, directors, employees, personnel, subconsultants, subcontractors, service providers, suppliers or manufacturers has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations in competing for the Contract;

(c) will cancel the portion of the financing allocated to a contract if it determines at any time that representatives of the Borrower or of a beneficiary of ADB financing engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations during the procurement or the execution of that contract, without the Borrower having taken timely and

appropriate action satisfactory to ADB to remedy the situation, including by failing to inform ADB in a timely manner at the time they knew of the integrity violations;

(d) will impose remedial actions on a firm or an individual at any time, in accordance with ADB's Anticorruption Policy and Integrity Principles and Guidelines, including declaring ineligible, either indefinitely or for a stated period of time, to participate[8] in activities financed, administered, or supported by ADB or to benefit from a contract financed, administered, or supported by ADB or otherwise, if it, at any time, determines that the firm or individual has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations; and

(e) will have the right to require that a provision be included in bidding documents and in contracts financed, administered, or supported by ADB, requiring Bidders, suppliers, contractors, consultants, manufacturers, service providers and other third parties engaged or involved in ADB-related activities, and their respective officers, directors, employees and personnel, to permit ADB or its representative to inspect the site and their assets, accounts and records and other documents relating to the bid submission and contract performance and to have them audited by auditors appointed by ADB.

2.2 All Bidders, consultants, contractors, suppliers, manufacturers, service providers, and other third parties engaged or involved in ADB-related activities and their respective officers, directors, employees and personnel, are required to cooperate fully in any investigation when requested by ADB to do so. As determined on a case-by-case basis by ADB, such cooperation is set out in detail in the Integrity Principles and Guidelines.

2.3 All Bidders, consultants, contractors and suppliers shall require their officers, directors, employees, personnel, agents to ensure that, in its contracts with its subconsultants, Subcontractors, and other third parties engaged or involved in ADB-related activities, such subconsultants, Subcontractors, and other third parties similarly are required to cooperate fully in any investigation when requested by ADB to do so.

2.4 The Contractor undertakes that no fees, gratuities, rebates, gifts, commissions or other payments, other than those shown in the bid, have been given or received in connection with the procurement process or in the contract execution.[9]

Part D- Environmental, Health and Safety (EHS)

Metrics for Progress Reports

Metrics for regular reporting:

a. Incidents for Non-Conformance

[8] Whether as a Contractor, Subcontractor, Consultant, Manufacturer or Supplier, or Service Provider; or in any other
capacity (different names are used depending on the particular Bidding Document).
[9] The undertaking also applies during the period of performance of the contract.

(i) Environmental incidents or non-conformance with contract requirements, including contamination, pollution, or damage to ground or water supplies
(ii) Health and safety incidents, accidents, injuries that require treatment, and all fatalities
(iii) Interactions with regulators: identify agency, dates, subjects, outcomes (report the negative if none)

b. Status of All Permits and Agreements*:*

(i) Work permits: number required, number received, and actions taken for those not received
(ii) Status of permits and consents:
  (a) List areas and facilities with permits required (quarries, asphalt, and batch plants), dates of application, dates issued (actions to follow up if not issued), dates submitted to resident engineer (or equivalent), and status of area (waiting for permits, working, abandoned without reclamation, decommissioning plan being implemented, etc.).
  (b) List areas with landowner agreements required (borrow and spoil areas, camp sites), dates of agreements, and dates submitted to resident engineer (or equivalent).
  (c) Identify and highlight major activities and environment, health, and safety activities undertaken in each area in the reporting period (land clearing, boundary marking, topsoil salvage, traffic management, decommissioning planning, decommissioning implementation).
  (d) For quarries: indicate status of relocation and compensation (completed, or details of activities and current status in the reporting period).
  (e) List parts of the Site for which Notice to commence work and confirmation by the Employer as per Sub-Clause 2.1 was received by the Contractor and the other parts of the Site for which such Notice is pending.

c. Compliance[10]

(i) Compliance status for conditions of all relevant consents and permits for the Work, including quarries, etc.: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance
(ii) Compliance status of SSHSMP (as per Sub-Clause 4.8 [*Health and Safety Obligations*]) and SSEMP (as per Sub-Clause 4.18 [*Protection of the Environment*]): statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance
(iii) Other unresolved issues from previous reporting periods related to environmental and social: continued violations, continued failure of equipment, continued lack of vehicle covers, spills not dealt with, continued compensation or blasting issues, etc.; cross-reference other sections as needed

d. Supervision

(i) Environmental Supervision
  (a) Environmental specialist: number of days worked, areas inspected, number of inspections of each (road section, work camp, accommodations, quarries, borrow areas, spoil areas, swamps, forest crossings, etc.), highlights of activities and findings (including violations of environmental requirements/best practices, actions taken), and reports to environmental specialist, construction, and site management

[10] For projects categorized as Category C for environment for which no EMP has been prepared, the item (ii) should be deleted.

(b) Community liaison person(s): number of days worked (hours community center open), number of people met, highlights of activities (issues raised, etc.), and reports to specialist, construction, and site management

(ii) Health and Safety Supervision
   (a) Health and Safety specialist: number of days worked, number of full and partial inspections, and reports to construction and project management
   (b) Number of workers, work hours, metric of personal protection equipment (PPE) use (percentage of workers with full PPE, partial, etc.), worker violations observed (by type of violation, PPE or otherwise), warnings given, repeat warnings given, and follow-up actions taken (if any)
   (c) Number of partial and full site inspections (by area: road section, work camp, accommodations, quarries, borrow areas, spoil areas, work site, clinic, HIV/AIDS center, community centers, etc.), highlights of activities (including violations of environmental, health and safety requirements observed, actions taken), and reports to health and safety specialist/construction/site management

e. Worker Accommodations:

(i) Number of expats housed in accommodations and number of locals
(ii) Date of last inspection and highlights of inspection including status of accommodations' compliance with national and local laws and good practice, including sanitation, space, etc.
(iii) Actions taken to recommend or require improved conditions, or to improve conditions

f. Training:

(i) Number of new workers, number receiving induction training, and dates of induction training
(ii) Number and dates of toolbox talks, number of workers receiving training related to Environment, Health and Safety (EHS)
(iii) Number and dates of communicable diseases (including sexually transmitted diseases [STDs]) sensitization and/or training, number of workers receiving training (in the reporting period and in the past), and same questions for gender sensitization and flag person training
(iv) Number and date of EHS-related prevention sensitization and/or training events, including number of workers receiving training on EHS Code of Conduct for Contractor's Personnel (in the reporting period and in the past), etc.

g. Grievances*:*

List of EHS-related grievances: grievances from affected communities and Worker grievances as recorded in the Contractor's grievance redress mechanism; traffic, road safety, and vehicles/equipment (health and safety or safeguard or environmental specialist needs to provide these requirements),

(i) Traffic and road safety incidents and accidents involving project vehicles and equipment: provide date, location, damage, cause, follow-up
(ii) Traffic and road safety incidents and accidents involving non-project vehicles or property (also reported under immediate metrics): provide date, location, damage, cause, and follow-up

(iii) Overall condition of vehicles or equipment (subjective judgment by environmentalist); non-routine repairs and maintenance needed to improve safety and/or environmental performance (to control smoke, etc.).

h.-Mitigations and Issues *(what has been done):*

(i) Environmental Mitigations

(a) Dust: number of working bowsers, number of watering per day, number of complaints, warnings given by environmentalist, actions taken to resolve; highlights of quarry dust control (covers, sprays, operational status); percentage of rock and spoil lorries with covers, and actions taken for uncovered vehicles
(b) Erosion control: controls implemented by location, status of water crossings, environmentalist inspections and results, actions taken to resolve issues, and emergency repairs needed to control erosion or sedimentation
(c) Quarries, borrow areas, spoil areas, asphalt plants, batch plants: identify major activities undertaken in the reporting period at each, and highlights of environmental protection—land clearing, boundary marking, topsoil salvage, traffic management, decommissioning planning, and decommissioning implementation
(d) Blasting: number of blasts (and locations), status of implementation of blasting plan (including notices, evacuations, etc.), and incidents of off-site damage or complaints (cross-reference other sections as needed)
(e) Spill clean-ups, if any: material spilled, location, amount, actions taken, and disposal (report all spills that result in water or soil contamination
(f) Waste management: types and quantities generated and managed, including amount taken off-site (and by whom) or reused, recycled, or disposed on-site
(g) Details of tree plantings and other mitigations required undertaken in the reporting period
(h) Details of water and swamp protection mitigations required undertaken in the reporting period
(i) The Contractor shall identify and report on any special or temporary right of way and any additional facility that have temporary and/or permanent impacts on affected persons' assets, access to assets and/or livelihoods (income sources). It shall put in place corresponding mitigation measures, and implement them.

(ii) Health and Safety Mitigations

(a) Details of hazard prevention and control mitigations required undertaken in the reporting period.

Annex to the Particular Conditions

Form of Performance Security

(Note: See corresponding form in Section 9 of bidding documents)

Annex to the Particular Conditions

Form of Advance Payment Bank Guarantee

(Note: See corresponding form in Section 9 of bidding documents)

Annex to the Particular Conditions

Form of Retention Money Guarantee

(Note: See corresponding form in Section 9 of bidding documents)

Annex to the Particular Conditions

Resettlement Plan (RP)

Section 9: Contract Forms

This section contains forms which, once completed, will form part of the Contract. The forms for Performance Security, Advance Payment Guarantee and Retention Money Security, when required, shall only be completed by the successful Bidder after contract award.

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Notice of Intention for Award of Contract

[on letterhead paper of the Employer]

[date of notification]

To: [name of the Bidder]
Attention: [insert name of the Bidder's authorized representative]
Address: [insert address of the Bidder's authorized representative]
Telephone/Fax numbers: [insert telephone/fax numbers of the Bidder's authorized representative]
E-mail Address: [insert e-mail address of the Bidder's authorized representative]

This is to notify you of our intention to award the contract [insert name of the contract and identification number, as given in the Bid Data Sheet]. You have [insert number of days as specified in ITB 41.1 of the BDS] days from the date of this notification to (i) request for a debriefing in relation to the evaluation of your Bid; and/or (ii) submit a bidding-related complaint in relation to the intention for award of contract, in accordance with the procedures specified in ITB 46.1.

The summary of the evaluation are as follows:

1. List of Bidders

Name of Bidder	Bid Price as Read Out at Opening	Evaluated Bid Price

2. Reason/s Why Your Bid Was Unsuccessful

……
….
……
….
……
….

3. The Successful Bidder

Name of Bidder:	
Address:	
Accepted Contract Amount:	
Duration of Contract:	
Scope of the Contract Awarded:	
Amount Performance Security Required:	

Authorized Signature: ……

Name and Title of Signatory: ……

Name of Agency: ……

Letter of Acceptance

[on letterhead of Employer]

[date]

To: [Name and address of the contractor]

Subject: Contract No. [please specify]

This is to notify you that your Bid dated [date] for execution of the [name of the contract and identification number, as given in the Bid Data Sheet] for the Accepted Contract Amount in the equivalent of [amount in words and figures and name of currency], as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by our Agency.

You are requested to furnish the Performance Security within 28 days in accordance with the Conditions of Contract and any additional security required as a result of the evaluation of your bid, using for that purpose the Performance Security Form included in Section 9 (Contract Forms) of the Bidding Document.

Authorized Signature: ……

Name and Title of Signatory: ……

Name of Agency: ……

Attachment: Contract Agreement

Contract Agreement

THIS CONTRACT AGREEMENT made the [date] day of [month], [year], between [name of the Employer] (hereinafter "the Employer"), of the one part, and [name of the contractor] (hereinafter "the Contractor"), of the other part:

WHEREAS the Employer desires that the Works known as [name of the contract] should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects therein.

The Employer and the Contractor agree as follows:

1. In this Contract Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Contract Agreement. This Contract Agreement shall prevail over all other Contract documents.

   (a) the Contract Agreement

   (b) Letter of Acceptance,

   (c) Letter of Technical Bid,

   (d) Letter of Price Bid,

   (e) the Particular Conditions – Part A – Contract Data,

   (f) the Particular Conditions – Part B – Special Provisions,

   (g) the Particular Conditions – Part C – Corrupt and Fraudulent Practices,

   (h) the Particular Conditions – Part D – Environmental, Health and Safety (EHS) Metrics for Progress Reports,

   (i) List of Eligible Countries as defined by the Bank,

   (j) General Conditions of Contract,

   (k) the Specifications,

   (l) the Drawings,

   (m) completed Schedules including Bill of Quantities,

   (n) Environment, Health and Safety Code of Conduct for Contractor's Personnel,

   (o) Environment, Health and Safety Management Plan (EHSMP),

   (p) the Joint Venture Undertaking (If Contract is a Joint Venture), and

   (q) any other documents shall be added here.[11]

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Contract Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

[11] Tables of Adjustment Data may be added if the contract provides for price adjustment (see GCC 13.7).

IN WITNESS whereof the parties hereto have caused this Contract Agreement to be executed in accordance with the laws of [name of the borrowing country] on the day, month and year indicated above.

Signed by ……
for and on behalf of the Employer

Signed by ……
for and on behalf the Contractor

in the presence of

in the presence of

Witness, Name, Signature, Address, Date

Witness, Name, Signature, Address, Date

Performance Security

[Bank's name, and address of issuing branch or office][12]

Beneficiary: ……. [Name and address of the Employer] …….

Date: ……..

Performance Guarantee No.: ……

We have been informed that [name of the contractor] (hereinafter called "the Contractor") has entered into Contract No. [reference number of the contract] dated [date] with you, for the execution of [name of contract and brief description of works] (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Contractor, we [name of the bank] hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [name of the currency and amount in words][13] [amount in figures] such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire, no later than the [date] day of [month], [year],[14] and any demand for payment under it must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.[15]

……
[Signature(s) and seal of bank (where appropriate)]

NOTE TO THE BIDDER

If the bank issuing performance security is located outside the Employer's country, it shall be counter-guaranteed or encashable by a bank in the Employer's country.

[12] All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

[13] The guarantor shall insert an amount representing the percentage of the accepted contract amount specified in the contract and denominated either in the currency(ies) of the contract or in any freely convertible currency acceptable to the Employer.

[14] Insert the date 28 days after the expected expiry of defect notification period. The Employer should note that in the event of an extension of the time for completion of the contract, the Employer would need to request an extension of this guarantee from the guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [6 months] [1 year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

[15] Or the employer may use "Uniform Rules for Demand Guarantees (URDG), ICC Publication No. 458, except that sub-paragraph (ii) of Sub-article 20(a) is hereby excluded" as appropriate.

Advance Payment Guarantee

[Bank's name, and address of issuing branch or office][16]

Beneficiary: ……. [Name and address of the Employer] …….

Date: ……..

Advance Payment Guarantee No.: ……..

We have been informed that [name of the contractor] (hereinafter called "the Contractor") has entered into Contract No. [reference number of the contract] dated [date] with you, for the execution of [name of contract and brief description of works] (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, an advance payment in the sum [name of the currency and amount in words][17] [amount in figures] is to be made against an advance payment guarantee.

At the request of the Contractor, we [name of the bank] hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [name of the currency and amount in words][18] [amount in figures] upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor:

(a) used the advance payment for purposes other than the costs of mobilization and cash flow support in respect of the Works; or

(b) has failed to repay the advance payment when it has become due and payable in accordance with the conditions of the Contract, specifying the amount payable by the Contractor.

It is a condition for any claim and payment under this guarantee to be made that the advance payment referred to above must have been received by the Contractor on its account number [Contractor's account number] at [name and address of the bank].

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as indicated in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that ninety percent (90%) of the Contract Price has been certified for payment, or on the [date] day of [month], [year],[19] whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.[20]

. . . . . .

[16] All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

[17] The guarantor shall insert an amount representing the amount of the advance payment denominated either in the currency(ies) of the advance payment as specified in the Contract, or in any freely convertible currency acceptable to the Employer.

[18] Footnote 1.

[19] Insert the expected expiration date of the time for completion. The Employer should note that in the event of an extension of the time for completion of the contract, the Employer would need to request an extension of this guarantee from the guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [6 months] [1 year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

[20] Or the employer may use "Uniform Rules for Demand Guarantees (URDG), ICC Publication No. 458, except that sub-paragraph (ii) of Sub-article 20(a) is hereby excluded" as appropriate.

[Signature(s) and seal of bank (where appropriate)]

NOTE TO THE BIDDER

If the bank issuing advance payment guarantee is located outside the Employer's country, it shall be counter-guaranteed or encashable by a bank in the Employer's country.

Retention Money Security

[Bank's name, and address of issuing branch or office][21]

Beneficiary: ……. [Name and address of the Employer] …….

Date: ……..

Retention Money Guarantee No.: ……

We have been informed that [name of the contractor] (hereinafter called "the Contractor") has entered into Contract No. [reference number of the contract] dated [date] with you, for the execution of [name of contract and brief description of works] (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, the Beneficiary retains moneys up to the limit set forth in the Contract ("the Retention Money"), and that when the Taking-Over Certificate has been issued under the Contract and the first half of the Retention Money has been certified for payment, payment of [insert the amount of the second half of the Retention Money or, if the amount guaranteed under the Performance Guarantee when the Taking-Over Certificate is issued is less than half of the Retention Money, the difference between half of the Retention Money and the amount guaranteed under the Performance Security] is to be made against a Retention Money guarantee.

At the request of the Contractor, we [name of the bank] as Guarantor hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of [name of the currency and amount in words][22] [amount in figures] such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

It is a condition for any claim and payment under this Guarantee to be made that the second half of the Retention Money referred above must have been received by the Contractor on its account number [Contractor's account number] at [name and address of the bank].

This Guarantee shall expire, no later than the [date] day of [month], [year],[23] and any demand for payment under it must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.[24]

[21] All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

[22] The Guarantor shall insert an amount representing the amount of the second half of the Retention Money or if the amount guaranteed under the Performance Guarantee when the Taking-Over Certificate is issued is less than half of the Retention Money, the difference between half of the Retention Money and the amount guaranteed under the Performance Security and denominated either in the currency(ies) of the second half of the Retention Money as specified in the Contract, or in a freely convertible currency acceptable to the Beneficiary.

[23] Insert the date 28 days after the expected latest of the expiry dates of Defect Notification Periods. The Employer should note that in the event of an extension of the Time for Completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [6 months] [1 year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

[24] Or the employer may use "Uniform Rules for Demand Guarantees (URDG), ICC Publication No. 458, except that sub-paragraph (ii) of Sub-article 20(a) is hereby excluded" as appropriate.

.....

[Signature(s) and seal of bank (where appropriate)]

NOTE TO THE BIDDER

If the bank issuing retention money security is located outside the Employer's country, it shall be counter-guaranteed or encashable by a bank in the Employer's country.

Kathmandu Valley Water Supply Improvement Project (Phase 2)

Bidding Document

For

Procurement

Of

Distribution Network Improvement Works in Kirtipur

Contract No.: PID/SKV/DNI2-Kirtipur

Volume I: Main Bidding Document

Volume II: Employer's Requirements

Volume III: Drawings

Issued on: 16 June 2026

Invitation for Bids No.: PID/SKV-R-01

OCB No: PID/SKV/DNI2-Kirtipur

Employer: Project Implementation Directorate, Kathmandu Upatyaka Khanepani Limited (PID/KUKL)

Country: Nepal

PROJECT IMPLEMENTATION DIRECTORATE
Kathmandu Upatyaka Khanepani Limited
Anamnagar, Kathmandu, Nepal

Kathmandu Valley Water Supply Improvement Project

(Phase-2)

Bid Document for

Distribution Network Improvement Works in Kirtipur

Contract No.: PID/SKV/DNI2- Kirtipur

Part II: EMPLOYER'S REQUIREMENTS

SECTION VI: WORKS REQUIREMENTS

June, 2026

SECTION VI: WORKS REQUIREMENTS

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SECTION VI-A: GENERAL REQUIREMENTS

1 PREAMBLE TO GENERAL REQUIREMENTS

This document called SECTION VI: WORKS REQUIREMENTS cover the principles, responsibilities, and requirements for items that will be applicable to all works pertinent to **Contract No. PID/SKV/DNI2-Kirtipur for Distribution Network Improvement Works in Kirtipur.** These specifications shall be read in conjunction with the Conditions of Contract, the Contract Agreement, the Bills of Quantities (BOQ), the Drawings and all other contractual documents.

The employer's general requirements, particular requirements and technical specifications provided in this document cover the Works under the Contract. If the Contractor requires additional specifications for more explicit description of the Works or to supplement the existing specifications, or any other specifications to complete the Works, the Contractor shall propose and submit such additional or supplementary specifications for the approval of the Engineer. All costs incurred for these additional specifications are deemed to be included in the unit rates quoted in the Bill of Quantities.

In this document the term "Engineer" shall be deemed to imply "Engineer's Representative" and vice versa where the context requires.

The apparent silence of the Specifications or Drawings as to any detail, or the apparent omission from them of a detailed description concerning any point, shall be regarded as meaning that good engineering practice, as necessary for a reliable, robust, complete and workable installation, is to be used instead of more specific instructions in the contract documents.

Any sections in this document which relate to materials or workmanship not required by the Contract shall be deemed to be not applicable and ignored by the parties.

2 INTRODUCTION TO KVWSIP (PHASE-2) PROJECTS

The Employer has been executing urban water supply infrastructure development works with the assistance of ADB (under Loan 1820, 2776 and 3255) and other partners, and will be extending infrastructure improvements (including this Contract, the Kathmandu Valley Water Supply Improvement Project (Phase 2)).

The major infrastructure works, completed and on-going, under the past and ongoing loans are:

1. Construction of a 26 km water diversion tunnel (with an ultimate carrying capacity of 510 MLD) to transfer 170 MLD of water to the Kathmandu Valley from the Melamchi River,
2. Construction and commissioning of two water treatment plants (WTPs) with a total treatment capacity of 170 MLD at Sundarijal,
3. Construction of 10 new water service reservoir tanks (SRTs) with a total capacity of 74,500 cum
4. Laying of 77 km of bulk distribution system (BDS) pipelines and 1200 km of distribution network improvement (DNI) pipelines with approximately 110,000 household connections.
5. Installation of a Supervision, Control and Data Acquisition (SCADA) system to control the distribution of water supplied from Sundarijal WTP through a system of Bulk Distribution Pipelines and Service Reservoir Tanks and Control Valves.

The Employer with own financing of Government of Nepal is implementing major infrastructure works under the next phase of the Kathmandu Valley Water Supply Improvement Project (KVWSIP) for the construction of:

6. Additional 11 km BDS Transmission Main from Sundarijal to augment the transmission line capacity from 222.5 MLD to 510 MLD,
7. Construction of 3 new water service reservoir tanks (SRTs) with a total capacity of 21,500 cum
8. Laying of 776 km of distribution network improvement (DNI) pipelines with approximately 60,000 household connections.

Kathmandu Valley Water Supply Improvement Project (Phase 2) is a continuation of ADB's support to improve the Valley's water supply system within an overarching consistent, coherent, and cohesive phased investment strategy that sequentially addresses the underlying causal deficiencies of water insecurity and

aims to ensure drinking water security in the Kathmandu Valley and expand water supply services to an additional 0.57 million people (2050) outside the core area of the Valley.

The Government of Nepal acting through the Ministry of Water Supply (MWS) will be the executing agency and Project Implementation Directorate-KUKL (PID-KUKL) will be the implementing agency overseeing the development initiatives for the said ADB project.

Details of the Distribution Network Improvement (DNI) improvement have been considered for the following areas under Kathmandu Valley Water Supply Improvement Project (Phase 2):

Sl. No	DNI ID and Description		Municipal Areas Covered
1	Contract No.: PID/SKV/DNI1-Bhaktapur	Bhaktapur	Bhaktapur, Suryabinayak
2	**Contract No.: PID/SKV/DNI2- Kirtipur**	**Kirtipur**	**Kirtipur, Nagarjun, Kathmandu Mahanagarpalika**
3	Contract No.: PID/SKV/DNI3-MadhyapurThimi	Thimi	Madhypur Thimi
4	Contract No.: PID/SKV/DNI4- Kapan and Jorpati north	Kapan and Jorpati-North	Kathmandu Mahanagarpalika, Budhinakantha
5	Contract No.: PID/SKV/DNI5- Jorpati South and Pepsicola	Jorpati-South and Pepsicola	Gokarneshwor, and Kathmandu Mahanagarpalika

3 EXISTING CONDITIONS

3.1.1 CONTRACT AREA

The Contract area is the Municipality of Kirtipur, Nagarjun and Kathmandu Mahanagarpalika, Kathmandu District in the Bagmati Province of central Nepal. Kirtipur is ancient city with Newars as the natives residence. It is located in the Kathmandu Valley 5 km south-west of the city of Kathmandu. It is one of the five dense municipalities in the valley.

3.1.1.1 CLIMATIC CONDITION

The Contractor shall take account of the climatic conditions at the Site.

The following information is provided as a guide to the climatic conditions likely to be encountered on the Site to assist the Contractor both in the supply of all plant, materials and equipment and the construction of the Works. This shall not relieve him of any of his responsibilities under the Contract.

3.1.2 Monthly Average Temperature

In the Kathmandu Valley, the average high summer temperature varies from 28 to 30 °C. The average low winter temperature varies from 2.5 to 10 °C.

3.1.3 Extreme Temperatures

37°C in May and -3.5°C in January.

3.1.4 Annual Average Rainfall

1502 mm per year, the majority falling in the monsoon months of June to September.

3.1.5 Monthly Average Relative Humidity

Maximum 85% (November) and Minimum 53% (April)

The Contractor shall satisfy himself as to the accuracy of the above climatic data which are stated here only for reference purpose.

3.1.6 TOPOGRAPHY

Elevations in the project area is about 1300m to 1350m from MSL.

3.2 TRANSPORTATION FACILITIES

Road alignment and surface types are shown on the Drawings. Access ways such as footpaths are not shown in the drawings. Footpaths for which pipelines will be laid shall be surveyed by the Contractor. Most of the roads in the project area are surfaced with asphalt (black top). Other road types are brick, block, concrete, earth and gravel.

3.2.1 OTHER FACILITIES AND UTILITIES

Other facilities and supplies such as: electric power, telephone and other communications, water and sewer systems in the Contract area are not shown on the Drawings, but are available with the respective utilities for the Contractor's information.

3.2.2 OTHER DATA AVAILABLE WITH THE EMPLOYER

All relevant data available are included as of part of this document. Information and data not available here can be collected from respective sources/authorities by the contractor, if necessary.

4 SCOPE OF WORKS

The study area encompasses ward no 1,2,3,9,10 of Kirtipur , some part of ward 14 of Kathmandu Metropolitan City and Nagarjun 10, totaling 176.488 hectares. The Kirtipur area has been divided into 4 different Water Management Units (OMU), each supplied from a specific reservoir:

- OMU-1: The area will be supplied from a new Overhead Tank (OHT) to be built near the existing Kirtipur reservoir. Water supply will be gravity-fed.
- OMU-2: The area will be supplied by gravity from the existing Kirtipur reservoir.
- OMU-3: The area will be supplied by gravity from a reservoir to be built in Kwacho.
- OMU-4: The area will be supplied by gravity from the existing Lyaku reservoir.

The base of the design was taken for 2025 and design horizon for the study is taken as 2050. Therefore, 25 years of the projection is taken as per the population projection and demand.

The main construction elements to be executed in this project are:

- Construction of a pipeline network of 47.07 km, of which 1.90 km correspond to the primary network with diameters ranging from 400 mm to 350 mm. Distribution networks diameters ranging 75 mm to 315 mm.
- Division of the supply area into 4 Outlet Management Units (OMUs) and 6 District Metering Areas (DMAs), with the aim of optimizing network efficiency, controlling leakages and illegal connections, as well as monitoring and controlling the areas from the Employer's SCADA system and automated pressure regulation in the network.

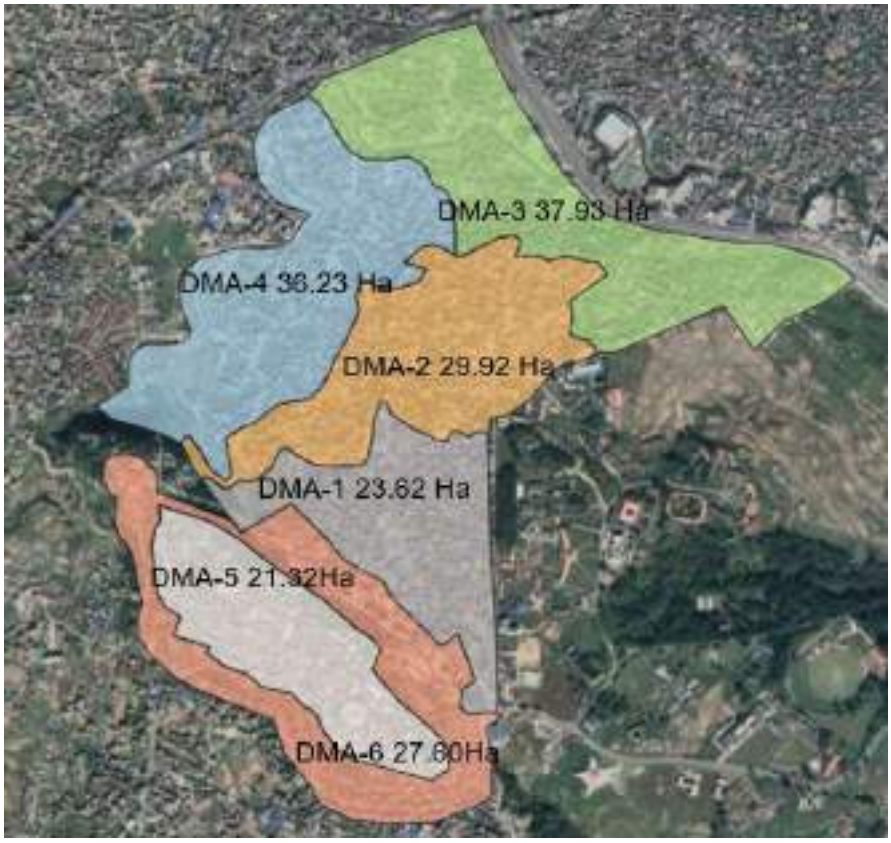


Figure 1Location of designed OMUs

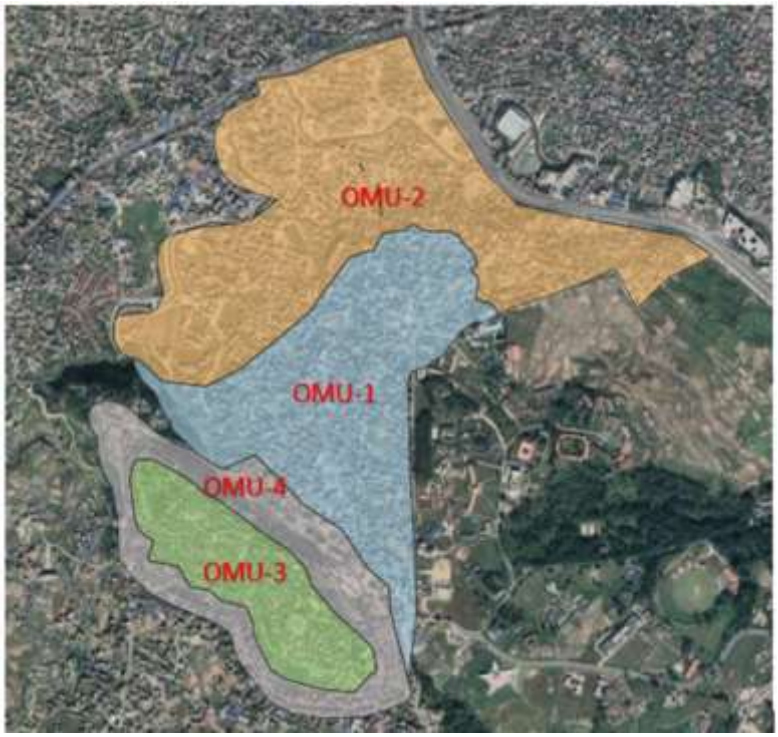


Figure 2: OMUs of the study Area.

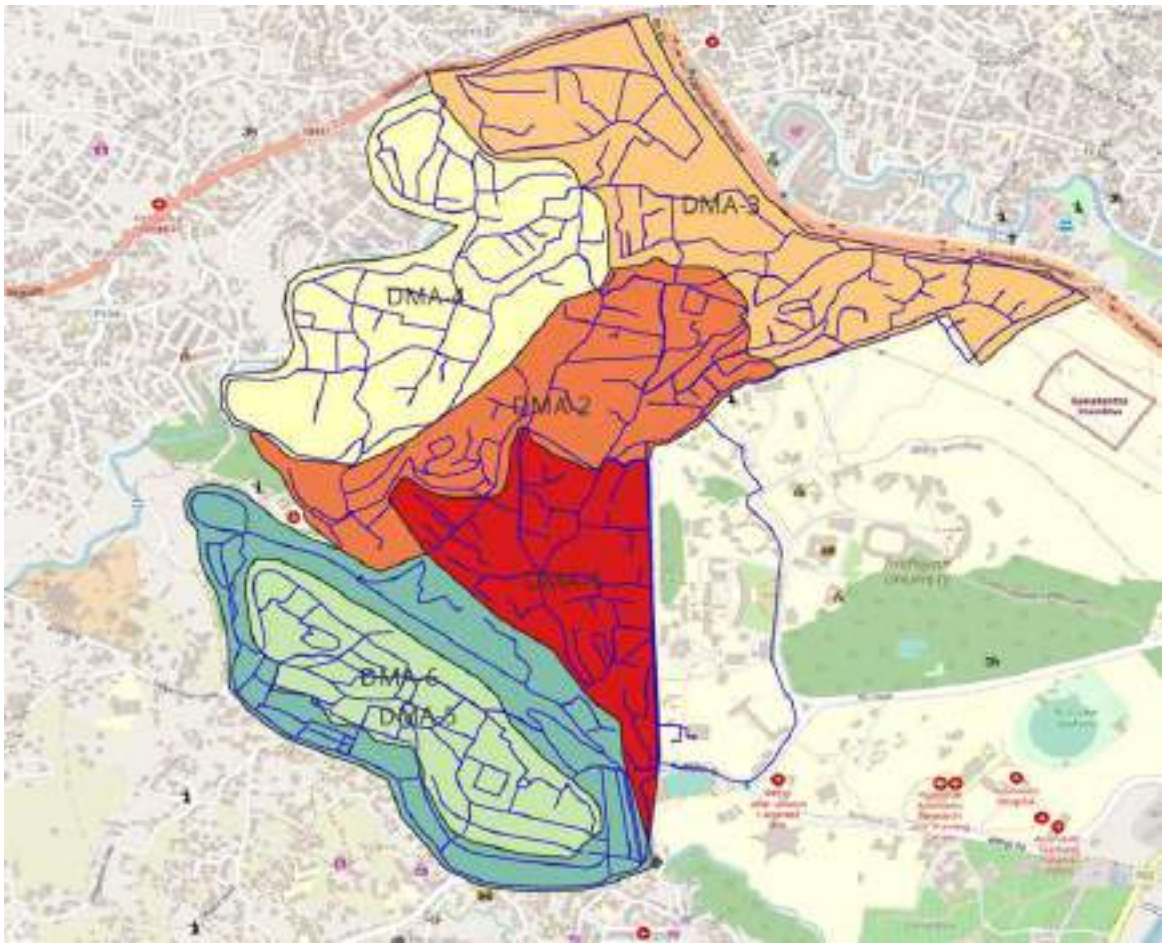


Figure 3: DMAs of the study Area.

- A new overhead water storage tank (OHT) with a capacity of 1500 m3will be built near the existing Kiritpur SRT. This tank will supply DMA-1 and DMA-2. Water will be pumped from the existing Kirtipur tank to this new tank.
- A new SRT reservoir with a capacity of 400 m3will be built near of Uma Maheshwor Temple. This tank will supply DMA-5. Water will be pumped from the existing Kirtipur tank to this new tank.
- A new pumping station will be constructed in the vicinity of the existing Kirtipur reservoir. This station will pump water to the OHT, Kwacho reservoir, and the existing Lyaku reservoir. It is included in the scope the electrical supply of this pumping station.
- Installation of 74 hydrants with different diameters: 100 mm, 80 mm y 50 mm.
- Installation of 6 ARVs (Air Release Valves) in the primary network and some points in the distribution network.
- Installation of 6 flushing points in the primary network and 25 in the distribution network.
- Installation of 83 isolated valves in the secondary network.

- Installation of 4 Pressure Test Points in each District Metered Area (DMA), monitored by the SCADA
- Installation of approximately 8,233 metered consumer connections.

Following completion and commissioning of the above works the Contractor will provide System Stabilization Services for 12 months for each Section of the Works.

4.1.1 SUCCESS FACTORS OF THE WORKS

The success factors of the Contractor's Works will be:

- That the pipelines and service connections and all other contract associated works are installed as per Quality Control Plan and pressure tested successfully in sections.
- That the pumping station's earthworks, concrete, mechanical and electrical works are executed as per Quality Control Plan and commissioned successfully.
- That each DMA is hydraulically isolated in the design/construction.
- That real losses are below an average of 100 liters per connection per day with any pressure adjustment (as detailed out in Section VI-C, Item 3.5.5 on Functional Guarantee tests).
- Transmission of all signals and data from OMUs and AMUs and incorporation into the existing overall SCADA system for Kathmandu Water Supply Improvements, in cooperation with KUKL's SCADA operator.
- Reliable implementation of System Stabilization Services

The Contractor's Works are expected, as a minimum, to comprise the following steps:

a) Verification survey and preparation of Working Drawings

b) Pipe works

- Supply and Install pipelines with required specials as per approved working drawing, according to selected method approved by the Engineer (Open Cut Excavation or (HDD) Horizontal Directional Drilling for specified sections)
- Supply and Install bulk meters and valves at all needed cross connections between DMAs.
- Sectional pressure and leakage testing.
- Cleaning and Disinfection of pipelines

c) Service Connections

- Supply and Install HH service connection at each required location.
- Connect the service connection with the water pipes, using new materials.
- Supply and installing revenue water meter at each service connection.
- Pressure testing of each service connection along with the distribution pipelines

d) Maximum Real Losses Requirements

- DMA 24-hour Full hydraulic pressure and disinfection testing.

e) Other Works

- Necessary traffic diversion / monitoring works during construction.
- Implementation of all safety aspects during Construction and environmental safeguards as per requirements
- Restoration of excavated roads according to given requirements.
- Repair/replace other utility lines in case they are damaged during the work at Contractors cost

- Provide alternative sources of water at Contractors cost for people while being disconnected from water supply system during the implementation.
- Authority coordination for all contract works.

f) Pumping Station:

- Execution of earthworks with all needed slope protection measures
- Execution of structure concrete works according to Quality Control Plan and approved method Statements.
- Execution of mechanical and electrical works according to Quality Control Plan and approved method Statements.
- Successful commissioning and operation of the facility.

g) SCADA Works

- Installation of necessary devices and transmission of all signals and data from OMUs and AMUs and integration into the overall SCADA system for Kathmandu Water Supply Improvements, in collaboration and cooperation with KUKL's SCADA operator.

h) System Stabilization Services

- Implementation of System Stabilization Services as per Section VI-D of the Employer's Requirements.

4.1.1.1 MAIN ACTIVITIES IN THE PACKAGE

- Commencement of works
- Survey of Service Area and Prepare Working Drawings
- Prepare Work Schedule
- Prepare all construction phase Plans requested in this document
- Construction and installation of facilities
- Testing of facilities
- System stabilization services
- Reporting of activities as requested in this document
- As built drawings and GIS Data Base submittal
- Obtain Completion Certificate
- Defects Liability Period

4.1.2 TASKS OF THE CONTRACTOR

The activities to be undertaken by the Contractor within this Contract include, although are not limited to, the following:

- To carry out all necessary topographic surveys, soils investigations, laboratory analysis or related investigations where necessary to supplement the data provided by the employer.
- To undertake all steps necessary for temporary way leave facilities and/or upgrading of roads, all related to access to the Site, or other related matters, where in his opinion differ significantly from those produced by the Employer.
- To take all steps necessary for the temporary or permanent diversion of existing services and the maintenance of services during the execution of the works, including diversion of overhead power lines, water supply lines, sewers and other underground services encountering at site.
- To supply all pipes, valves, fittings, appurtenances and other materials and equipment required for construction of the works. The Contractor's supply items for the installation may include manufacture, testing, collection, transportation and delivery to Site. The Contractor will be responsible for ensuring

that all procedures are adequately covered and that the materials fully conform to the Contract requirements. These responsibilities will include all necessary charges or dues related to insurance, freight, taxes (including customs and excise duties, surcharges etc.) and all testing and inspection for quality control.

- To provide necessary Contractor's personnel and workmen (including all necessary specialists, operators, tradesmen, artisans etc. in addition to semi-skilled and unskilled workers) necessary for execution of the Works through to completion and for commissioning/trial run and defect liability period. Where appropriate, the Contractor shall provide all suitable facilities and accommodation for the personnel and workmen and he shall make provision for all costs related to such provision and for medical, re-location, taxes or other expenses.
- To provide electrification of all valves with electric actuators, OMUs, AMUs and electromagnetic flowmeters so that system could be operated/ commissioned by using electric power,
- To provide all equipment, machinery, tools etc. and related spares for maintenance and consumables necessary for implementation of the Works.
- To provide all site offices, stores, workshops and facilities necessary for use by the Employer, Engineer and support staff and for the Contractor himself and his support staff.
- To undertake all operations necessary to complete the works. These operations shall include: excavation, shoring, dewatering, provision for temporary removal of excavated material and bringing it back, haulage and installation of suitable bedding and backfill material and disposal of surplus excavated material; distribution, laying and jointing of pipes; installation of all special pipe work, valves, devices, etc. and construction of all related concrete structures or other activities together with all testing and disinfection of completed Works. The Contractor's attention is drawn to the restricted working space in some parts.
- To complete hydrostatic test construction of laid pipelines, installed fittings, valves, appurtenances and other specials. Disinfection of pipelines should be carried out immediately after completing hydrostatic test.
- To supply & install valves compatible for both manual and SCADA system operations. All electromechanical items should have provision to be compatible for integration with SCADA System proposed in the project for monitoring the parameters and important functions as well as the observations of day-to-day operational sequences and faults etc.
- To provide and connect necessary devices and communication systems for all OMUs, AMUs and electromagnetic flowmeters as necessary to transmit and receive signals and data and integrate into KUKL's SCADA system for the KVWSIP, in cooperation and collaboration with KUKL's SCADA operators.
- To liaise with other contractors on the site and to ensure harmonious co-operation with them so that conflicts are avoided and areas of common interest, construction interface or potential overlaps are addressed without cost to the Employer or delays in completion.
- To carry out all operations and works to the highest safety standards including but limited to provision of all necessary excavation supports, traffic and pedestrian barriers and lighting, personal protective equipment, safety induction training for all persons entering or working at site and toolbox safety talks held weekly and before each new activity to train and emphasis the need for safety.
- To prepare documentary records of the Works in the form of "as- built" drawings and GIS data, schedules etc., and to train staff of the Employer in the procedures for operating laid pipes, valves and fittings.
- To provide System Stabilization Services as elaborated in Section VI-D.

All the above activities shall be performed in a professional way and with good engineering and/or construction practices. Upon completion of the works the scheme shall be fully operational with minimum disruption or inconvenience to interested stakeholders, including landowners, and there shall be no outstanding matters requiring attention.

5 STANDARDS, CODES AND ABBREVIATIONS

5.1 Reference Standards and Codes

The Works shall be carried out in accordance with the relevant quality standards, test procedures, or codes of practice, collectively referred to as Reference Standards, listed in the relevant parts of the Specifications. The applicable issue of any Reference Standard shall, unless otherwise stated in the Specification, be the issue current at the date two months preceding the date for submission of the Bids for the contract.

The Contractor shall familiarize himself fully with the requirements of such standards. If no standard is indicated then the relevant ISO Standard or, in the absence of such standard, the relevant European, British, American, Nepalese or Indian Standards shall apply, or others, if so approved by the Engineer.

The Contractor may propose, at no extra cost to the Employer, the use of any alternative relevant authoritative internationally recognized Reference Standard which shall be no less exacting, in the opinion of the Engineer, than the corresponding standard quoted in the Specification. The Contractor shall demonstrate to the Engineer that the alternative standard is suitable and equivalent to the specified standard, as well as provide proof of previous successful use. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. The Engineer shall decide whether or not the use of such alternative will be allowed as a Reference Standard.

The Contractor shall obtain and keep on Site at least one copy of each approved Reference Standard and each Reference Standard referred to in the Specifications and will make these accessible to the Engineer at any time upon request.

The Contractor shall obtain the Reference Standards from the addresses given below:

- ISO, International Organization for STANDARDIZATION, Rue de Verme, Geneva, Switzerland
- EN, Publications Office of the European Union, 20, rue de Reims, 2417 Luxembourg, Luxembourg
- BSI, British Standards Institution, 389 Cheswick High Road, London W4 4BR, England
- AASHTO American Association of State Highway and Transportation Officials, Suite 341 National Press Building, Washington, D.C. 2004, U.S.A.
- AWWA, American Water Works Association, 6666 West Quincy Ave. Denver, Colorado.
- NS Nepal Standards, Nepal Bureau of Standards and Metrology, Balaju, Kathmandu, Nepal.
- IS, Indian Standards, Mana Bhawna - 9, Bahadur Shah Jamar Marg, New Delhi, 11002

5.2 Metric Units

S.I. units of measurement shall be used throughout the Contract. All information and data originating in another system shall be transferred by the Contractor into the S.I. system.

5.3 Abbreviations

ABBREVIATIONS OF INSTITUTIONS

AA	Aluminium Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AHA	American Hardboard Association
AI	The Asphalt Institute

AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute, Inc.
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Non-destructive Testing
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BS	British Standards
BSi	British Standards Institute
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DIN	Deutsches Institut für Normung (German Industrial Standards)
DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
EN	European Norm, standard that has been adopted by one of the three recognized European Standardization Organizations (ESOs): CEN, CENELEC or ETSI
EPA	Environmental Protection Agency
FM	Factory Mutual System
GON	Government of Nepal
HPMA	Hardwood Plywood Manufacturers Association
IEC	International Electro Technical Commission
IEE	Institution of Electrical Engineers
IEEE	Institute of Electrical and Electronics Engineers
IS	Indian Standard
ISA	Instrument Society of America
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization

ITE	Institute of Traffic Engineers
KUKL	Kathmandu Upatyaka Khanepani Limited (Water Utility Operator in Kathmandu)
KVWSMB	Kathmandu Valley Water Supply Management Board
MSS	Manufacturers Standardization Society
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards (Now NIST)
NEA	Nepal Electricity Authority
NEC	National Electrical Code (USA)
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association (USA) or National Fluid Power Association or National Forest Products Association
NISO	National Information Standards Organization
NS	Nepalese Standard
NWMA	National Woodwork Manufacturers Association
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RCRA	Resource Conservation and Recovery Act
RMA	Rubber Manufacturers Association
RWMA	Resistance Welder Manufacturer's Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPR	Simplified Practice Recommendation
SSA	Swedish Standards Association
SSPC	Society for Protective Coating
SSPWC	Standard Specifications for Public Works Construction
TIA	Telecommunications Industries Association
TPI	Truss Plate Institute
UBC	Uniform Building Code
USCS	Unified Soil Classification System
VDE	German Association of Electrical Engineers
WEF	Water Environment Federation

OTHER ABBREVIATIONS

BOQ	Bill of Quantities
CBR	California Bearing Ratio
cm	Centimetre
cum	Cubic Meter
DCI	Ductile cast iron
DI	Ductile iron
dia	Diameter
DN	Nominal Diameter
FGL	Finishing Ground Level
FRP	Fiberglass Reinforced Plastic
GRP	Glass Reinforced Plastic
km	Kilometre
m	Meters
m^2	Square meters
m^3	Cubic meters
mm	Millimetres
MPR	Monthly Progress Report
MS	Mild Steel
OD	Outer diameter
OMC	Optimum Moisture Content
OPC	Ordinary Portland Cement
pcs	Pieces
PE	Polyethylene
PI	Plasticity Index
HDPE	High Density Polyethylene
PN	Pressure, nominal
PVC	Polyvinylchloride
RC	Reinforced Concrete
SDR	Standard dimension ratio
Sqm	Square meters
STD	System Test Pressure

5.4 Measurement and Payment

In general, no separate measurement and payment will be made for items provided under SECTION VI-A: GENERAL REQUIREMENTS and SECTION VI-B: PARTICULAR REQUIREMENTS, the cost of which shall be deemed to be included in the rates of the BOQ, unless there is a specific BoQ rate related to the item described in these documents as to be measured and paid independently, or if it is otherwise specified in other Contract Documents with prevalence over this document.

6 FACILITIES FOR THE ENGINEER

6.1 Engineer's Site Office

The Contractor shall provide, furnish, equip and maintain, for the entire construction period, site offices for the sole use of the Engineer's site staff. The location of the office shall be approved by the Engineer. Basic construction details and dimensions shall generally conform to local building standard or as approved by the Engineer. The site office may be mobile, semi-mobile or hired permanent building forming a single block.

Each site office shall have an internal area of at least 60 m2, a ceiling height of at least 2.5 m and shall have at least, 2 office rooms (each having not less than 13 m2), a conference room (not less than 16 m2), a kitchen and a toilet. The layout of the site office and the sizes of the individual rooms shall be agreed upon between the Engineer and the Contractor. The Contractor shall submit proposals for the site office within 14 days of the issue of the Notice to Commence or whenever requested by the Engineer.

Each office room in these site offices shall be weatherproof, shall have a floor that is at least 200 mm above the ground, and shall be provided with a ceiling and a lining to the walls, or equivalent insulation, with an acceptable type of door with a secure lock, and two opening windows of glazed area at least 6 m2. Each office room shall be well ventilated and shall be so insulated as to provide comfortable working conditions. The window frames shall be close fitting and protected by fly screens. Sun blinds shall be provided. A continuous supply of cold water under adequate pressure shall be maintained, either from the public supply or from another source of equivalent standard and shall have drinking water quality. If water has to be provided by tankers to the site office, 2 (two) storage tanks (1 ground tank of at least 3 m3 and 1 roof tank of 1 m3 capacity including booster pump) shall be provided and connected to the piping of the site office. A suitable drainage system with septic tank or otherwise shall be provided. Each site office shall be provided with an AC and heat pump, and fluorescent lighting and shall have at least 3 no. 13 Amp power sockets in each room of these offices. The contractor shall provide and maintain a standby generator or power backup system of adequate capacity, in addition to the public power supply. Each site office shall have a telephone connected to the public system. Each site office shall have broadband internet connection. The telephone and internet shall be available for use by the Engineer at all times. The site offices shall be fully furnished to the satisfaction and approval of the Engineer including curtains and door mats. The following set of new furniture/appliances shall be provided in each site offices:

a. 5 nos. tables or desks with lockable drawer
b. 5 nos. chairs with arm
c. 1 nos. conference table with chairs for eight persons.
d. 2 nos. steel cabinet with drawers for storage of large size drawings.
e. 2 nos. pin boards each 3m2
f. 1 nos. sink unit, stainless steel, with adjacent kitchen bench unit g. 1 nos. water filter, 5 ltr.
g. 1 nos. electric hot plate or gas burner
h. Kitchen ware, cutlery, etc. for 8 persons
i. 3 nos. portable dry-powder fire extinguisher
j. 1 set of First-aid-kit

k. 1 number of maximum-minimum thermometers

6.1.1 Office Equipment to the Engineer

The Contractor shall provide the following set of new equipment for each site office of the Engineer:

a) 2 Nos. Desktop Computer, and 2 Notebook Computer, with the following specifications (At least with following details or higher version - advance version will be acceptable):

- Core- i7 processor (4.0 GhZ)
- 12GB RAM
- NVIDIA Graphics
- 1 TB HD
- Licensed Windows 7 Professional OS or higher version
- Licensed MS Office 2013 or higher version
- Latest Anti-virus software, valid for 3 years
- Latest AUTOCAD software (for one unit only)
- Latest MS Project software (for one unit only)
- 18" Monitor for Notebook Computer and 27" Monitor for the Desktop Computers (or higher version)
- 750 VA Uninterrupted Power Supply (UPS)
- Digital Camera with Minimum 24.1 megapixel.

b)1 Nos. A3 Laser Jet Printer, automatic paper feeder with paper tray, and minimum 30 ppm

c) 3 Nos., 32 GB USB Data Stick

d) 2 Nos., Hard portable drive

6.1.2 Office Stationery to the Engineer

The Contractor shall provide adequate consumable items in each site office during the duration of the contract. Following is the general requirements (but not limiting) of the site office:

a. Supply of field and level books
b. Supply of items as paints, concrete and wooden and steel pegs
c. Supply of hammer, axes, nails
d. Supply of millimeter papers, pencils, erasers, note pads
e. Supply of photocopying paper A4 and toners
f. Supply of dot pens, sign pens, marker pens, cello tapes, glues and gums
g. Supply of stapler machines and pins, paper clips, punching machines
h. Supply of index files, ring files, and cardboard files
i. DVDs for data storage
j. Any other office supplies requested by the Engineer
k. Supply of purified mineral water

Each office building shall be ready for occupying and all the equipment provided within 14 days after the Engineer's approval.

Each site office and equipment shall become the property of the Contractor upon completion of the Contract and shall be removed from the Site.

The Contractor shall supply and erect, at approved locations, name boards in Nepali and English approved by the Engineer, giving a description of the Project as well as names and titles of the Employer, Engineer and

Contractor as ordered or as shown on the Drawings. The Contractor shall keep the name boards in good repair for the duration of the Contract and shall remove them on completion of the Contract.

6.2 Survey Equipment and Field Assistance

The Contractor shall make available all the survey equipment as required by the Engineer for the verification of any topographical need of the permanent or temporary works in the contract.

All equipment shall be supplied with their tripods, staff and such other equipment/item as the Engineer's Representative may require for the measuring or setting -out of the work.

The Contractor shall be solely responsible for the maintenance of all such instruments and equipment and shall ensure they are, at all times, calibrated, in good repair and adjustment. All equipment other than expendable items shall revert to the Contractor upon completion of the works.

The Contractor shall provide the Engineer, throughout the Contract period, with all necessary surveyors, assistants and chainmen to assist with surveying work. The assistant shall keep the survey equipment in good order.

This assistance will not be paid separately, and it is deemed to be included in the rates of the BOQ, as there is not a specific BoQ rate related to this item.

6.3 Vehicles for the Engineer

The Contractor shall lease or rent, maintain and make available to the Engineer and his team, vehicles (two-wheeler motorbikes and double- cab pickup). The numbers and months required for the vehicles shall be as per the BOQ. Unless and otherwise mentioned in BOQ, the motorbikes and pickup vehicles shall conform to the following:

Two-wheeler Motorbikes

Criteria	Specifications/Requirements
Engine	At least 2025 AD model or new 4-stroke, air-cooled, single cylinder, displacement: 150 cc (approximate), max. net power (7000-8000 rpm), 4-speed constant mesh
Suspension	Telescopic fork (front), adjustable spring-loaded hydraulic shock absorbers(rear)
Dimension	Ground clearance: minimum 165 mm; wheelbase: 1265 to 1320 mm
Starting	Self/electric and kick start
Brakes	Disc type or mechanically expanding drum type (front); mechanically expanding drum type(rear)
Fuel tank capacity	Minimum 10 liters with minimum of 1.2 liters capacity(approximately)in reserve

Pick-up Vehicles 4x4

Criteria	Specifications/Requirements

Engine	At least 2022 AD model or newer model or new turbo diesel with intercooler, 4 cylinders in- line, common rail piston displacement, 2200 cc minimum; min 270 Nm of torque, fuel type: diesel;
Transmission	5 speed manuals shifted five forward and one reverse; change over system from 2WD to 4WD (part time 4WD)
Chassis/Suspension	Front: double wishbone type with coil springs/torsion bar, gas-filled shock absorbers and stabilizer bar. Rear: leaf spring type rigid axle with gas filled shock absorbers 265/65 R17 Tires/Alloy Wheels
Steering	Power-assisted rack and pinion
Brakes	Front: ventilated discs. Rear: drums

The Contractor shall provide drivers for the pickup vehicles. For both pickup and motorbikes, the Contractor shall provide comprehensive insurance, fuel and lubricants, regular maintenance and service, etc., including immediate replacement vehicle when needed.

The vehicles must be deployed for at-least 1300km a month, and paid on a monthly basis. Pro-rata measurement shall be applied, incase vehicles are available for less than 1300km. However, for more than 1300km a month the costs shall be deemed to be included in the monthly rate.

6.4 Site Safety Equipment for the Engineer's Team

The Contractor shall provide the Engineer and his team with the PPEs safety equipment set listed in the OHS Plan and Policy Clause below, in each site office, at his own cost.

The Contractor shall replace each item after it wears out and becomes unsuitable for use.

7 PROVISION AND MAINTENANCE OF SITE INSTALLATIONS

7.1 Labor Camp for Contractor's Staff

The Contractor shall provide adequate temporary accommodation with all necessary amenities and facilities for his staff and labor. The location and type of accommodation whether pre-fabricated or in-situ buildings or rental is the Contractor's choice.

During the whole period of existence, from setting up through operation to final removal upon completion of the Works, the Contractor shall be fully responsible for constantly carrying out all measures necessary for safeguarding the natural environment affected by his camp or camps.

It shall cause the least possible interference with existing amenities, whether man-made or natural. No trees shall be felled except as authorized by the Engineer.

Latrine and ablution facilities and first-aid services shall be provided in sufficient type and numbers to the satisfaction of the Engineer and shall be maintained in a clean and sanitary condition at all times.

The general requirements for the labor camp are:

- Labor camps must be located such that it is < 30 degree of cross slope and 300 ft. away from any natural water course, swamps, pools, sink holes and/or other surface water collection bodies.
- Every shelter in the camp must be constructed on a stable foundation and in a manner, which will provide protection against the elements of nature, theft and or wild animals.

- Campsite must have suitable accessible road. The grounds and open areas surrounding the shelters must be maintained in a clean and sanitary condition free from rubbish, debris, wastepaper, garbage, or other refuse.
- There should be a clear separation between the camp and construction area through footpath, fencing.
- Labor camps must have adequate welfare and sanitary facilities such as toilets, bathrooms, potable and sufficient drinking water facilities.
- Campsite must be adequately drained and not be subjected to flooding, and or shouldn't pollute any domestic or public water supply.
- Campsites must not be located in community forest designated areas.
- Each Camp Site shall have printed table (in A3 Paper) being plastic laminated and pasted in the main entrance door with at least following details: Room No., Name of worker, Gender, Age, mobile number, Permanent Address, Next to kin Name and contact number, date of deployment. In addition, Nepali translated table of above being plastic laminated should be pasted in door of the room in which camp in charge lives.
- Space requirement for every person living in the camp shall not be less than 50 sq. ft. - for 20 persons' the camp shall not be less than 1,000 sq. ft. per person.
- Separate sleeping arrangements must be provided for female workers and workers with spouses. They should not be kept in the same room as the rest, a separate room should be provided to them.
- Separate rooms for sleeping, cooking, dining and storing equipment must be provided.
- Not more than 8 workers should share a room. There should be mobile partitions or curtains to ensure privacy
    - Minimum floor space for each person in the sleeping area must not be less than 30 sq. ft. per person.
    - A camp in charge must be appointed to monitor all activities within the camp and be responsible for maintaining the hygiene, safety and fire standards within the camp.
    - Uniform boundary fencing, such as plain post and wire, or colored steel sheet on iron frame must be around the property boundary with appropriate security measures.
    - Portable fire extinguishers, fire grenades or fire buckets, clearly marked must be made available at readily accessible locations.
    - An emergency evacuation plan must be in place and all workers residing within the camp must be made aware of it. Residents of the camp should be aware of the evacuation plans and the emergency assembly points.
    - Where possible the worker's accommodation should be close to the work site so that they do not spent undue amounts of time travelling to their worksites.
    - Recreational and personal belonging storage facilities must be provided for all workers.

On completion of the Works or as soon as the facilities provided by the Contractor are no longer required, the Contractor shall remove such facilities and clear away all surface indications of their presence. Each camp area shall be reinstated to the satisfaction of the Engineer.

7.2 Contractor's Offices, Stores and Services

The Contractor shall provide at his own cost, erect, construct, maintain, and subsequently remove proper offices, stores, workshops, laboratories, storage, and parking areas for his own use. Such facilities shall be sufficiently sized and equipped to enable him to manage his operations and those of his Sub-contractors in a professional manner and to enable him to carry out all his obligations under the Contract.

Sheds for storage of materials that may deteriorate or corrode if exposed to the weather shall be weatherproof, adequately ventilated and provided with raised floors. No material or equipment shall be placed directly on the ground.

Within his offices, a meeting room shall be available for site meetings with the Engineer and the Employer. These Contractor's facilities shall be subject to the same stipulations regarding sitting, interference with amenities and environmental protection as the Contractor's camp.

7.3 Preparation of the temporary Stockyard in the Site of Sub-project

The preparation of the stockyard for pipes, valves and fittings shall include:

a) Clearance of the Site
b) Construction of side drains around the stockyards to avoid water logging
c) Construction of access tracks
d) Covering of construction material
e) Erection of a security fence
f) Construction of a guard house / storekeepers office

7.4 Contractor's Construction Equipment

When working in built-up areas, the Contractor shall provide and use suitable and effective silencing devices for pneumatic tools and other Equipment that would otherwise cause a noise level exceeding 85 dB (A) during drilling, excavation and other work. Alternatively, he shall, by means of barriers, effectively isolate the source of any such noise in order to comply with above requirement.

7.5 Water Supply

The Contractor shall make his own arrangements for the supply of water for his camp, office and other temporary buildings as well as for the execution of the Works.

Temporary water connection may be arranged with nearby local system if any exist, at established rates. When using other sources of water such as stone spouts, etc. the Contractor shall have due regard to and coordinate with other users, particularly with the local communities.

Water for drinking purposes shall be of drinking water quality, and shall be tested for proper disinfection.

7.6 Sanitation

The Contractor shall maintain the Site and all working areas in a hygienic condition. In all matters of health and sanitation he shall comply with the requirements of the local Health or other competent authority.

7.7 Sewage and Waste Disposal

The Contractor shall make provision for the discharge or disposal of from his camp, offices, and the Works of all wastewater as well as of all liquid and solid waste products however arising. The methods of disposal shall be to the satisfaction of the Engineer and of any authority or person having an interest in any land or watercourse over or in which water and waste products may be so discharged, and shall not in any manner be disposed of untreated to the environment.

7.8 Energy Supply

The Contractor shall install, operate, maintain and subsequently remove temporary supplies of electricity for power, heating, cooling, lighting and ventilation of all camps, offices, stores, laboratories and other

temporary buildings used by the Contractor in addition to all electricity requirements in connection with the construction, testing and Defects Correction of the Works.

The Contractor shall ensure that all proposed electrical installations comply with the requirements of the Nepal Electricity Authority and shall be responsible for and shall bear all costs associated with obtaining the written approval of that authority for such installations and their operation.

Prior to placing orders for transformers, conductors, cables and associated equipment, the Contractor shall ensure by enquiry with the Nepal Electricity Authority that his proposed equipment is suitable for use with the existing or proposed medium/high tension electricity supply lines.

7.9 Pollution

The Contractor shall take all reasonable measures to minimize any dust nuisance, sound pollution, pollution of streams and inconvenience to or interference with the public (or others) as a result of the execution of the Works. These measures shall be properly stated in the Environmental Management Plan, but shall be carried out as well if not properly described in the same.

7.10 Supply of Fuel, Lubricants, etc.

The Contractor shall be responsible for arranging and ensuring that adequate supplies of petrol, diesel oil, motor oil, kerosene, lubricants and other petroleum products are available at all times to meet his requirements for the purpose of or in connection with the Contract; the Contractor's particular attention is drawn to this requirement as from time-to-time shortages and interruptions in the supply of fuel oils, etc., may occur.

The Contractor is required to store fuel to cover a minimum of 28 days of its requirements. It should provide additional stored fuel if supply conditions require so.

The Contractor is not allowed to purchase and use firewood.

With regard to the transportation, storage and handling of all his fuel requirements, including all electrical connections, he must strictly comply with all relevant safety codes and regulations.

Particular care is to be taken to avoid pollution due to spillage of fuel and oils. They shall be stored within a bounded area, all equipment drive by diesel or petrol engines shall be installed on a drip tray, waste oils shall be disposed of in a proper manner.

7.11 Temporary Telephone and Internet Connections

The Contractor shall arrange at his own cost for temporary telephone and internet connections to his offices, Engineer’s offices and other installations.

He shall be responsible for all installations, connection and disconnection charges for his and his Representative's offices.

7.12 First Aid

The Contractor shall make his own arrangements for treatment of casualties on the Site. First-aid kits or units shall be provided. The Contractor shall be responsible for the construction of such first-aid units and their management and operation and rapid removal by ambulance of injured or sick employees to nearby hospitals. The first-aid service shall cover the Contractor's own personnel as well as that of the Employer, the Engineer, and all Sub-Contractors while working on the Site.

First aid kit shall be ensured at least one unit for each for following locations: Engineer's site office, Labor camps (multiple), Active work sites (multiple). Each First aid kit shall include, but not limited to, following: Adhesive Bandages – 5 Nos, Sterile Gauze Pads (small and large), Adhesive Tape – 1 Nos, Antiseptic Cream or Solution - 2 Nos, Cotton Swabs, Eye Wash Solution – 1 Nos, Elastic Bandages for sprains – 2 Nos, Burn Dressing or Gel – 1 Nos, Scissors, Tweezers, Medical Gloves, Infrared Thermometer (Micro life or better brand), Paracetamol – 20 Tabs, Ibuprofen – 10 Tabs, Digene – 15 Tabs, Pantoprazole – 10 Tabs, Oral Rehydration Salts (ORS) – 10 packets, First Aid Manual (in Nepali) with contents acceptable to Engineer, Emergency Contact Numbers, Spiral pad and Pen.

7.13 Fire Protection

No naked fire shall be used by the Contractor on or about the Site without the permission of the Engineer in writing. If in the Engineer's opinion the use of naked fire may cause a fire hazard, the Contractor shall at no extra cost to the Employer take such additional precautions and provide such additional fire-fighting equipment as the Engineer considers necessary.

The term "naked fire" shall be deemed to include electric arcs and oxyacetylene or other flames used in welding or cutting metals.

Compliance with the requirements of the Engineer shall not relieve the Contractor of any of his obligations under the Contract.

7.14 Contractor's Canteen

The Contractor shall provide adequate healthy eating facilities for his employees and workmen.

7.15 Testing Facilities, Laboratory

Testing of materials for backfilling, compaction and for items such as concrete structures, shall be carried out by a site laboratory established and allocated exclusively for that purpose, all testing shall be carried out by the Contractor's Senior Materials Engineer under the direction and supervision of the Engineer's staff. All tests shall be performed in strict accordance with the appropriate Indian Standards or other standards as approved by the Engineer.

The Laboratory shall be adequately staffed by the contractor with materials laboratory technicians and assistants in the numbers deemed necessary by the Engineer so that no interruption of unnecessary delay shall occur to construction activities due to delays in sampling or testing, in-site or in the laboratory, as required by the Contract. The testing equipment provided in the laboratory shall be sufficient to carry out the following tests;

- Modified Proctor compaction tests
- Field Density tests using core cutter and sand replacement methods
- Crushing strength of 150mm size concrete cubes.
- Sieve analysis
- Asphalt density test using core cutter

Alternatively, the contractor can get the testing done in an approved laboratory as agreed to by the Engineer. If in case the tests are to be done in an approved laboratory, such an approval shall be obtained from the Engineer within 15 days of commencement of Contract.

Any testing relating to the Works as required by the Engineer which cannot be carried out in the site laboratory or in the approved external laboratory shall be carried out, at an independent laboratory approved by the Engineer at contractor's cost.

The name and qualifications of independent testing laboratories shall be submitted to Engineer for approval no less than 28 days prior to the date the laboratories are to be used. Once approved, dismissal and replacement of the approved independent testing laboratory shall require written authorization by the Engineer.

The Contractor shall be responsible for the sampling, curing, and transport to the laboratories of all materials for testing, and all testing costs including laboratory fees, and/or all costs in running the on-site laboratory, i.e., chemicals, reagents, and other test consumables, staff, and utilities.

The provision of laboratory facilities on site, as specified, shall in no way relieve Contractor of the responsibility for providing additional laboratory space and testing equipment as necessary in order to control materials at mixing plants and elsewhere and enable him to fulfill his obligations under the Contract.

The Contractor shall provide, furnish, equip, keep clean and maintain to the satisfaction of the Engineer a laboratory building of a floor area not less than 30sq.m. The building shall be provided with electrical power, potable water, drainage, and shall have adequate daylight and artificial lighting.

The Contractor shall, at the Commencement of the Contract, submit a detailed list of the equipment he is proposing to provide showing for each item its type and model, serial number, manufacturer's name and year of manufacture for the Engineer's approval.

The testing of the works by the Engineer, in no way, absolves the Contractor from his responsibilities to carry out his own testing of the quality of his works and the materials used.

The laboratory building and equipment shall be used exclusively for the purposes for which they are intended and shall, together with all equipment, all samples and records, be open to inspection by the Engineer during all working hours.

After removal of the laboratory the Contractor shall clean and level the site removing all foundations, drain water pipes and other services installed for the laboratory and return the ground to its original condition.

Contractor's QAQC Engineer

The Contractor shall provide full-time QAQC Engineer to be responsible for the day-to-day activities of the laboratory and for site testing. He shall be directly and solely responsible to the Engineer or designated members of his staff. S/he shall have excellent experience of the testing of earthworks and of concrete for structures, and shall be fully conversant with the testing of materials as per latest Indian Standards. The experience and qualifications of the QAQC Engineer shall be to the approval of the Engineer.

Sample

The Contractor shall submit samples of all materials and goods for inclusion in the works to the Engineer and only those approved by the Engineer and to the standards specified elsewhere in the Contract may be ordered for supply. Samples shall be submitted promptly in order not to delay the works.

All work executed shall be of equal standard in all respects to the approved samples and the Engineer may reject any work which, in his opinion, does not comply with the approved samples.

Payment

Unless otherwise stated in the BOQ, there is no pay item for provision of establishment of testing laboratory or testing of materials. Payment for the provision of testing instrument and support service is deemed to be included in the rates for other pay items of the bill of quantities.

7.16 Protection of Overhead and Underground Services

The Contractor will be held responsible for any damage to known services (i.e. overhead services that are visible within the Site and underground services shown on the drawings or found in trial pits) and he shall take all necessary measures to protect them. All work or protective measures shall be subject to approval of

the Engineer. In the event of a service being damaged he shall inform the Engineer and the authority concerned; the Contractor shall not repair any such service unless instructed to do so.

Where no underground services are shown on the drawings or scheduled but the possibility of their presence can reasonably be inferred, the Contractor shall, in collaboration with the Engineer, ascertain whether any such services exist within the relevant section of the Site. The Contractor shall complete such an investigation well in advance of the start of construction work in the said section, with all needed trial pits or any other means, and he shall submit a report in good time to enable the Engineer to make whatever arrangements are necessary for the protection, removal or diversion of the services before any construction activities commences.

As soon as any underground service not shown on the drawings is discovered, it shall be deemed to be a known service and the Contractor will be held responsible for any subsequent damage to it.

It is the responsibility of the Contractor to coordinate any relocation and repair of damage to any utility with the concerned Authority. The Employer and Engineer will help the Contractor with any formal communication, but the responsibility of the coordination is the contractors.

Where the authority concerned elects to carry out on its own account any alterations or protective measures, the Contractor shall co-operate with and allow such authority reasonable access and sufficient space and time to carry out the required work.

Responsibilities of the Contractor in this matter are stated in **SECTION VI-B: PARTICULAR REQUIREMENTS, Appendix D,** but temporary diversions, supports, etc. will be executed at the Contractor's cost.

7.17 Signboards

Signboards of approved sizes shall be placed at each project office site and at both end of each section of the Contract, in English and Nepali, at least following information should be mentioned in each signboard:

a) the name of the Project and section no.
b) the names and addresses of the Employer, the Contractor and the Consultant with contact number.
c) the name and short description of the Project
d) the amount of the Contract Price
e) the starting and completion dates

They shall be of durable construction capable of withstanding the effects of the climate until the end of the Defects Liability Period.

The Contractor shall keep the signboards in good repair for the duration of the contract, replace them if necessary, and shall remove them on completion of the Contract.

In addition, an overhead warning signboard or flex sheet shall be installed with dimensions of at least 2 meters in length and 1 meter in width. The signboard shall be hung/positioned with sufficient vertical clearance to ensure safe movement of vehicles below it. The signboard must provide minimum information of the construction activity and display the following message in a highlighted format: "Working site, possible road blockage, use diversion". The signboard shall be installed at least 24 hours prior to commencement of the work. Its location shall be at the starting point of the branching section leading to the active work section. The Contractor shall ensure the signboard remains securely fixed and legible till the workforce is planned to be at the section. Besides these signboards the Contractor shall not, except with the written authority of the Engineer, exhibit or permit to be exhibited on the Site any other form of advertisement.

7.18 Site Roads, Loading and Turning Areas

The Contractor shall provide and maintain such access to the various sections of the Works as he requires for the proper execution of the work. Existing roads and bridges shall be upgraded for the construction transport purposes, and site roads, loading and turning areas shall be so arranged as to minimize inconvenience to adjoining landowners or occupants and to the general public. The site roads shall be of gravel or equivalent material providing a hard surface for vehicles. Temporary roads, loading and turning areas shall be removed when they are no longer required and the location reinstated to the satisfaction of the Engineer, and damage to existing roads or bridges shall be repaired and reinstated to the satisfaction of the Engineer.

7.19 Site Drainage

The Contractor is responsible for all access roads to all sites and shall keep each Section of the Works well drained until the Engineer certifies that it is substantially complete and shall ensure that, so far as is practicable, all work is carried out in the dry. Site areas shall be kept well drained and free from standing water except where this is impracticable having regard to methods of Temporary Works properly adopted by the Contractor.

The Contractor shall provide, operate and maintain in sufficient quantity such pumping equipment, well points, pipes and other equipment as may be necessary to minimize water flood damage, inconvenience and interference and shall construct, operate and maintain all temporary coffer-dams, sumps, ditches, drains and other temporary works as may be necessary to remove water from the Site while construction is in progress. Such Temporary Works and construction equipment shall not be removed without the approval of the Engineer.

Notwithstanding any approval by the Engineer of the Contractor's arrangements for the removal of water, the Contractor shall be responsible for the sufficiency thereof and for keeping the Works safe at all times and for making good at his own expense any damage to the Works.

The Contractor shall be responsible to keep the Site clear of water at whatever pump rate is found necessary.

The Contractor’s site drainage facilities shall not cause pollution in any local watercourses, he shall be responsible for any legal action resulting from pollution events.

7.20 Cleaning-up of Site

Before application is made for the Employer to accept any substantially completed Section of the Works, all items shall be complete, ready to operate and in a clean condition. All trash, debris, unused building materials and temporary facilities shall have been removed from the Site. Tools and construction equipment not needed during the subsequent Defects Liability Period for repair and adjustment shall not remain on the Site. The temporary walkways, parking areas and roadways shall be completely swept and broom.

7.21 Measurement and Payment

Unless there is a specific BOQ rate related to any item described above as to be measured and paid independently, or if it is otherwise specified in other Contract Documents with prevalence over this document, no separate measurements and/or payment shall be made for all activities/works described under this section (Provision and Maintenance of Site Installations). All the cost associated with this section is deemed to be included in the other item rates of the Bill of Quantities.

8 PROVISION OF TEMPORARY FACILITIES

8.1 Temporary Wayleaves and Access

The Contractor shall be responsible for obtaining temporary wayleaves.

The cost of obtaining wayleaves, including crop compensation, for temporary working areas, additional working easement and for any additional areas, required by the Contractor in connection with the Works as well as for the access to all of these shall be borne by the Contractor himself. The Contractor shall arrange for the serving of any Statutory Notices in connection with any temporary working area and shall give to the occupier of each such area 14 days' notice of his intention to enter and shall ensure that his methods of working cause the minimum of disturbance to the land and to its owners and occupiers.

The Contractor shall at all times provide proper facilities for access and inspection of the Works by the Engineer, his assistants, inspectors, agents and representatives of public agencies having jurisdiction.

The extent of each temporary working area and the period of time for its occupation shall be such as the Engineer considers necessary having regard to the Contractor's reasonable requirements which shall be submitted together with the Work Program to the Engineer.

The Contractor shall reinstate any temporary working areas to the condition prevailing prior to his initial entry as soon as possible after the work in those areas has been completed so as to keep the period of occupation to a minimum. The Contractor shall in any event restore the areas to a tidy and workmanlike condition. Boundary walls, fences and other structures that have been damaged, removed or otherwise interfered with by the Contractor shall be restored to a condition at least equivalent to their original condition.

8.2 Temporary Diversion of Utilities

If in the opinion of the Contractor it is necessary to make temporary diversion of services in connection with the Works, the Contractor shall arrange with the relevant authority for the construction of diversions.

The Contractor may at his own cost and subject to the approval of the authority concerned, make such temporary diversions as may facilitate the carrying out of the Works. These temporary diversions shall be reinstated to the full satisfaction of the Engineer and the relevant authority on completion of the Works.

Whether the diversions are needed to be final and permanent, then the cost will be borne by the Employer, as stated in **SECTION VI-B: PARTICULAR REQUIREMENTS, Appendix D,** but temporary diversions, supports, etc. will be executed at the Contractor's cost.

8.3 Provision of Temporary Services

When the execution of the Works requires the temporary disconnection of existing public utilities, the Contractor shall provide the affected users with temporary services in at least the same standard as the original services.

For water supply he may install temporary lines or arrange for regular supply by tankers. The amount of water to be provided for the interruption period for a specific area shall be assessed by the Contractor. The Contractor shall submit to the Engineer, for its approval, the recommended volume of water to be provided.

When forced to disconnect existing sewers the Contractor shall install temporary pipes of adequate size to carry off sewage from any private sewer facilities cut off by construction work. Connections to temporary pipes shall be made immediately by the Contractor upon cutting off the existing facility. No sewage shall be allowed to flow from any severed facility upon the ground surface or into the trench excavation. Pipes used in temporary sewers may be plastic or approved flexible material.

When the Contractor is forced to disconnect power or telephone connections the relevant authority shall provide temporary connections at the Contractors expense.

Upon completion of work the Contractor shall replace all severed connections, with the assistance of the concerned authority where necessary, and restore to operating order the existing facilities.

No valve or other controls in public service facilities shall be operated by the Contractor without approval of the Engineer and the relevant authorities. All users affected by such operation shall be notified by the Contractor at least one hour before the operation and advised of the probable time when service will be restored.

8.4 Access and Protection of Adjoining Property

8.4.1 Access to Adjoining Property

If the Contractor's work will cause unavoidable interference with access to adjoining property, the Contractor shall first give 7 days' notice to the occupier of such property and shall provide temporary means of access for vehicles, animals and pedestrians.

Convenient access to driveways, houses and buildings adjoining the work shall be maintained and temporary approaches to intersecting streets and alleys shall be provided and kept in good condition by the Contractor.

As soon as a section of surfacing, pavement, or a structure has been completed, it shall be opened for use by traffic at the request of the Engineer.

The Contractor shall not prevent the free access to public water valves, water hydrants, or utility valves

8.4.2 Land

The Contractor shall control the movement of his crews and equipment on the working easement including access routes approved by the Engineer so as to minimize damage to crops and property and shall endeavor to avoid marring the lands. Ruts and scars shall be obliterated and damage to land shall be corrected and the land shall be restored as closely as possible to its original conditions before final taking-over of the Works.

The Contractor shall be responsible directly to the tenant / land owner for any excessive or avoidable damage to crops or lands resulting from his operations whether on lands adjacent to right-of-way or on approved access road and deductions will be made from payment due to the Contractor to cover the amount of such excessive or avoidable damage if adequate compensation is not paid by the Contractor, in the opinion of the Engineer.

8.4.3 Buildings and other Structures

The Contractor shall be responsible and take all measures in order to protect adjoining property including buildings, electrical and telephone poles, bridges and culverts, retaining walls, compound walls and fences, and other structures and urban furniture and installations. Prior to the commencement of the activities, the Contractor shall assess the probability and extent of unavoidable damages, if any, to the building and properties and submit his assessment to the Engineer. The Engineer may make his own opinion and if required may order arrangements for protection or repair of such likely unavoidable damage in which event the Contractor shall complete the activities.

8.5 Reinstatement Upon Completion

Temporary facilities shall be provided by the Contractor, only for as long as required after which he shall dismantle and remove the same from their place of use as speedily as possible. Re-usable components shall be safely stored by the Contractor in his yard.

The place of use shall be cleared and reinstated immediately to at least the condition existing before the temporary facilities were provided, and to the satisfaction of the Engineer.

8.6 Measurement and Payment

Unless there is a specific BOQ rate related to any item described above as to be measured and paid independently, or if it is otherwise specified in other Contract Documents with prevalence over this document, no separate measurements and/or payment shall be made for all activities/works described under this section (Provision of Temporary Facilities). All the cost associated with this section is deemed to be included in the other item rates of the Bill of Quantities.

9 SUBMISSIONS BY THE CONTRACTOR

9.1 Pre-Construction Surveys and Setting Out

The contractor shall be responsible for the true and proper setting-out of the works in relation to the lines and levels of reference given by the Engineer or shown on the Drawings, and for the correctness of the position, levels, dimensions and alignment of all parts of the works, as well as for the provision of all necessary instruments, appliances and labour used in connection therewith.

Before the Works, or any part thereof, are commenced, the Contractor shall carry out a detailed pre-construction survey of the site, including a detailed topographical survey of his own (to be confident on the tender topographical survey, as the actual situation may have varied in time) and shall supply full details to the Engineer. The Contractor and the Engineer shall together agree on the dimensions and elevations upon which setting out of the Works shall be based.

The topographical survey shall comprise the following content with the related criteria:

CONTENT	CRITERIA
Geodetic reference datum	The reference UTM system must be determined, altogether with the Grid Zone applying to the project area
Official National Reference Benchmarks	Usually there is a National Reference Benchmark system, and those in the project area must be stated, as a reference to produce the project benchmarks
Permanent project benchmarks	Project benchmarks must be stated from national reference benchmarks, including some physical work for making them permanent and usable during all construction works period
Calibrated Equipment	The Equipment for the survey must be stated (model and serial nº), as well as the calibration official certificate
Spot surveying and permanent features report	The spot surveying must be taken every 20 meters, and also all the singular points that define permanent features, natural ones (lakes, rivers, peaks, reefs, etc.) and manmade (in cities, houses, streets, electric poles, utility covers, street furniture)
Contour interval drawings	With the spot survey report, the triangulation is made and the contour interval lines each 1 and 5 meters must be calculated and defined in drawings
Topographical drawing layers	Topographical drawings shall be structured in different layers: spot points (with elevations), grid lines, one layer for each permanent feature and one layer for each set of contour lines

The contractor shall also collect the customer Service connection details using the online database provided by the Employer as a part of Pre-Construction Survey. Information to be collected at this stage shall be, but not limited to, the followings:

a) Number of domestic connections in each DMA boundary with street/House number and number of occupant in the house.
b) Number and type of Non- domestic / Institutional/ Commercial connection in each DMA boundary with Identifying Name, Landmark, street and anticipated consumer connection size.
c) Number of vacant but plotted land parcel with approx. area of parcel, width of adjoining road and landmark in each DMA boundary.
d) Number and approx. area of undivided/undeveloped land in each DMA boundary.

9.1.1 Existing levels and Layouts

Before commencing operations of any section of the works, the Contractor shall survey all existing detail in that section, in plan and in level and shall plot the results in such detail and to such scales as shall be to the satisfaction of the Engineer. These survey plots shall be supplied to the Engineer at least four weeks before the intended commencement of construction on the section. Unless otherwise instructed by the Engineer the detailed survey plots will be supplied in 1:200 scales both as soft and hard copy.

In addition to the above-mentioned requirements, horizontal control lines shall be marked out by pegs at intervals of not more than 20m and the lines traversed with theodolite by steel band or by any other method acceptable to the Engineer. The alignments established shall be referenced by pegs offset at suitable distance on each side of the horizontal control lines. These offset pegs shall be painted in a conspicuous colour.

Cross sections of the existing ground and of the ground after completion of earthworks shall be taken at intervals not exceeding 20m along the horizontal control lines in an approved and acceptable manner.

9.1.2 Benchmarks, Survey Points

As the work proceeds, the Contractor shall establish, at suitable location, substantial permanent benchmarks, clear of the works, from which, all subsequent setting out and levelling shall be carried out. The location of the benchmarks shall be agreed with the Engineer before they are established.

Benchmarks shall be constructed in M 20/20 concrete, with minimum dimensions of 0.3m x 0.3m, the upper surface being approximately 50mm above ground level. A 20mm diameter mild steel rod, not less than 300mm in length, shall be cast into the concrete so that it projects about 10mm above the centre of the surface of the concrete. The concrete surface shall be clearly engraved with the reference number of the benchmark. The co-ordinates and level of each benchmark shall be determined in meter to 3 decimal places.

The Contractor shall check co-ordinates and levels of benchmarks at monthly intervals and immediately notify the Engineer of any discrepancies.

Site benchmarks shall be accurately and safely established, maintained and removed upon completion of the Works, all to the satisfaction of the Engineer. The Engineer will indicate the position, coordinates and elevation of benchmarks near the works, as shown on the Drawings.

The Contractor shall prepare a plan detailing the location of the benchmarks and keep this up-to-date throughout the period of the Contract. Reproducible copies of the plan so prepared shall be supplied to the Engineer, as and when he may require.

All setting out and leveling shall be based on permanent Benchmarks (BM) provided by the Employer/Engineer and correlated/close traversed with the BMs attained from the concerned authority by the Contractor.

9.1.3 Setting Out Procedure

The levels shall be related to the benchmarks and shall be plotted and drawn up by the Contractor. After agreement of the drawings, which shall be signed by the Engineer and the Contractor, these levels shall form the basis of setting out of the Works.

After checking all lines, levels, etc., the Contractor shall verify all measurements and be responsible for their correctness. Any differences which may be found between actual measurements and the dimensions given in the Contract Documents shall be submitted to the Engineer, in writing, for consideration and directives before proceeding with the Works. Any delay or loss resulting from errors in the setting out of the Works shall be the responsibility of the Contractor.

The Engineer reserves the right to order as many levels as are considered necessary for the full and proper supervision and measurement of the works, to be taken at any time by the Contractor. The Contractor shall provide all assistance which the Engineer may require for taking measurements of the Works, including labour, equipment and transportation.

9.2 OHS Plan and Policy

OHS policy is to be submitted as per Good International Industrial Practice and signed by the top management of the Contractor. Contractor is to conduct management reviews regularly with a set of clearly defined input/agenda items to be discussed in the meeting and action items to be circulated to relevant parties. Follow-up of the action items to be taken accordingly. The contractor shall submit its reports to the Employer/Engineer.

Contractor shall develop, implement and submit an auditable OHS Management Plan. The contractor shall then prepare specific H&S manuals for the different activities being carried out on site or job specific SOPs (Standard Operating Procedures) shall be developed and implemented in-line with the manual that supports and provides further detailed information on OHS aspects of the activities. This safety management plan shall also cover works to be performed by sub-contractors. Such manuals and SOPs must be submitted to Employer/Engineer before the start of job and no activity will be allowed to start unless the SOPs for the same has been approved by competent authority of Employer/Engineer. As minimum, the plan must cover the elements listed in **SECTION VI-B: Appendix D, Annex 3**, and also the requirements in this chapter.

The first draft version of the OHS Plan is to be provided by the Contractor to the Engineer within 28 days from the date of execution of the Contract Agreement.

Unless the Engineer, within 21 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.

In order to guarantee public safety from and around the work the Contractor shall provide all labour, and materials, and construct and maintain temporary traffic diversions throughout the construction activities, to the directive and approval of the Engineer. It is therefore recognized that there is a particular responsibility placed upon the Contractor to take special precautions for public safety and to minimize the scale and extent of disruption to public and commercial life. Plans for traffic diversion shall always be submitted to the Engineer and to the Employer for their prior approval.

The Contractor shall deploy a full time Safety Officer at the site form the commencement of the work. The Safety Officer shall have the qualification and the authority to issue instructions to the Contractor's personnel regarding protection measures to prevent accidents. The Safety Officer shall be assisted by an experienced safety in-charge/assistant for each Safety, Environment and Social Safeguard (SESS) working team. Moreover, the Contractor must deploy separate independent SESS team(s) of workers managed by the Safety Officer to install & remove the safeguard /traffic items installed during the execution of the work for all working SESS team. The Contractor to demonstrate that adequate SESS working team are mobilized comparable to the installation working teams.

The Contractor shall provide the public with adequate information on all risks with respect to the construction works. If the general public sustains any kind of bodily injury or death, the Contractor shall be responsible for providing all necessary medical care and compensation.

During construction the Contractor shall erect, maintain sufficient barricades and remove subsequently, hoarding boards, guards, lighting, sheeting, shoring, temporary sidewalks and bridges, danger signals as well as temporary covering of potential accident areas.

The Contractor shall be responsible for ensuring that all persons working in the vicinity of power lines are aware of the relatively large distance that high voltage electricity can "short" to earth when cranes or other large masses of steel are in the vicinity of power lines. Where work is to be carried out in the proximity of buildings, bridges, tanks or other structures, the Contractor shall take all necessary precautions, including shoring and strutting, where necessary, to ensure the safety of the structures that are at risk.

The Contractor shall be responsible for all damages or injury which may be caused on any property by trespass by the Contractor's or his Sub-Contractor's employees in the course of their employment, whether the said trespass was committed with or without the consent or knowledge of the Contractor.

The Contractor shall ensure that the works are carried out in a safe manner, according to internationally accepted guidelines on safe working procedures and to the satisfaction of the Engineer.

9.2.1 General OHS requirements

The following requirements shall be complied with by the Contractor:

a. Protective Clothing – The Contractor shall ensure that all personnel on site are supplied with the necessary protective clothing such as safety helmets, goggles, face masks, earmuffs, gloves, boots, harnesses for working at heights, etc., depending on the operations being performed.

b. Scaffolding – Suitable and sufficient scaffolds shall be provided and properly maintained for all work that cannot safely be carried out from the ground or from part of the structure or from a ladder. Every scaffold shall be of good construction, of suitable and sound material and of adequate strength for the purpose for which it is used. Unless designed as an independent structure, every scaffold shall be rigidly connected to a part of the structure which is of sufficient strength to afford safe support. Protective headgear shall always be worn.

c. Lifting Device – Every rope, chain, pulley, bloc, hook, winch, crane or other lifting gear used for raising or lowering pipes or any material as a means of suspending them shall be of good construction, sound material, adequate strength and free from defects. They shall be properly maintained and tested at regular intervals by a competent person, who shall be to the approval of the Engineer.

d. The Personal Protective Equipment which shall be made available shall include but not limited to following:

- Protective head gear
- High reflective jackets
- Metal toe safety boots
- Rubber Gloves.
- Lifting harness with ropes
- Harnesses when working at heights
- Hand-lamps with spare batteries
- First aid kit including infrared thermometers

Throughout the period of the Contract, the Contractor shall provide safety helmets and high reflectivity jackets to all Consultant's staff and visitors. Barriers must be provided to all excavations for the safety of the public and flagmen must be used for all items of plant for the safety of the operatives, supervision staff and members of the public

The Contractor shall strictly comply with the Safety, Environment and Social Safeguard (SESS) Checklist appended in **SECTION VI-B: Appendix D.** Failure to comply with the SESS checklist and attain minimum score of 70%, will result in the suspension of all works under the contract and other contractual measures as stated in Particular Conditions of Contract. To resume the work, the Contractor will need to demonstrate that compliance can be attained to the satisfaction of the Engineer.

The Engineer will also instruct to suspend the works if there is a high risk to any stakeholder or related people and goods or facilities during the construction works, as well as when the reiterative instructions from the Engineer regarding OHS measures are not considered and complied with by the Contractor.

The Contractor shall strictly comply the requirements of Occupational Health and Safety (OHS) for its workers and personnel as per ADB- SPS Policy 2009.

9.2.2 Safety Equipment for Engineer

The Contractor shall provide the Engineer with sufficient quantity of the safety equipment set listed below in each site office. The Contractor shall replace each item after it wears out and becomes unsuitable for use:

Safety helmets, High Reflective Jackets, Umbrellas, Rain coat, Rubber water boots, Safety boots and gloves, Gas detector lamps with lead acetate papers, Gas masks with torch, Flashlights.

9.2.3 Working in confined space:

Working in existing manholes etc., checks shall be carried out before entry to ensure that the atmosphere is fit for respiration and no smoking naked lights or flames are to be permitted in any sewer, manhole or chambers or in their vicinity when these are open. Ventilation with fans and air ducts/tubes shall be provided.

In addition to the listed equipment above, dangerous gas detectors and breathing apparatus shall be made available.

9.3 Traffic Management Plan

The Contractor shall develop a detailed traffic management Plan for the work under the contract. The purpose is to develop a Traffic Management plan to cope with traffic as a result of construction activity by identifying strategies for traffic management on the roads and neighborhood impacted by the construction activities. The Contractor is responsible for attaining traffic diversion and traffic management plan from concerned authority. The Contractor shall implement the Traffic Management Plan throughout the whole period of the Contract.

The basis for the Plan shall into consideration the following principles:

a. to minimize the inconvenience for road users and the interruption to surface traffic through the area impacted by the construction activities;
b. to ensure the safety of road users in the impacted area;
c. to facilitate access to the construction site, and to maintain reasonable construction progress. d. to ensure traffic safety at each construction site.

The Contractor shall prepare an integrated plan showing the arrangement to be made for accommodating road and pedestrian traffic, at individual construction site and continuously along the alignment, to smooth traffic operations and for the safety of both construction workers and road users.

The Plan shall consider different measures such as:

a. proper phasing and timing of traffic signals;
b. modifications to intersection geometry, changes in lane usage;
c. parking prohibitions;
d. re-location of bus stops;
e. reduction width of footpaths and median;
f. right-turn prohibition;
g. work site access management;
h. minimizing the duration of any road closure;
i. reversible lane operations;
j. modification of roadway alignment affected by the construction, which shall be in conformance with the requirements and regulations defined by the relevant authorities;
k. safe pedestrian routes around construction areas and barriers; and
l. Other traffic Employer's engineering measures as may be applicable.

9.3.1 Mitigation of Traffic Disturbances

The Contractor shall manage the vehicular and pedestrian right of way during the period of construction. The Contractor shall take account of the need to maintain essential traffic requirements, as these may influence the construction process.

The Contractor shall include local traffic diversion routes and assess traffic impacts caused by the construction in the affected areas. Signage layout shall be including to ensure that adequate will be provided for traffic diversions.

The Contractor shall mobilize separate independent team(s) for the traffic management at the site during entire execution of the works.

Where it becomes necessary to close a road or intersection, or supplementary lanes are required to satisfy the traffic demands, traffic diversion schemes to adjacent roadways shall be development with quantitative justifications, The Contractor shall co-ordinate with all relevant authorities.

Other’s considerations include:

a. The minimum lane widths for fast traffic and mixed traffic shall follow the regulations of the different authorities;

b. any road or intersection that has no alternative access shall not be fully closed for construction;

c. Emergency access to all properties shall be maintained at all times;

d. Access to business premises and property shall be maintained to the extent that normal activities are not seriously disrupted;

e. Minimum footpath width shall be 1.5 m, unless otherwise indicated. The footpath shall be separated from vehicle traffic and not necessarily immediately adjacent to vehicle traffic;

f. where existing footbridges and underpasses are demolished or closed, provision shall be made for pedestrian crossing to minimize the conflicts between traffic lanes;

g. Construction traffic shall be separated from other traffic wherever possible;

h. Any traffic related facilities (bus stop, parking, etc) which are affected by the construction works shall be maintained or relocated to appropriate locations;

i. Motorists, pedestrians, workmen, plant and equipment shall be protected from accident at all times;

j. Roadway design, traffic management schemes, and Supply &installation of traffic control devices shall be in conformance with the requirements and regulations defined by the relevant authorities; and

k. Where applicable, utility diversions shall be incorporated in the traffic management plan.

9.3.2 Approval for temporary Traffic Arrangements and Control

The Contractor shall make all arrangements with and obtain the necessary approval from the Road authorities and the Traffic Police Department for Road Cutting Permits, temporary traffic arrangements and control on public roads. In the event that the Contractor, having used its best endeavors, fails to secure the necessary approval from the authorities, then the Employer will use its best endeavors to assist the Contractor to secure such approval but without responsibility on the part of the Employer to do so.

The Plan shall consider the obligation of working at night in roads where traffic is too heavy at daytime, when so requested by the road authority.

9.3.3 Temporary Traffic Arrangements and Control

a. Temporary traffic diversions and pedestrian routes shall be surfaced and shall be provided where work on roads or footpaths obstruct the existing vehicular or pedestrian access. The relevant work shall not be commenced until the approved temporary traffic arrangements and control have been implemented.

b. Temporary traffic arrangements and control for work on public roads and footpaths shall comply with the requirements of the Traffic Police. Copies of documents containing such requirements shall be kept on the Site at all times.

c. Temporary traffic signs, including road marking, posts, backing plates and faces, shall comply with the requirements of the Traffic Police and should be in accordance with the requirements of Ministry of Surface Transport. All overhead traffic management signs that are fixed to bridges and gantries shall be illuminated at night. Pedestrian routes shall be illuminated at night to a lighting level of not less than 50 lux.

d. Adequate number of traffic marshals shall be deployed for smooth regulation of traffic.

e. Temporary traffic arrangements and control shall be inspected and maintained regularly, both by day and night. Lights and signs shall be kept clean and legible. Equipment which are damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced promptly.

9.3.4 Particulars of Temporary Traffic Arrangements and Control

The following particulars of the proposed temporary traffic arrangements and control on public roads shall be submitted to the Engineer for consent at least 28 days before the traffic arrangements and control are implemented:

a. Details of traffic diversions and pedestrian routes;

b. Details of lighting, signage, guarding and traffic control arrangements and equipment;

c. Any conditions or restrictions imposed by Traffic Police or any other relevant authorities, including copies of applications, correspondence and approval.

d. Where concrete barriers are used to separate flows of traffic, the barriers shall be in a continuous unbroken line. No gaps shall be left between any sections of the barrier.

e. Site perimeter fencing and barriers along the roadway, shall have flashing amber lights positioned on the top of them every 50 meters apart and at every change in location. Directly below the flashing light shall be fixed, in the vertical position, a white fluorescent light with a waterproof cover.

9.3.5 Use of Roads and Footpaths

a. Public roads footpaths on the Site in which the work is not being carried out shall be maintained in a clean and passable condition.

b. Measures shall be taken to prevent the excavated materials, site or debris from entering gullies on roads and footpath; entry of water to the gullies shall not be obstructed.

c. Surfaced roads on the Site and leading to the Site shall be not used by tracked vehicles unless protection against damage is provided.

d. Contractor's Equipment and other vehicles leaving the Site shall be loaded in such a manner that the excavated material, mud or debris will not be deposited on roads. All such loads shall be covered or protected to prevent dust being emitted. The wheels of all vehicles shall be washed when necessary before leaving the Site to avoid the deposition of mud and debris on the roads.

9.4 Environmental Management Plan (EMP)

The Works are required to be carried out with a minimum of disruption to the environment and minimum negative impact on the socio-economic conditions of the local population along and adjacent to the Project Area.

9.4.1 Responsibilities and Liabilities

In conjunction with his obligations defined under the Contract, the Contractor will plan, execute and document construction works pursuant to the Environment Management Plan of the Project, and shall submit his own Environment Management Plan for the Construction Phase based on this general project EMP.

The Contractor is liable for all damages to natural resources caused by the execution of the works or the methods used for execution.

Under the Contract the term "Project Area" means:

a) The land where work will be carried out; or

b) The land necessary for the implantation of construction facilities (work camp, workshops, offices, storage areas, concrete production plants) and including special access roads; or

c) Quarries for aggregates, rock material and riprap; or

d) Borrow areas for sand and other selected material; or

e) Stockpiling areas for backfill material or other demolition rubble; or

f) Any other location, specifically designated in the Contract as a Project Area.

The term "Project Area" encompasses any individual Project Area or all Project Areas.

For the sake of clarity, Project Area is a different concept than Site under Conditions of Contract (CC) Sub-Clause 1.1.6.7.

Project Area defines an area within which the Contractor is to comply with environmental, social, health and safety obligations defined in the present Specifications.

Site is the places where the Permanent Works are to be executed and to which Plant and Materials are to be delivered, and where right of access to, and possession of, is to be given by the Employer to the Contractor. The Employer is under no similar obligation for any area located outside the Site, even if within the Project Area, where access is at Contractor’s risk.

In terms of physical footprint, the GCC Sub-Clause 1.1.6.7 Site is included in the Project Area. The Project Area is then of greater geographical extent than the Site.

The Environmental Specifications refer to the Protection of the natural environment (water, air, soil, vegetation, biological diversity) in areas within any Project Area and its surroundings, i.e. including but not limited to access roads, quarries, borrow areas, stockpiling of backfill material, camps or storage areas;

9.4.2 Subcontractors

The present Environment Specifications apply to the Contractor and unless explicitly agreed with the Engineer, all Subcontractors used for the execution of the Works. Pursuant to Sub-Clause 4.4 of the GCC, the

Contractor is fully liable for all actions, non-compliance and negligence by Subcontractors, their representatives, employees and workers, to the same degree as it would be held liable for its own actions, non-compliance or negligence or that of its own representatives, employees or workers.

9.4.3 Applicable regulations

The Contractor must identify all international, national and local regulations in relation to the protection of the environment (water, air, soils, noise, vegetation, fauna, flora, waste, groundwater) and must list all texts, standards and other regulatory limitations in its Worksite Environmental Management Plan and specify the means taken for compliance.

9.4.4 Worksite Environmental Management Plan (Worksite-EMP) Document

The Contractor prepares, submits and ensures prior validation by the Engineer, the implementation and regular update of a Worksite Area Environmental Management Plan (Worksite-EMP).

The Worksite-EMP represents the unique reference document in which the Contractor defines in detail all organizational and technical provisions implemented to satisfy the obligations of the present Environment Specifications.

The Worksite-EMP covers the entire period from the Contract Agreement signature date to the date of issue of the Performance Certificate by the Engineer.

Unless agreed otherwise by the Engineer, the Worksite-EMP is written in the language of communication defined under Sub Clause 1.4 of the CC.

The first draft version of the Worksite-EMP is to be provided by the Contractor to the Engineer within 28 days from the date of execution of the Contract Agreement.

Unless the Engineer, within 21 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer’s Personnel shall be entitled to rely upon the programme when planning their activities.

No physical work or activity shall commence on any Project Area until such time the Worksite-EMP are approved by the Engineer.

During the execution of the works, whenever instructed by the Engineer, the Worksite-EMP will be updated by the Contractor and reissued to the Engineer. The revised version shall highlight the new elements incorporated in the document.

The Worksite-EMP shall be structured according to the plan specified in **SECTION VI-B: Appendix D**, with at least covering the environmental impacts and mitigation measurements for the Pre- Construction and Construction Phases.

9.5 Quality Control Plan

As described in Quality Control Chapter of these Employer’s Requirements.

9.6 Detailed Design of Temporary Works

The Contractor shall submit for approval full particulars, including drawings of any of the site installations and Temporary Works. If required the Contractor shall also submit calculations of the stresses, strains and deflections which will arise in falsework or other Temporary Works and these calculations shall be accompanied by detailed Working Drawings to show the Contractor's proposals. Approval by the Engineer of the Contractor's proposals, calculations or drawings shall not relieve the Contractor of any of his duties or responsibilities under the Contract. The detailed design of all temporary works are at the cost of the Contractor.

9.7 Programme and Progress of Works

9.7.1 Construction Program

The Contractor will prepare a detailed Construction Programme (or Time Schedule or Program of Performance) for all contract components for the Engineer's approval and submit it to the Engineer within 28 days after the Commencement Date.

In amplification of the requirements of Clause 8.3 of the Conditions of Contract, the program shall be in the form of a Bar Chart with Critical Path Method (CPM) Diagram showing, sequences, dependencies, durations and dates for execution of all major items following the sub-divisions in the Bills of Quantities for the execution of the Works within the periods stated in the Contract.

If the Contractor's programme, in the opinion of the Engineer, has not properly achieved the objectives of the works, then the Contractor shall be instructed to revise his Programme and the Contractor shall revise the programme forthwith; for this reason, the Contractor is advised to liaise closely with the Engineer during the production of his Programme.

The Work Programme shall be prepared using software such as MS Project or Primavera or similar approved project management software, and shall be presented in hard copy and electronic form (editable and pdf) to the Engineer. The programme shall state the sequencing of work, the interrelationship between elements of work, critical path work item, time taken for completion of different elements of work; it will also show the histograms of plant/equipment/ personnel/workers and key work elements. The program should clearly indicate nonworking periods of certain activities like i.e.: the monsoon period and major festivals.

In carrying out the Works due attention shall be paid to all measures which can reasonably be taken in order to diminish the inconvenience which the work may cause to services and access to property.

The general points to be (at least) considered when preparing the Construction Programme are as follows;

- Mobilization and Demobilization
- Procurement of materials
- Setting out
- Trial pits for underground utilities location
- Installation of Primary Pipelines: Excavation, Installation, Surface Reinstatement
- Installation of Distribution Pipelines: Excavation, Installation, Surface Reinstatement
- Installation of Service Connections
- Installation of OMUs, EMFM and Pressure Test points
- Sectional pipeline pressure and leakage testing
- Functional Guarantee Tests
- Submission of as-build drawings and GIS database
- Submission of final construction report/ completion report.
- Indicate nonworking duration of affected activities due to the nonworking period/ban by the authorities to allow road cutting and other major festivals. Further a duration of 15 days in one year should be allocated as non-working period/duration due to unknown reasons (i.e.: strikes).

The Contractor shall be engaged with the physical works (Supply and installation of pipe, fittings, and specials, and construction of chambers) as per time schedule.

Works which, by their nature, will create disruption and / or obstructions to supply of water shall be programmed to be undertaken in a continuous sequence of events from the initial disruption until the restoration of supply without and significant delay between operations.

The Contractor shall note that different work in various parts of the site by other Contractors may be in progress or may commence during the Contract Period. It will be the Contractor's responsibility to liaise with Contractors on adjacent sites in order to ensure the detail progress. The Contractor's Programme will be phased and will make full allowance for the need for a co-operative timing with adjacent Contractors.

9.7.2 Updating, Monitoring and Progress Reporting

The Contractor shall monitor the progress of the Works including information provided by his Sub-Contractors and suppliers, as necessary, for purpose of network planning, scheduling and updating and shall confirm the actual progress on each current activity shown on applicable CPM networks. The CPM networks shall form part of the Monthly Progress Report and shall indicate changes of schedule, if any in network activity duration and start/finish imposed-imposed dates. It shall also be provided in electronic form.

The Contractor shall prepare written explanatory notes on the particular activities which are overrunning or going to overrun against the Master Schedule. If any such overrunning work is on the critical path, the Contractor shall state what corrective actions will be taken by him to bring it back on the schedule.

9.7.3 Micro Work Plan

The Contractor shall submit detailed micro-work plan prior to commencement for laying for pipeline, in any segment / stretch. The micro-plan shall be submitted at least 28 days in advance to the Employer/Engineer.

The micro plan shall include:

1. Details of the segment taken up for laying of pipeline, in drawing
2. Width of road including alignment of pipeline, showing trench width and available space
3. Details of utilities as per trial trench / information from utility agencies
4. Details of Traffic management plan, as applicable including traffic diversion plan
5. Permission and approvals (from Traffic, Utility agency as applicable)
6. Details of resources (equipment, tools and manpower) to be engaged
7. Scheduled commencement dates and timelines for:
    (a) Road cutting / dismantling
    (b) Lowering, laying and jointing of pipeline
    (c) Hydro-testing / Sectional testing of the segment of pipeline
    (d) Backfilling for the pipeline segment
    (e) Temporary road restoration with bituminous course
    (f) Baseline survey of vulnerable structures including common properties and heritage structures, if any, along with photographic evidences

Contractor (in coordination with Employer and Engineer) will seek consultative inputs from local community (shop owners and residents) and concerned local government office and ensure that these are appropriately considered and incorporated in the work plan.

Approval of the Employer/Engineer of the plan is required for the Contractor to proceed with pipe laying.

A copy of the approved micro-plan will be shared by the Contractor with the local government office at least 7 days prior to commencement of civil work. Key Information of the micro-plan (on the schedule of pipe laying works, traffic management plan, road restoration plan and scheduling of baseline survey of vulnerable structures) will also be shared (at least 7 days prior to start of civil work) with local community though hand bills, pamphlets and other appropriate communication tools, in co-ordination with Employer.

The Contractor shall ensure that backfilling of the pipeline shall commence immediately after hydro-testing / sectional testing of the pipeline and affected roads/streets will be restored and made functionally fit for vehicular movement and pedestrian use, no later than 7 days after commencement of road cutting / dismantling. Reinstatement (black topping, where necessary) of the road will be completed within a maximum of 42 days of commencement of civil work in the project affected section. Road restoration with paver blocks / interlocking blocks will be undertaken within a maximum of 28 days of commencement of road cutting/excavation.

Any delay in road restoration (temporary or permanent) will be communicated to the Employer and local government offices with reasons explained. Project progress monitoring reports submitted by the contractor will include status of road restoration (both temporary and permanent) and reasons for reported delay.

In case, there is delay on the part of the Contractor to undertake the sectional hydro-testing, the contractor may seek additional time from the Employer / Engineer, specifying the reasons for delay. If the reasons for delay are not justified, the backfilling shall forthwith commence, and the Contractor shall undertake the sectional testing later at his own risk and ensure the successful hydro-testing of the pipeline segment to the satisfaction of the Employer / Engineer.

In case, the available space for public / traffic is inadequate and impacts (full or partial road closure) are likely, the Employer or Engineer may instruct the Contractor to plan the pipe laying works at night. The Employer / Engineer reserves the right to instruct the Contractor to ensure minimum impacts during pipe laying and to make suitable arrangements to undertaken pipe laying works at night time. The sectional testing including backfilling works in such cases shall be undertaken under priority and meticulous planning and shall be done under emergency conditions.

The aforesaid activities are to be considered within the scope of the works and no separate payment will be made for undertaking the same.

9.7.4 Detailed Fortnightly Programme

The Contractor shall submit at the end of each working fortnight a detailed bar chart program for the next fortnight. The program shall identify where further drawings or instructions are to be issued by the Engineer to avoid disruption to the progress of the Works.

9.7.5 Monthly Progress Reports

Contract Management Plan and Reporting Requirements:

The Contractor, the Project Manager and Supervision Consultant will use a dedicated web-based dashboard (PMD) system for monthly reporting. The PMD will be supplied free of charge by the employer & training on how to use the system will also be provided.

For Implementation Consultant / Engineer:

Provide the Employer with detailed monthly progress reports, including (without limitation) details concerning the progress of the design and construction, forecast completion date, a project cost report identifying forecast cost to completion and variation trends, risk register and mitigation action, health and safety issues, and recommendations for mitigation measures if required. The consultant must utilize the employer's web-based dashboard monitoring platform (PMD) for the creation and submission of the monthly progress reports.

In additional, The Contractor shall submit to the Engineer four (4) copies of a Monthly Progress Report (MPR) in English and 1 copy of the same in pdf, describing the progress and current status of the Works.

MPR must comprise (but not limited to) the following sections:

- Physical and financial progress summary, including S-Curves graphics.
- Financial Status:
    - Interim Payment Certificates Summary
    - Quarterly Cash-flow Forecast
- Description of Progress of works:
    - Sstatus of major project components (percent complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred

  - Progress made on critical activities indicated on the CPM Schedule
  - Explanations for any lack of work on critical path activities planned to be performed during the last month.
  - Explanations for any schedule changes, including changes to the logic or to activity durations.
  - A list of the critical activities scheduled to be performed in the next month period.
- Organization and Resources in site during the month (Personnel and equipment)
- Quality Control and Tests by Contractor, according to Quality Control Plan Approved.
- Notices to claim from both Contractor and Employer
- Variation/change orders status summary
- Submittals status summary
- Safety and environment status
- Other Activities and Events in site
- As-Built Drawings and GIS database of the work carried out during the month, including both existing utilities found and newly laid works.
- Progress Photographs: Minimum 1 daily photograph representative of the work carried out during the month in all sectors, showing date of taking. Photographs shall be submitted also in soft photograph files .jpg or similar.
- Quality Control Tests Results
- Chronology of letters sent (with subject and Ref) between the parties.

The CONTRACTOR may include any other information pertinent to the status of the project. The CONTRACTOR shall include any other additional status information requested by the EMPLOYER or the ENGINEER.

The MPR shall be submitted no later than the fifth day of each next calendar month and it shall account for all works actually performed from the first day to the last day of the previous month.

A monthly meeting to monitor the progress of the project shall be convened by the Employer and attended by the Contractor's Representative and representatives of all Interfacing Parties shall be invited and may also be present in the meeting.

9.8 Method Statements

The contractor shall submit method statements for construction of his chosen work fronts. These method statements shall for the following activities the following;

a. Topographical Survey and setting out
b. Trench Excavation method including shoring works
c. Installation of pipelines
d. Trench Backfilling and compaction
e. Surface/road Reinstatement
f. Service Connections Installation including water meters' installation
g. Concrete Chambers execution
h. Appurtenances electro-mechanical and ICT installation
i. Sectional Pressure Tests
j. Functional Guarantee Tests

k. Testing of equipment and communication for integration into the existing KUKL SCADA system for Kathmandu Valley Water Supply Improvements

9.9 Working Drawings

9.9.1 General Issues

It shall be the Contractor's responsibility to prepare such Working Drawings as he may require for the proper setting out and construction of all structures, facilities and permanent works. For the initial start of the work as well as for the initial/partial procurement of the material, the construction drawing and preliminary quantities indicated in the tender documents can be used. However, the final procurement of the material shall be done as per approved working drawings only.

The Working Drawings shall follow the pre-construction and topographic surveys and setting out carried out by the Contractor as stated in previous clauses.

Within 28 days of the date of the Letter of Acceptance, the Contractor shall submit to the Engineer a Drawings Submittal Schedule for all the Working Drawings, listing the anticipated dates upon which they will be submitted for approval by the Engineer. The submission dates shall be spaced at reasonable intervals to allow at least 28 days for the Engineer to duly check and to either approve them or to request changes or modifications, as the case may be.

All dimensions shall be in metric units and each drawing shall be properly identified by a drawing head and a numbering code in the form prescribed by the Engineer upon commencement of the Works. ISO or DIN standard size sheets shall be used. Drawings shall be scaled at A1 size, and plotted at A1 size and A3 size.

Prior to submittal, the Contractor shall also check the drawings prepared by his Sub-Contractors for accuracy and completeness, especially that the relation to adjoining work is accurately shown.

The Contractor shall submit 3 (three) hardcopies of all working drawings for approval and a soft copy in both editable (.dwg) and pdf format.

Any changes or modifications to the Working Drawings that the Engineer considers necessary shall be made by the Contractor promptly and the drawings resubmitted for approval.

No examination by the Engineer of any document submitted by the Contractor or of the Contractor's Working Drawings, nor the approval expressed by the Engineer in regard thereto, either with or without modification, shall absolve the Contractor from any liability imposed upon him by any provision of the Contract.

9.9.2 Reference Tender and Construction Drawings:

The drawings issued with the Bidding Documents are the Tender Drawings, which list is shown in **SECTION VI-B: PARTICULAR REQUIREMENTS, Appendix B**. The Tender Drawings were prepared in such detail as is necessary to give a comprehensive idea of the works. These drawings may be clarified subsequent to the bid, to suit the site requirements, or modified, expanded or replaced subsequent to opening of bid. The Tender Drawings standing finalized at the time of executing the agreement, together with additional drawings and/or modified drawings, signed and made part of the contract will be called the Construction Drawings for the Contract. Any questions or alterations affecting the requirements or information on the Contract Drawings shall be submitted in writing to the Engineer and shall be reviewed by the Engineer.

The lines indicated on the Construction Drawings denoting locations of the existing utilities or services are approximate locations. The Contractor is not to assume that they are exact. He has to confirm the exact location of the utilities in consultation with the relevant authorities and also by taking trial trenches which is a BoQ item.

The Contractor shall note that the Drawings and Quantities in the Tender Documents, whilst detailed, have to be considered as preliminary, and only provide an indication of the locations, layouts and scope of works. The locations, layout and scope of works may be altered and in such cases the Contractor shall not be entitled

to any claim whatsoever for such alterations over and above the measured works or measured variations at the tendered rates except in accordance with the provisions of relevant Clauses of the Conditions of Contract.

9.9.3 Working drawings

The Construction Drawings shall be supplemented by working drawings or shop drawings prepared by the Contractor which are required for the execution of the works. Contractor shall prepare alignment/layout survey drawings as part of his working drawings soon as he commences work. Existing ground levels shall be taken at intervals not exceeding 3 m. Information related to all existing structures, obstructions and services should be located in the survey drawing.

The working drawings shall be made for all pipe laying layouts and details to suit the contractor's submission, mechanical drawings, piping drawings, reinforcement details such as bar-bending schedules for all structures including valve chambers, valve chamber schedules, setting out details, interconnection works (incl. reinforcement details , interconnection details with existing pipelines), utility relocation and protection if any required, and any other detail the Engineer may ask during construction. The existing services, as determined by site excavation, should also be marked up on these plans.

The working drawings/shop drawings and documents, including diagrams and schedules shall show the details of proposals for the execution of the works at specific chainages/locations and shall include information necessary for the following purposes:

- To illustrate in detail, the arrangement of the various section of the works and to identify the various components.
- To integrate the various sections of the works

The working drawings required shall include but not be limited to the following

- General layout drawings for equipment and like items as deemed necessary by the Engineer.
- Detailed layout drawings of all pipe laying works and interconnections with existing/future works: profile and plan view showing all needed bends, fittings, air-valves, wash-outs, other appurtenances, etc.
- Detailed civil work and mechanical drawings of all structures including all valve chambers (gate/sluice valves, butterfly valves, air-valves, washout system) and bulk meter chambers
- Electrical and ICT drawings and diagrams for OMUs, AMUs, electromagnetic flowmeters and their related devices for integration with the existing KUKL SCADA system for Kathmandu Valley Water Supply Improvements
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The costs of furnishing working drawings shall be included in the rates for various paying items given in the Bill of Quantities.

Working drawings and documents shall be made available in sufficient time in order to maintain the Programme of Work on site.

In this respect the Contractor shall employ his Engineers and CAD Technicians specifically for planning and preparation of working drawings. The Contractor's Staff mobilization schedule shall specify the Engineers and CAD technicians he intends to mobilize. The Contractor shall also provide as part of the mobilization to site, latest model of Computers and software together with new color printer, for the preparation of his working Drawings. The Engineer shall have access to this Computer. In case the Contractor fails to mobilize such staff and equipment as described above to site, the Employer reserves the right to mobilize the necessary staff and deduct the cost of such mobilization from any money due to the Contractor.

9.9.4 Approvals of working drawings, and Request for Approval (RFA) for Materials and Construction

The Contractor shall liaise with the Engineer for the period required for any approval, which shall be a maximum of two weeks.

The Engineer shall mark up the drawing in yellow and red; Yellow showing acceptance and red showing requirement for revision; The Contractor shall revise the portions marked up in red and round it off in green color to show that he has complied with the correction required. On resubmission of the drawing, the engineer shall check the revisions made and if his instructions are complied with. The approved shop drawing/working drawing shall be filed for future reference.

Final approval of Working Drawings will be given by the Engineer in the form of a stamp "RELEASED FOR CONSTRUCTION" together with the date and the authorized signature. Only those Working Drawings carrying the signed and dated stamp shall be used for execution.

Copies of all such approved Working Drawings together with one unreduced transparency shall be supplied to the Engineer by the Contractor immediately after approval.

Should it be found at any time after approval has been given by the Engineer to a Working Drawing submitted by the Contractor that the said Working Drawing does not comply with the terms and conditions of the Contract, such alterations and additions as may be deemed necessary by the Engineer shall be made therein by the Contractor and the work carried out accordingly without entitling the Contractor to extra payment on account thereof, except where such alternations and additions are to be made in direct consequence of written order by the Engineer to vary the Works.

The Contractor shall ensure that all items to be ordered by him can be accommodated in the positions shown on the drawings and for taking all necessary dimensions on site together with any supporting information which may be necessary for preparing working drawings.

No materials or equipment shall be ordered, nor construction of the associated works be commenced until such approval has been obtained from the Engineer.

The contractor shall submit Request for Approvals (RFA) for all materials to be incorporated in the Works as early as possible in the contract period, so that the Engineer gets sufficient time to study the request and compare the submissions with the specifications. If the Engineer so requests, then the Contractor shall submit samples of materials prior to approval. The Material Approval Request forms shall be finalized by the Contractor in consultation with the Engineer. The Approval Request shall, as a minimum, comprise the reference to BoQ item, clause of specification, details of source and supplier/manufacturer's specifications. In the normal course, the Engineer shall give his comments/approval within 14 days of submission of the RFA.

Request for Approval for Construction: the contractor shall submit RFA for construction prior to commencing any construction. The RFA shall be for specific work. The RFA shall indicate each stage of construction i.e. Excavation, sheet piling, normal or conventional shoring, preparation of ground for foundation, formwork, reinforcement, concreting, laying pipe bedding, pipe laying, & other works, in the same application. Each stage of construction shall get approval from the Engineer prior to and after completion of the particular stage. The RFA for construction shall be accompanied by a copy of the approved working drawing for that particular stretch or location.

9.10 As-Built Drawings and GIS Data

In addition to the requirements of the General Specification, the Contractor is responsible for the preparation of As- Built drawings completed with GIS data as follows.

The approved Working Drawings as have been selected by the Engineer shall be correctly modified for inclusion in the As-Built Drawings incorporating such variations to the Works as have been ordered and executed. Such drawings shall show the actual arrangement of all structures and items of equipment installed

under the Contract, based on the Contractor`s setting out of pipe alignment/topographic surveys and other investigations (e.g. soil surveys through augers, trial pits or GPR surveys for utility detection, etc.).

The as-built drawings shall be accurate record drawings to specified quality and size, to the scales as otherwise stipulated, showing works as executed complete with existing and finished levels (top, invert and formation levels, gradients, plans, cross and longitudinal sections, locations of all junctions, valve chambers, inlets, extent of concrete beds and structure and all things necessary to form a complete pictorial record of the finished works). Also to be shown are the exact locations of existing utilities and the locations of new service ducts, cables, pipes, etc. constructed under this contract.

All reproducible as-built drawings so prepared shall be dated and countersigned by the Contractor's Representative. Each as-built drawing shall be a clear and legible reproducible on specified material. Each drawing set will be bound. During the course of the Works, the Contractor shall maintain a fully detailed record of all changes from the approval to facilitate easy and accurate preparation of the As-Built Drawing.

As-built drawings shall be compatible to the submitted GIS Data as specified below.

9.10.1 As-Built Drawings requirements

The As-Built drawings shall show the actual arrangement of all pipelines, structures, facilities and items of equipment installed under the Contract, which at least shall be the following:

a. Permanent project benchmarks with geodetic UTM reference system.
b. Plan and profile drawings of all primary, secondary and tertiary pipelines installed, with correct final coordinates and elevations, including type and size of the existing utility lines found during the works.
c. Spot surveying and permanent features in the plan view, natural ones (lakes, rivers, peaks, reefs, etc.) and manmade (in cities, houses, streets, electric poles, utility covers, street furniture, etc.)
d. Location and details of all temporary construction such as utility supports, etc., which are permanently left in place.
e. Plan drawings of all service connections with correct final coordinates.
f. The plot boundaries and the plan details of existing development within these areas
g. Plan and sections (civil, mechanical and electrical) drawings of all structures, with correct final coordinates and elevations.
h. Profiles and cross-sections of structure excavations. In addition to showing the as-built elevations, cross-sections included with the contract shall be revised to show the existing ground elevations as surveyed by the contractor prior to start of construction.
i. Final Landscaping and Surface drainage system. All usable bench marks, pipe sizes, lengths, direction of flow, and levels shall be shown. Each sheet shall include an identification legend which is identical to that shown on the Contract Drawings as well as a small scale location plan. A drainage schedule should supplement the plans if not already provided in the Contract Drawings.
j. Shop Drawings (e.g. specific manufactured drawings, specific assembly drawings in workshop before delivery at sites for specific works, e.g. valve assembly, river crossing pre-assembly, etc.) may be included in the Record Drawings set as supplementary information in order to more accurately illustrate the as built conditions. It is not mandatory to include all shop drawings. Several shop drawings may be grouped together to form one sheet if they describe a common work category as detailed in tender/contract drawings. Shop drawing details may be redrawn on the original tender/contract drawing sheets, if required, for clarity.
k. When a shop drawing is included in the as-built drawings set it may retrain its original (Contractor's) title block. If required, these shall be reproduced to the same size as described above. Other supplementary drawing shall bear the designers title block, with the Drawing No. Block left blank.

9.10.2 GIS Data requirements

Simultaneously to the preparation of the as-built drawings, the Contractor shall produce and submit GIS data in GIS platform of the constructed works geo-referred accordingly. The contractor shall conduct all necessary survey work and shall ensure that vertical and horizontal measurements shall be captured at an accuracy of

+/- 0.1m at a 95% confidence level, using the most suitable and cost-effective field data collection technology and methodology. All horizontal and vertical survey measurements will be referenced to the present KUKL GIS geo-reference.

GIS data for the project will be delivered in an ESRI ArcGIS compliant file geo-database. The Contractor will be provided the existing KUKL GIS system. The initial GIS attribute list is to be as per the attached **SECTION VI-B: PARTICULAR CONDITIONS, Appendix E.** The contractor is responsible for the base maps, platform, software and compatibility with the existing KUKL GIS system or upgrade of existing GIS to ensure that the provided GIS data can be updated in the course of time.

The Contractor will survey the three-dimensional position (x, y, z) of all point and line assets constructed under this project, e.g., exact position of SRTs, pipelines, bridge crossings, manholes, chambers, valves, dismantling joints, meters, hydrants, plugs, reducers, and tees. Nodes shall be created to clearly delineate different pipe sections in terms of material and/or diameter and to allow for future development of a hydraulic model in the GIS platform. Nodes shall also require a three-dimensional position, and through this, the position of the ends of a pipeline segment shall be defined. Point and line data (i.e., the pipeline) should be consistent with the attributes of the existing KUKL GIS. However, the Engineer and the Employer may require the Contractor, at no additional cost, to create new attributes to include non-survey data, e.g., valve model, name of the manufacturer, images or plans, etc. Prior to the field survey, the Contractor shall submit to the Engineer, for approval, the GIS design in terms of themes, feature types and attributes.

The Contractor shall develop a checklist of quality control (QC) checks for each type of deliverable and will be responsible for ensuring that these QC checks are performed. The Contractor shall assign a GIS quality officer to manage the quality review process. This officer shall be independent of the capture and production teams.

The Contractor shall be required to integrate the GIS deliverables with the KUKL existing pipe network data, i.e., ensure that the GIS data connects with existing KUKL system. This may entail revising GIS data of existing pipes at connection points.

9.10.3 Submissions of As-built Drawings and GIS Data

The progressing set of As-built Drawings and GIS data, shall be submitted along with the IPC and also included in every monthly progress report with the progress payment request of the same submitted by the Contractor. The GIS Data shall also be submitted along with As-built Drawings, as per the requirements stated above.

The final set of as-built drawings and GIS data, recompilation of all previous drawings and data submitted in the monthly progress reports, conveniently checked and modified if needed (with notice of corrections/modifications to the Engineer for final approval) shall be submitted before applying for the Taking-Over Certificate of the respective Section of the Works. Irrespective of the other contractual prerequisites no Section of the Works will be considered substantially completed until the respective As-Built Drawings have been approved by the Engineer.

The Contractor shall submit 1 (one) soft copy, in both editable (.dwg) and pdf formats, and 1 (one) hard copy print of all As-Built Drawings clearly named as such to the Engineer for approval. After Engineer's approval of the As-built Drawing the Contractor shall submit 1 (one) soft copy, in both editable (.dwg) and pdf formats, and 3 (three) prints of all As-Built Drawings.

The Contractor shall also provide a licensed copy of the drafting software (at least AUTOCAD 2018). The software shall become the property of the Employer and shall be used to view the As-built Drawings.

9.11 Operation and Maintenance Manual

The Contractor will submit an operation and maintenance manual, providing details of all the plant/mechanical, electrical and ICT facilities (valves, meters, etc.) he supplies and give details of recommended maintenance intervals and procedures.

9.12 Measurement and Payment

Unless there is a specific BOQ rate related to any item described above as to be measured and paid independently, or if it is otherwise specified in other Contract Documents with prevalence over this document, no separate measurements and/or payment shall be made for all activities/works described under this section (Submissions by the Contractor). All the cost associated with this section is deemed to be included in the other item rates of the Bill of Quantities.

10 LOCATION OF UTILITY SERVICES

Before the Contractor proceeds with the Works in any given area he is required to establish the precise location of all services in that area.

The utilities especially BDS pipeline, Primary pipeline, pumping pipeline, transmission pipeline from local sources, outlet/inlet pipelines and existing distribution pipelines shall be dismantled and relocated as required to facilitate the construction.

In such cases, the Contractor will make arrangements for discontinuing temporarily the pipe lines and make alternative arrangement of pumping line, transmission main and distribution pipelines. The utilities such as water supply pipelines, power cables and telecom cables shall be protected at site during excavation. The Contractor is solely responsible for the said utilities if any damage occurs during the excavations due to his negligence or workmanship.

The contractor is required to dig Trial Pits or trenches manually and carefully at designated locations in order to exactly locate the utilities (i.e.: water pipelines and power lines). Trail Pit Digging is a payable item of the work. The number and locations of Trail Pits shall be decided in consultation with the Engineer.

10.1 Final Cleanup

The CONTRACTOR shall promptly remove from the vicinity of the completed WORK, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the EMPLOYER will be withheld until the CONTRACTOR has satisfactorily performed the final cleanup of the SITE.

10.2 Final Testing

The CONTRACTOR shall establish dates for testing, acceptance periods, and onsite instructional periods (as required under the CONTRACT). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the EMPLOYER, the ENGINEER, and their authorized representatives sufficient time to schedule attendance at such activities.

10.3 Final Submittals

The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the ENGINEER for transmittal to the EMPLOYER:

- Written guarantees, where required.
- Technical Manuals and instructions (Operation & Maintenance Manuals)
- New permanent cylinders and key blanks for all locks.
- Maintenance stock items; spare parts; special tools.
- Completed as-built drawings and GIS data.
- Sectional Pressure tests certificates
- Functional Guarantee Tests certificates
- Testing of equipment and communication for integration into the existing KUKL SCADA system for Kathmandu Valley Water Supply Improvements
- Certificates of inspection and acceptance by local governing agencies having jurisdiction.

- Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

11 OTHER REQUIREMENTS

11.1 Record procedures

A work order book shall be maintained by the contractor at site/workshop for taking instructions from employer or his representative. The Contractor shall maintain records pertaining to the quality of installation / erection work and inspection, testing, compliance with all technical requirements in respect of all this works as described before. The Contractor shall submit such records to the Employer after the completion of any particular work before submitting the bill. All such records shall be as verified and approved by the Engineer.

11.2 Public Authorities

The Contractor shall comply with all rules & regulations, bylaws and directives given by any local or public authority in connection with this work and shall himself pay fees or charges which are liable on him without any extra cost to the Employer.

11.3 Safety of Materials supplied to site

The Contractor will be responsible for safety of the material supplied and kept in joint custody of the employer and the Contractor till completion of contract. The Contractor shall at his own expense arrange for the safety of his labour / supervisor staff employed by him directly or indirectly for performing the work, as per statutory requirement. The Contractor shall report any accident or unusual occurrence with the work at site that take place to employer immediately with the action, which he might have taken.

11.4 Acquaintance with Site and Work Conditions

The Bidder shall study the site and general conditions in respect of access to the site, method/sequence of work construction, site logistics, approaches, laborers, climate and the data included in the tender documents and get it verified with actual inspections of the site, before submitting the tender. In case of doubt about any item or data included in the tender, the same shall be got clarified in pre-bid meeting. Once the tender is accepted, it shall be concluded that the Contractor has verified and made himself conversant with all the details required for completing the work as stipulated conditions and specifications and will not be eligible for the claim related to above said.

11.5 Store Shed Repairs Shop, Office and others

The Contractor shall make necessary arrangement at his own cost for store shed, repairs shop/office meter testing etc.

11.6 Temporary hoardings for protection of work area

The contractor shall protect the work area with temporary hoardings. These hoarding shall be light weight and easy to dismantle and relocate. Their purpose is to prevent public from entering the work area and creating work hazard.

The hoarding shall be made of hot dipped galvanized iron corrugated sheet of 0.6 mm thickness, fixed on self-standing M.S. frames. The sheets shall have 100mm thick zinc coating. They need to be painted as shown in drawings. There shall be provision for interlocking the M.S. frames in order to increase its stability. The hoarding shall be at least 2.0m high.

11.7 Structure Design Requirement

During the construction, the contractor has to provide the services of a structural engineer or other engineers for temporary structures/facilities or changes or additional permanent structure proposed by the Contractor, at his own cost.

11.8 Working at Night

As some of road stretches are so busy for the existing traffic load, working on these stretches during day time is very difficult and inefficient. It is essential to work during night (Night Shift) time in order to make function traffic management plan efficiently. Also, the concerned authority may approve working only at night time for whatever reason they deem necessary.

The Contractor shall get prior approval from the Engineer before starting the work during nights. No extra payment will be made for doing the work in the nights, except if there is BOQ items. One shift will be considered as 8 hours' time period. If the night shift is less than 8 hours, then any payment will be on a pro rata basis.

12 COORDINATION WITH OTHER AUTHORITIES

As far as possible the Contractor shall acquaint himself with the actual location of all existing public utilities such as sewers, water mains, drains, cables for electricity, telephone lines, lighting poles, masts, etc., before commencing any activities likely to affect the existing utilities. The Contractor shall with the assistance of the Employer obtain such information directly from the responsible authorities as early as possible.

12.1 Permits, Licenses and Approvals

The Contractor has the responsibility to obtain any permit, license or approval as required by the Laws in relation to the execution and completion of the Works and the remedying of any defects. The Employer shall provide, at the request of the Contractor, such reason able assistance as to allow the Contractor to obtain properly the same. The Contractor shall be aware of the time process and bureaucratic procedures of the Nepali administration and shall not claim for any delay due to this matter.

Well in advance of the programmed start of any work which may affect traffic or any existing utilities the Contractor shall give advance notice to the Employer indicating the type, the exact location, the programmed starting time and the expected duration of the activities and shall provide whatever particulars may be required by the authorities to issue any required permits and make all necessary arrangements. The Employer will, without prejudice to the Contractor's responsibility to obtain necessary approvals, provide assistance and communication with the relevant authority based on the schedule/data submitted by the Contractor. The Contractor must then follow up the process for the final approval from the concerned authority.

If the Contractor fails to execute the works as per the schedule, further process to acquire the same permit will be the responsibility of the Contractor and the Employer cannot be responsible for the time to re-attain the permission/permit, etc and any delay to works due to the above said.

12.2 Witnessing and Post-Construction Clearances

It is expected that the issue of these permits will be tied to the requirement that the work may only be carried out in the presence of authorized inspectors from the authorities concerned. Their job will be to witness and assess any damage or interference with their respective utility. Should such disturbances occur it will be at their discretion to authorize either the Contractor to correct them or to arrange for specialized repairs through their own personnel.

The Contractor shall be fully responsible for all costs whatever resulting from avoidable damages of or interference with other utilities.

As proof that the activities in question have been completed to the satisfaction of the authorities concerned the Contractor shall submit to the Engineer upon request official post-construction clearances issued by the respective authorities.

12.3 Restrictions to Heavy Vehicles

The Contractor must be also aware about the restrictions to heavy vehicles during daytime in some parts of the working sites, which means that he may need to transport materials, labor and/or machinery at night in those sites. No extra payment will be made for this circumstance.

13 QUALITY CONTROL

13.1 Quality Control Plan and Procedures

The Contractor shall be responsible for establishing and maintaining procedures for quality control that will ensure that all aspects of the Works comply with the requirements of the Contract.

As soon as reasonably practicable prior to the commencement of the Works the Contractor shall submit for approval a Quality Control Plan giving detailed proposals for control of quality of all aspects of work on the Site and at suppliers' workshops.

The Quality Control Plan shall include at least the following:

a. Contractor’s Quality Policy Statement
b. a list of the Contractor's staff engaged in quality control
c. a list of any outside testing agencies employed by the Contractor for work in connection with quality control
d. where a testing laboratory is to be established on Site under the Contract, a list of major items of equipment and a layout of the laboratory, together details of the tests which will be carried out there,
e. a list of manufactured items and materials, obtained by the Contractor for the Works, which require inspection at the suppliers' premises, and the proposed procedures for ensuring quality control,
f. a list of materials and operations to be inspected by the Contractor at the various stages of construction work on Site, together with inspection procedures, test types and frequencies
g. sample of proposed quality control records, testing and reporting forms.
h. Table of test frequency and no. of materials tests required as per the test frequency

Unless the Engineer permits otherwise, the approved Quality Control Plan shall be followed throughout the construction of the Works. Any approval by the Engineer of the Contractor's plan and procedures shall not relieve the Contractor of his obligation to ensure that the Works comply with the requirements of the Contract.

The Contractor shall appoint a suitably qualified member of his staff to be responsible for all aspects of quality control and to maintain effective liaison with the Engineer.

Strict quality control during installation of pipes, fittings, valves, meters, and relocation of existing water lines and other utilities, etc. is the key to achieve targeted functional guarantee. Poor workmanship like installation by untrained pipe jointers, welders and use of non-standard equipment/materials will lead to repeated work of installation and testing which are all included in Contractor’s risk.

The Quality Control Plan shall clearly identify and update from time to time with the details of Contractors personnel responsible for installation and supervision of quality during installation, real losses assessment works. The real losses assessment works shall be taken up only under the supervision of experienced Contractor's personnel.

Implementation of any work shall be permitted only after approval of Contractor's Quality Control Plan compatible with Engineer's QAQC Manual and all works of installation and repair shall be carried out in compliance to the approved Quality Control Plan.

Quality audit shall be undertaken by the Engineer once every 3 months to verify the adherence of implementation in accordance to the approved Quality Control Plan. If the quality audit, brings out implementation issues which are notified to the Contractor in writing, the same shall be implemented and compliance demonstrated within 7 working days. In the event, the Contractor fails to implement the quality measures even after the Engineer's notification, all works shall be stopped by the Contractor and the Contractor shall take immediate action to implement suggested quality measures. All delays associated arising due to poor quality in execution is attributable to the Contractor which shall be redone at Contractors cost. All costs towards quality assurance and control are deemed to be included in the Contractors quoted rates.

13.2 Sampling and Testing

The Contractor shall provide for the approval of the Engineer, samples of all construction materials and manufactured items required for the Permanent Works. All approved samples shall be stored by the Contractor in a sample room, at a location approved by the Engineer, for the duration of the Contract, and any materials or manufactured items subsequently delivered to Site for incorporation in the Permanent Works shall be of a quality at least equal to the approved sample. The approved samples may only be disposed of with the Engineers approval. All samples rejected by the Engineer shall be removed from Site.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Engineer. Samples for testing will generally be selected by the Engineer from materials to be utilized in the project and all tests will be under the supervision of, and as directed by, and at such points as may be convenient to the Engineer.

Material requiring testing shall be furnished in sufficient time before intended use so as to allow for testing. No materials represented by tests may be used prior to receipt of written approval of said materials.

The Contractor shall give the Engineer at least 28 days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the suppliers' premises or at a laboratory approved by the Engineer or at the site laboratory and unless the Engineer shall attend at the appointed place and time the test may proceed in his absence. The Contractor shall in any case submit to the Engineer within 7 (seven) days after every test such number of certified copies of the test readings as the Engineer may require.

Approval by the Engineer as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Engineer's powers under the Contract.

The provisions of this Clause shall also apply to materials supplied under any nominated subcontract.

After all construction is completed and before applying for taking-over, the Contractor shall perform field tests as called for in the Specifications. The Contractor shall demonstrate to the Engineer the proper operation of the facilities and the satisfactory performance of the individual components. Any improper operation of the system or any improper or faulty construction shall be repaired or corrected to the satisfaction of the Engineer. The Contractor shall make such changes, adjustments or replacement of

equipment as may be required to make the same comply with the Specifications, or replace any defective parts or materials.

In addition to any special provision made herein as to sampling and testing materials by particular methods, samples of materials and workmanship proposed to be employed in the execution of the Works may be called for at any time by the Engineer and these shall be furnished without delay by the Contractor at his own cost. Approved samples will be retained. The Engineer will be at liberty to reject all materials and workmanship that are not equal or better in quality and character than such approved samples.

The tests required for quality control shall include but not be limited to:

a. tests conducted at the premises of the Contractor, Subcontractor, manufacturer or supplier which are normally or customarily carried out at such premises for the items or materials being supplied for the Works
b. tests which are normally or customarily conducted on the items or materials being supplied for the Works by the Contractor, Subcontractor, supplier or manufacturer but which have to be conducted at an approved laboratory because the necessary testing facilities are not available on the premises of the Contractor, Sub-Contractor, supplier and manufacturer
c. tests on locally obtained materials or items either on the Site or at an approved laboratory for the purpose of obtaining the approval of the Engineer to the classification, use and compliance with the Specifications of such items or materials
d. routine quality control tests conducted by the Contractor to ensure compliance with the Specifications
e. regular testing of concrete and other materials as specified in the relevant Chapters of the Technical Specifications
f. standard shop and Site acceptance tests, including trial assemblies, of Plant.

13.3 Inspection and Acceptance

The Engineer will not inspect any item of fabricated or finished work until such time as the Contractor shall have forwarded to the Engineer the approved Working Drawings covering the items to be inspected, together with copies of the respective orders.

Manufactured items and materials delivered to the Site shall be inspected by the Contractor on arrival. Any defects shall be notified to the Engineer. Minor defects to surface finishes and the like in manufactured items shall be made good in an approved manner to the satisfaction of the Engineer. Items with more serious defects shall be returned to the Contractors for correction or replacement as appropriate.

13.4 Third Party Independent Inspection

All contract/permanent work pipes, fittings, specials, meters, valves, fire hydrants, etc will require third party inspection. The Contractor will need to write in time to attain confirmation/approval from the Engineer for the material/equipment requiring the third-party inspection (TPI). The Engineer requires minimum 28 days for confirming TPI requirement for the requested material.

The Contractor is responsible to submit at least three (3) quotations from independent reputed international Third-Party Inspection Agencies (TPIA) to undertake the TPI for each inspection item/lot. The quotation should clearly detail out the cost of the inspection, i.e., item and activity wise together with the cost justification. The Engineer requires minimum 28 days after all clarification to approve the quotation.

Upon approval of the quotation of TPIA, as agreement between the Contractor and TPIA need to be formalized and duly signed. The terms of the agreement and any deviations thereafter needs to be approved by the Engineer. The Engineer requires minimum 28 days after all clarifications to approve the agreement.

TPI agreement shall include contact address (with email and phone) of technical coordinator from the TPI Agency and Expert/Inspector involved in the inspection process, among others. A copy of the formalized and duly signed agreement is then required to be provided to the Engineer to facilitate payment during the submission of upcoming IPC.

The Contractor is reminded that the Employer may also want to participate in the inspection. Accordingly, the Contractor is required to write in formally to the Engineer for each inspection item/lot providing the schedule of the inspection and the schedule should allow a minimum of 56 days for the Employer to confirm their attendance.

The Contractor is totally responsible for all activities associated with the TPI, i.e., coordination with the manufacture, TPIA, Employer; payment to the TPIA; report checking whether it is as per approved QAP or not, submission of the report, etc. For dispatch of the inspected material/equipment, the Contractor shall formally provide the TPI report to the Engineer. The Engineer will approve the TPI report after any clarifications.

Upon arrival of the material/equipment at the site, a post inspection of the said material/equipment shall be undertaken by the Engineer/Employer and/or a TPIA upon request from the Contractor. Only after approval of the post inspection, can the material/equipment be used/installed for the permanent contract works.

Any samples of materials which may be required for such tests shall be provided by the Contractor at no extra cost to the Employer.

The cost of making any such independent tests/inspection shall be borne by the Employer, unless it is shown that the workmanship or materials under test are not in accordance with the Specification, and in such case, the cost of the test shall be to the account of the Contractor.

Any materials, workmanship or completed pipes, which are shown by such independent tests not to be in accordance with the Specification shall be rejected, notwithstanding any previous certificate which may have been provided.

The engagement of the TPIA will not relieve the Contractor on any of his obligations under the Contract.

13.5 Materials/Plant Certificates

Where certificates are required by the Specifications or relevant Reference Standard, the original and one copy of each such certificate shall be provided by the Contractor.

Any vendor of any material/equipment/instrument must have an ISO 9001 Quality System Certificate to be approved, and the ISO (or equivalent standard) certificates referring to the product he manufactures.

Certificates shall be clearly identified by serial or reference number and shall include information required by the relevant Reference Standard or Specification Clause.

The timing for submittal of certificates shall be as follows:

a) manufacturer's and Contractor's test certificates shall be submitted as soon as the tests have been completed and, in any case, not less than 7 calendar days prior to the time that the materials represented by such certificates are needed for incorporation into the Permanent Works

b) certificates of tests carried out during the construction or on completion of parts of the Permanent

Works shall be submitted within 7 days of the completion of the test.

No materials, articles or items of fabricated or finished work to be supplied by the Contractor or Subcontractors which have been inspected and tested by the Engineer or the inspecting Engineer shall be

dispatched unless a Passing Certificate has been requested by the Contractor from the Engineer and subsequently been issued by the Engineer to the effect that the same are approved. Neither the Contractor nor Sub-Contractors shall make use of any materials or articles ordered by them for the purpose of fabrication until a Passing Certificate covering the said materials and articles shall have been issued by the Engineer or inspecting Engineer.

13.6 Site Records

Daily records of on-site testing and inspection shall be kept on forms of approved format. Test results shall be certified by the responsible member of the Contractor's staff. All test certificates and inspection records (including any from Contractors or other outside testing agencies) shall be clearly identified with the appropriate part of the Works to which they refer, and they shall be submitted to the Engineer together with the respective Passing Certificate.

Once each month, or at such other intervals as the Engineer may require, the Contractor shall submit in an approved form a summary of all quality control inspections and tests performed at Site and elsewhere in the intervening period.

Test results shall be summarized in tabular form or graphically or both in a way that best illustrates the trends, specific results, and specification requirements. Where the tests show that the specified requirements were not achieved, the report shall describe the action that was taken.

Each report shall also contain a forecast of quality control work likely to be carried out during the period to be covered by the succeeding report.

The Contractor shall keep detailed and up-to-date inventories in an approved form of goods and materials already approved by the Engineer for which Passing Certificates have been issued as well as of all other goods and materials subject to quality control which are on order, delivered, found faulty, lost during the work or found to be surplus to requirements. The Engineer shall have access to these records at all times.

13.7 Daily Log Book

The Contractor shall keep a Daily Log Book at each site location/area of work where major construction activities are taking place. This Daily Log Book shall be in a form approved by the Engineer and shall contain, but not be limited to, the following major items of information:

a. name of Contractor and Package No;
b. date;
c. weather conditions (max./min. temperature, hours and intensity of rainfall, cloudy, sunny, windy);
d. work carried out during the day per Section (description, quantities);
e. major equipment used at the site/work area;
f. strength of labour force at the site/work area;
g. delays (cause, effects such as idle time etc.);
h. unusual events (earthquakes, floods, fires, storms, accidents, strikes, agitation, rallies etc.);
i. visitors at Site.

Each daily log shall be signed by the responsible Site Manager of the Contractor and "noted" by the Engineer.

13.8 Measurement and Payment

Unless otherwise provided in the Contract, no separate measurements and/or payment shall be made for all materials and works required under this section. All the costs associated under this section are deemed to be included in the item rates of the Bill of Quantities.

14 SECURITIES, GUARANTEES AND INSURANCES

14.1 Performance Security

The Contractor shall provide Performance Security in the required amount and currencies from an approved bank/financial institution in accordance with Sub-Clause 4.2 of the Conditions of Contract (at his cost).

14.2 Guarantees by the Contractor

All the guarantees that the Contractor shall submit to the Employer from the Commencement Date to the date as required (i.e., Advance Payment, Retention Money recovery, etc.) are at the cost of the Contractor.

14.3 Insurance of Works and Contractor's Equipment

The Contractor shall also insure all his works and equipment against damages and losses with an approved insurance agency/ institution as stipulated in the Conditions of Contract on his own cost.

14.4 Insurance of Contractors Workmen and Employees

The Contractor shall insure all his employees and workmen against such liability as stipulated in Condition of Contract and submit the policy document to the Engineer within stipulated date on his own cost.

14.5 Third Party Insurance Policy

The Contractor shall obtain a Third-Party Insurance Policy as stipulated in the Conditions of Contract from an approved insurance agency/institution in the form acceptable to the Employer.

14.6 Insurance of Employer's Personnel

The Contractor shall insure all nominated personnel of the Employer including the Engineer's personnel against such liability as stipulated in the Conditions of Contract and submit the policy document to the Engineer within stipulated date on his own cost.

14.7 Measurement and Payment

Unless otherwise provided in the Contract, no separate measurements and/or payment shall be made for all the Insurance but, there must be submission and approval of all insurances policies including receipts by the Engineer. The Contractor shall extend the validity period of all kinds of insurances until the completion of the project including any approved extension of time given, if any. No any cost will be paid for the extension of validity period after original time of completion until the approved revised time of completion, if any.

The Employer will not pay any bank charges for Performance Security and any other bank guarantees.

15 ITEMS TO BE SUPPLIED BY THE EMPLOYER

There are no items to be supplied by the Employer. All required items to be managed by the Contractor at his own cost (please refer to **SECTION VI-B: PARTICULAR REQUIREMENTS, Appendix A**).

SECTION VI-B: PARTICULAR REQUIREMENTS (APPENDIXES)

1 Appendix A: Items Supplied by the Employer

There are no items to be supplied by the Employer in this contract.

All required items not mentioned in BOQ or elsewhere in the contract, however required to complete the works as stated in the Scope of the Works, are the Contractor's only responsibility, and are to be managed by the Contractor at his own cost, as deemed included in the other rated BoQ items.

2 Appendix B: List of Tender Drawings

The List of Tender Drawings is provided in document **SECTION VI-E: DRAWINGS**.

3 Appendix C: Resettlement Action Plan (RAP) for KVWSIP Project

The Resettlement Action Plan (RAP) for Kathmandu Valley Water Supply Improvement Project is available at Employers website kuklpid.org.np.

A specific worksite Resettlement Action Plan for this contract is not needed, as there is no land acquisition under the proposed project.

Nevertheless, working practices and the protection of people and populations living near the Project Area, but exposed to the general disturbance caused by works are to be cared and mitigated.

The social impacts of this contract are limited to the following:

- Temporary disruption of business activities and income
- Temporary shifting of vendors and hawkers during construction works within the right of way (RoW) for the DNI system.
- Temporary impact on blockage of access to house or business location
- Accidental injuries to public

Temporary disruption for pipe laying works will be for 1 or 2 days and not more than 4 days depending on unforeseen circumstances. Contractors are required to maintain access to shops to avoid and/or limit the disturbance to extent possible. Mitigation measures are incorporated into their contracts, as outlined in the Environmental Management Plan (EMP), and will be monitored by the construction supervision consultants. In the event roads are fully closed with access to shops disrupted for 5 days, as per the approved Resettlement plan of this project, only then, the compensation for lost income will be made for the time of disruption.

4 Appendix D: Environmental, Health and Safety EHS Management System Plans

The Contractor shall be provided with the Environmental, Social, Health and Safety EOHS Management Plan for Kathmandu Valley Water Supply Improvement Project on request however the following EMP/OHS related specific action points are noted below for compliance by the Contractor in his own worksite EMP-OHSP to be submitted to the Engineer as specified in SECTION VI-A.

This document is an abstract of the main documents which are available upon request. The referred main documents are entitled:

- PPTA 4893- NEP; Updated Resettlement plan, 2013 by DSC 3
- Initial Environmental Examination (IEE) of Second Kathmandu Valley Water Supply Improvement Project, Submitted by Kathmandu Upatyaka Khanepani Limited, Ministry of Water Supply, Government of Nepal for the Asian Development Bank, 2022
- Contract Documents.

This document highlights the pertinent safeguards policies of the contract: environmental, resettlement matters and Occupational Health and Safety (OHS) matters, that the contractor needs to observe and implement and comply strictly.

The EHS Specifications refer to:

a) Protection of the natural environment (water, air, soil, vegetation, biological diversity) in areas within any Project Area and its surroundings, i.e. including but not limited to access roads, quarries, borrow areas, stockpiling of backfill material, camps or storage areas;

b) Health and safety conditions to be maintained for the Contractor's personnel and any other person present on the Project Areas, or along access routes;

Any noncompliance by the contractor will surely lead to serious contractual implications (see Particular Conditions of Contract) and only the contractor is responsible for the same.

Further, the resources and associated costs for compliance of these safeguards policies should be included in the bid/contract price, irrespective if there is no item mentioned in the Bill of Quantities. Where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.

4.1 Environment Management Plan

A.1 Environmental Impacts and Mitigation

All the following statements, instructions and measures shall be compulsorily included in the Contractor's Worksite EMP to be submitted to the Engineer for approval. No approval of said EMP will be granted if omissions of this document are detected. Any omission of the statements in this appendix in the Contractor's approved EMP shall be considered to be included in the document, even if it is approved by the Engineer without them.

The environmental impacts due to the laying of pipes and construction of structures for the distribution of drinking water are discussed in this section.

Environmental impacts on the physical, biological, and socio-economic and cultural environments during the pre-construction, construction and operation and maintenance phases are discussed in detail with the mitigating measures.

The summary of the anticipated impacts and the mitigation measures are given in **Table 1** below. Further the technical specifications and works requirements to the contract are required to be referred for compliance of this plan as well.

A.1.1 Pre-construction Phase:

One of the most important aspects before construction is the identification of the likely adverse impacts and their mitigation measures before the commencement of construction works. Also important is to establish an efficient and working environmental safeguards assurance mechanism with sufficient inputs of environment and OHS specialists in consultant's and contractor's team. This is the stage of work when internal and external communication and consultation, and grievance redress mechanisms shall be established. Safeguard reporting mechanism among the employer, consultant and contractor also needs to be established at this stage of work. Moreover, the field environmental compliance monitoring checklist and the template of quarterly and semi-annual environmental compliance monitoring report shall be prepared.

Haphazard constructions of camps for workers without basic amenities could result in social stress and the degradation of the local environment. Therefore, it is very important that workforce camps with sanitary amenities at designated areas should be established.

An employment policy should be prepared so that the local people may not be deprived of the opportunities, thereby raising tensions and dissatisfaction. The local people, especially SPAF, PAF and women above the age of 16 should be employed and given first preference (Nepal Citizenship Act, 2006). Wages should be settled based on DWEC (District Wage Evaluation Committee) with the list of employees.

A.1.2 Construction Phase

a. Soil and Pipe Trench Management

Impacts likely to occur from the improvement and construction of water distribution will include trench excavations and topsoil stripping which may induce air pollution, muddy roads and slope instability. The following mitigating measures have been proposed:

Trail Trenches/Pits: The contractor has to dig trail trenches (pits) as directed by engineer at designated locations in order to exactly locate the underground utilities. The trial trenches shall be of required size and full depths i.e. invert level of pipe.

Zero soil in park area road: soil from trench excavation shall be directly deposited on standby truck or tractor, and excess soil carried away for proper disposal at an approved location by the Engineer. Excavated soil from the foundation trench shall not be deposited haphazardly on park area road at any time. The excavated soil could be used for backfilling only for sub-grade purpose. Contractor shall temporary stack excavated material in his own yard and bring back for the backfilling purpose.

Backfilling and Surface/Road Reinstatement:

The following instructions for backfilling of trenches and surface/road reinstatement shall be applied in the construction works:

- Supply proper graded sub-base and base material of a specification as approved by the Engineer. The road shall be cleaned daily either manually or mechanically i.e. washed/vacuumed until the road is sealed temporarily.
- The backfill needs to be completed within the same day, immediately followed by reinstatement with sub base material within the same day and base material the following day unless due to unforeseen circumstances.
- The sub base and base material road surface shall be rolled daily as required or minimum 4-5 days for removal of undulation after reinstatement.
- Sealing of the pipe laid trench area with asphalt (temporary cold emulsion or permanent asphalt concrete) shall be undertaken within one week of the pipe installation works of a particular stretch. No pipe laid trench area, shall be left not sealed with asphalt for more than 7 days.
- Stone and brick pavements, particularly in heritage areas and old city areas shall be reinstated properly using required percentage of new stone and bricks within a day of opening the trench. Skilled labour in laying stone and brick pavements shall be kept at standby by the contractor at all times.

- Contractor to have standby machinery (per say Backhoe loader and 10T roller) 24x7 to "rescue" any vehicles bogged in the trench area for a minimum 3-4 days after pipe laying for the particular day of road stretch that had been worked.
- Contractor is reminded that the Employer/Engineer can engage others at Contractor's cost to undertake any non-compliance of the above said.

Shoring: For trenches deeper than 1.5 m or as directed by the Engineer, shoring is to be installed in order to stabilize the slope/cut.

Pressure test: first stretch of the pipeline is to be tested upon laying 300m for a particular diameter, only then second stretch pipeline work can be allowed to be laid while first stretch is tested. However, third stretch of pipe laying shall not be allowed until 1st stretch of 300m is pressure tested and has passed it satisfactorily.

b. Pollution (air, noise and vibrations)

Earth excavation, scarifying and road clearing for priming will produce dust (TSP, PM10), hydrocarbons (CO, CO2, CH4), SO2, NOX, H2S, etc., noise and vibrations. This will increase noise levels to above 90 dB affecting health. **Annex 1** gives the national ambient air quality standards for Nepal and **Annex 2** Recommended noise exposure limits.

Trench dust control: in order to control the air/dust pollution, water is to be sprinkled by the contractor minimum 3 times a day on daily basis or as instructed by the engineer, until the road is sealed.

c. Damage to Utilities and Relocation

During the construction phase numerous utilities may be damaged. In order to prevent utility damage, the contractor has to dig trail trenches (pits) as directed by engineer in the Project Roads and sites at designated locations to exactly ascertain and verify the underground utilities. These trail pits shall be a paid item in the Bill/Contract and all its records are to be submitted to the Employer/Engineer.

Services/utilities identified during trial pits i.e. known utilities shall be protected, removed or diverted before the commencement of the permanent works.

Special attention is drawn to the Contractor for management/taking care of the utilities and the associated responsibilities as follows:

- The temporary diversion, support, and protection of any existing services and/or utilities known or found during works shall be at the cost of the Contractor.
- The repairing of damages of any existing services and/or utilities known or found during works shall be at the cost of the Contractor and shall be repaired before backfilling the excavated trench.
- The final relocation of any existing services and/or utilities known or found during works, needed because collision with the construction of the permanent works, and approved in written by the Engineer, shall be at the cost of the Employer.
- The provisional sums stated in the BoQ for payment of damage repairing of some utilities will be only used for compensation charges of works carried out by the specific utility companies by themselves, when the damage cannot be solved directly by the contractor, this circumstance approved by the Engineer, and until the PS approved amount is exhausted.

The Contractor is reminded that the Employer/ Engineer can engage others at Contractor's cost to undertake any noncompliance of the above said.

d. City Aesthetics

Contractor shall implement the work by maintaining the aesthetics of the capital city and the old heritage sites at all times, and shall undertake the following:

- All green nets shall be proper, clean and tightly hung on blue colored metal stands

- All signboards shall be clean and properly mounted on stand and kept at appropriate location, as instructed by the Employer or his authorized representative
- All hard barricades shall be painted with blue colour or covered with flexi sheets with beautiful pictures or awareness generation materials
- Public notice board with start and completion date of work for a length of road, and the name & address of the project office, contact person's name, and contractors name shall be placed at all work sites
- Ugly looking old and damaged equipment, plant and vehicles shall be restricted for use in the project work. Only vehicles, equipment and plants looking decent with repair and proper layer of paint shall be allowed by the Engineer to be used for the project work.
- Separate colour of hard hat and jacket shall be used for various division of labour
- All drivers working for the project shall use designated hard hat and jacket at all time

e. Mitigation and Monitoring:

Anticipated environmental impacts and mitigation measures have been dealt in detail in **Table 1**. The Table list the environmental impact, its mitigating measures; the parameters to be monitored (including location, measurement and frequency) and the party responsible for the cost. The program will evaluate the extent and severity of the adverse environmental impacts as compared to what was predicted, how effective the mitigating measures were and compliance with the regulations and the Overall effectiveness of the EMP.

The environmental monitoring of the Second Kathmandu Valley Water Supply System Improvement Project includes field supervision and reporting of project activities prior to and during the project construction and operation in order to ensure that the works are being carried out in accordance to the approved design and that the environmental mitigation measures are fully implemented in accordance with the EMP. To help timely identification of the actions needed for correction, a system of monitoring has been proposed involving i) front line monitoring ii) monitoring by the government line agencies or independent monitors and iii) auditing through the involvement of government agencies, donor agencies and independent auditors.

Contractor must take special precautions for public safety to minimize the scale and extent of disruption to public and commercial life. See also the safeguards checklist – **Table 2** which needs to be complied in totality and all cost shall be included/ apportioned in the bid/contract price. Different checklists have been developed as per the nature of works. On the basis of these checklists monitoring will be done regularly and will be evaluated out of total 100 scores. Scoring of marks below 70 will result in stopping of the work.

f. Environmental Reporting

Monthly monitoring report of environmental parameters during construction phase: noise, air/dust pollution, etc. (see Table 1).

Quarterly and semi-annual environmental compliance monitoring report shall be prepared.

4.2 Occupational Health and Safety Plan

GON is highly committed to Health and Safety of its all projects. Thus, Contractors must strictly refer to Nepal Government's Policies and ADB's Policy Paper i.e. ADB's Safeguard Policy Statement, June 2009 for the compliance of Health and Safety matters in their packages. Any noncompliance by the contractors will surely lead to serious contractual implications and only the contractor is responsible for the same. Further the resource and associated cost for compliance should be included in the bid/contract price, irrespective if there is no item mentioned in the Bill of Quantities, it is deemed that all associated cost has been adequately considered/apportion in the contract price.

B.1. Contractor's OHS Management Responsibility

1. OHS plan and Policy

OHS policy is to be submitted as per Good International Industrial Practice (GIIP) and signed by the top management of the Contractor. Contractor is to conduct management reviews regularly with a set of clearly

defined input/agenda items to be discussed in the meeting and action items to be circulated to relevant parties. Follow-up of the action items to be taken accordingly. The contractor shall submit its reports to the Employer/Engineer.

Contractor shall develop, implement and submit an auditable safety management system, as per ADB's Safeguard Policy Statement requirements. The contractor shall then prepare specific H&S manuals for the different activities being carried out on site OR job specific SOPs (Standard Operating Procedures) shall be developed and implemented in-line with the manual that supports and provides further detailed information on OHS aspects of the activities. This safety management plan shall also cover works to be performed by sub-contractors. Such Plan and SOPs must be submitted to Employer/Engineer before the start of job and no activity will be allowed to start unless the SOPs for the same has been approved by competent authority of Employer/Engineer.

The minimum topics to include in OHS Plan are listed in Annex 3.

2. Training

Contractor shall provide following trainings to their staffs/workers:

- Training program must include minimum of OHS training, visitor orientation, new task employee and contractor training, area signage, labelling of equipment, hazard communication and any other as required by law and/or site-specific hazards.
- Staff training plan based on the Training Need Analysis to their labours and field staff in their local language.
- Risk assessment training to their OHS officer as per ADB requirements.
- Accident investigation and root cause analysis training to their Site HSE staff along with site supervisors.
- Contractor's OHS officer shall be trained on near miss reporting and analysis system.
- Develop and maintain a program of training and exercises to ensure competency of all individuals and teams involved in the emergency response, in accordance with national and ADB requirements.
- Site specific emergency plan trainings to its staffs/workers. In this training the staffs/workers shall be made aware of their roles and responsibilities in emergency situations.
- Provide first aid, survival, lifesaving and fire-fighting training to its staffs/workers. Where applicable, contractor shall provide fit-for-purpose survival equipment; first-aid equipment, life-saving equipment, fire-fighting equipment and oil/chemical spill equipment and ensure that they are competent in its use.

Unless otherwise agreed with Engineer/Employer in writing, all training is at contractor's cost.

3. Reporting

Contractor shall prepare and submit a number of reports. The reports include:

Submit reports of audits, reviews and inspections to Engineer/Employer.

Demonstrate effective implementation of findings from audits, reviews and inspections.

Submit on a monthly basis an OHS Performance Report to Engineer/Employer. See also the checklist which needs to be complied in totality. Besides the checklist this report shall contain the following data, as related to the work:

- Progress against implementation of the Contractor OHS Plan.
- A list, including a brief description, of all incidents (including near misses and potential incidents)
- Exposure hours (including Sub-contractor exposure hours), broken-down per worksite/location
- Number of Fatalities
- Number of Permanent Total Disabilities

- Number of Lost Workday Cases
- Number of Restricted Workday Cases
- Number of Medical Treatment Cases
- Number of First Aid Cases
- Leading performance indicators as agreed with the contractor. This may include numbers of OHS training hours, inductions, management visits, review meetings as planned, toolbox talks, inceptions/audits as planned, safety observations, completed worker health surveillance, quality of risk assessments and consultative meetings as planned.

Contractor shall allow access to Employer/Engineer/ADB staff for OHS audit as and when required. OHS Audit Content is shown in **Annex 4**.

4. Contractor's Responsibilities on OHS

Regarding the OHS Plan, the Contractor shall:

- Appoint a safety officer at site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the works, the contractor shall provide whatever is required by this person to exercise this responsibility and authority.

  The Contractor's appointed Safety Officer shall:

  - Conduct risk assessment, prioritize hazard and determine its control measures meeting the legal requirements. He/she shall inspect the site to ensure it is hazard free. These hazards must include physical hazards (rotating and moving parts, noise, vibration, electrical, eye hazards, welding and hot work, industrial vehicles and site traffic, work environment temperature, ergonomics and manual handling, work at height and illumination etc.), chemical hazards (air quality, fire and explosions, corrosive and reactive chemicals, asbestos) biological hazards, radiological hazards, PPE and special hazard environment (confined space, lone workers). This assessment shall be well documented.
  - Provide OHS trainings to Engineer/Supervisor level staff on topics including Risk assessment, Incident investigation, Legal and project OHS requirements, Safety management systems, Scaffold safety, moving equipment, manual handling etc. Records of such trainings shall be maintained for audit purposes.
  - Develop, implement and improve a set of instructions for each activity and conduct regular toolbox meetings at each site. See annex 2 for different topics to be included in Toolbox meetings.
  - Verify that all tools and equipment are adequate and safe for use. He/she shall maintain tagging system of his/her inspection.
  - Develop, implement and improve emergency plans. He/she shall train labours on how to manage emergency situations and carry out emergency response drills regularly.
  - Develop, implement and improve the permit to work system.
  - Conduct all incident investigations inclusive of near miss incidents, verify injury logs and maintain its records.
  - Maintain documentation and prepare monthly reports inclusive of analysis of all OHS related activities. This OHS officer shall perform audits, reviews and inspections on the worksite as required by Safety Management Plan or by Engineer/Employer.
  - Ensure that all staffs/workers are aware of contractor's emergency procedures.

- Appoint a dedicated OHS team comprising minimum of 1 safety officer, 2 safety assistants and 4 workers responsible for maintaining safety. This person shall be qualified to fulfil their responsibilities. The safety assistants are to be trained by Safety officer. Contractor shall provide all necessary support to the team to exercise this responsibility and authority. Contractor shall maintain a personnel list of the OHS team along with their names, minimum requirements for OHS competency, relevant qualifications and their critical OHS role. Contractor shall provide this information upon request by the Engineer/Employer.
- Identify and minimize, so far as reasonably practicable, the causes of potential hazards to workers. And provide preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances
- Provide appropriate equipment to minimize risks and requiring and enforcing its use.
- Training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment.
- Having emergency prevention, preparedness, and response arrangements in place. Documenting and reporting occupational accidents, diseases, and incidents
- Introduce a system of site ID card after the labours attend induction training. Contractor shall also introduce monthly colour coding system of tools and equipment.
- Develop, implement and improve a system to maintain the uniformity between the sites and colour coding of signage being installed on site.
- Provide Standard of worker's accommodation as per applicable ADB/Nepal Government's guidelines/requirement.
- Develop, implement and improve a system of workers' health surveillance and regularly submit such reports to Employer/Engineer.
- An emergency vehicle standby at their sites at all times.

Table 1: Environmental impacts and Mitigation Measures

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
Detail design								
Incorporation of sloped areas in project design	Soil erosion and slope instability	Incorporate measures and sites for handling excessive spoil materials Incorporate drainage plan in final design	Contractor's SEMP with design on drainage incorporation and spoil material dumping site	Project Site	Design report	PID	Once	No additional cost needed
Manual preparation	Health and safety of community and workers	Prepare training manuals in Nepali with sketches on community health and safety and potential occupational health and safety	Review information for errors and quality	Project Site	None	DSC/PID-SSU	Once	Cost allocated in respective BOQ item
Pre- construction								
Apply for relevant permits	Delay in project due to absence of necessary statutory permits and approvals	Apply for all tree cutting, Archaeology, road cutting, etc., if required. This is to be done early in the design period. Consult relevant authorities and submit applications to get approvals. Submit such agreement and permits to DSC for official information. Obtain Letters of Approval and agreement for: (i) temporary acquisition/easements of land and properties;	Letter of approval, permits and submitted to DSC for information/action	Project Site	Approvals received from authorities or not	Contractor/DSC/ PID	Once	No additional cost required

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
		(ii) disruption of water supply and other utilities; (iii) required permits from relevant authorities						
Identify the temporary areas, if required by the project and locate them with proper marking	May result in social tensions	Prepare the details of contractor's temporary land use and other private properties and discuss with owners	• List of selected locations Review agreements/ meeting minutes with owners	Project site	Record verification	Contractor/DSC/ PID	Once	No additional cost required
Construction of work force camp	Haphazard camps resulting in social stress and degradation of local environment	Establish the work force camps in designated sites as per IFC EHS Guidelines and in consultation with local community. All camps are to be included with sanitary facilities for men and women.	Ensure labor camps are identified in contractor's design Ensure workforce camps are established within designated area Records of vegetation and other properties maintained	Project Site	none	Contractor/ DSC	Monthly	Cost allocated in respective BOQ item
Air quality Monitoring (Base line)	Social stress	Monitoring of Status of ambient air quality	Air sample collection and analyses by accredited third party laboratory	Project Site	PM_{10}, SPM	DSC/Contractor	Quarterly	Cost allocated in respective BOQ item
Noise Level Monitoring	Social stress	Monitoring of Status of Noise	Noise level analysis by in house laboratory or	Project Site	Sound level (dBA); feedback	DSC/Contractor	Quarterly	

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
(Base line)			accredited third party laboratory		from nearby residents			
Construction phase: Physical environment								
Disposal of excess materials in designated area only.	Soil erosion, and slope instability due to topsoil stripping and excavation for trenches and structures. Surface water discharges to local drainage from trench construction.	Separate stockpiling of topsoil for further use; spoil disposal at designated and stabilized sites; excavated areas backfill to be compacted and include replacement of topsoil; adopt cut and fill approach; avoid work during the rainy season as much as possible; Soil / sand stockpiles to be graded to prevent erosion. Shoring adopted to prevent soil collapse.	Standby truck or tractor to carry the excess soil for proper disposal at an approved location by the Engineer Management of excessive spoil materials	Project Site	Visual inspections and the local people's views if excavation and other site works have been taken offsite immediately and whether spoils have been disposed in approved areas or not and whether the contractor has taken mitigation measures or not.	Contractor/ DSC	During construction (Daily/Weekly)	Cost allocated in respective BOQ item
Quarrying from river bed	Change in river hydrology and morphology	No quarrying/mining activities in river/streams				Contractors/DSC		
Dumping of waste in the river;	Water and land pollution	Provide designated areas with collection bins for wastes.	Water quality and health status of workers before and during construction	Project Site	Baseline water quality of receiving water (complete physical, chemical and	Contractors/DSC	Quarterly	No additional cost required

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
Construction of toilets in the camps; Storing of materials in the project area; Handling of toxic materials; Dumping of excess material;		Provide toilet facilities with septic tank and prohibit open defecation. Prohibit washing of vehicles next to rivers and streams. Proper storage of construction aggregates, hazardous and toxic materials, lubricating oils and used batteries in safe areas and the proper segregation and disposal of chemical containers, packaging materials, plastic bags etc. Provide training to workforce on environmental mitigation and management.	Production and management of solid waste		bacteriological tests). Health of workers in camp Check amount of solid waste generated and if solid waste management is carried out efficiently.		Monthly during the construction period	
Quarrying operations; Movement of vehicles; Operation of crusher; Earthworks; Stockpiling of construction waste and construction materials	Air quality deterioration, Impact on nearby houses. Health impact of workers	Dust suppression on roads or at open sites by sprinkling water as required at regular intervals. Cover earth stockpiles using plastic sheets or cement jute bags while spoil shifting. Limit vehicle speed. See that vehicles comply with the National Vehicle Mass Emission Standards, 2056 BS. Regular maintenance of vehicles. Provide proper ventilation in confined working areas.	Air quality analysis Implementation of dust control procedures Vehicle maintenance records, renewal of “green stickers”.	Project Site	PM_{10}, SPM Visual inspection if water is sprinkled or not Check maintenance records and “green stickers”	Contractor	Quarterly During construction/ everyday Quarterly	

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
Movement of vehicles; Operation of construction machineries and equipment; Horn honking	Noise	Monitoring of noise levels regularly at site to meet the noise standards Fit mufflers in vehicles to control noise. Limit the speed of vehicles. Regular maintenance of equipment and vehicles Compensate and repair the damages caused by vibration if caused by construction activities. Prohibit the horn honking	Adoption of noise level control measures as specified	Project Site	Sound level (dBA); feedback from nearby residents Check vehicle maintenance records; renewal of "green stickers"	Contractors/DSC	Quarterly	LS cost allocated in air and noise quality monitoring
	Air quality	Monitoring of Status of ambient air quality and comparison with baseline established in Pre-Construction phase	Adoption of air quality level control measures as specified	Project Site	Increase water sparkling measures	Contractor/DSC	Quarterly	LS cost allocated in air and noise quality monitoring
Construction phase: Biological environment								
Vegetation clearance	Vegetation clearance	Avoid tree cutting, Use of LPG cylinder for cooking	Availability of LPG/Kerosene	Project Site	Check availability of	Contractor/DSC	Regularly	Cost in BoQ Items

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
					LPG gas to the work force			
Construction phase: Socioeconomic environment								
Laying of DNI pipes on roads	Temporary easements and impacts to business activity including temporary relocation of vendors.	• Prior to construction, hold community meetings to inform them of construction works. Distribute project information. Advanced notice should be provided at least 1-2 weeks in advance. • Place KULK/PID phone hotline on signs in visible areas. Make community fully aware of grievance mechanism and provide contact info of PID and KUKL branch offices • Prepare traffic management plan • Erect traffic diversion signs including necessary barricades • Maintain access to avoid disturbance to residents and businesses by providing planks and leaving spaces for businesses and residents to maintain access. • Manage traffic flows, conduct Lighting where possible • Open trenches shall backfill quickly after the work completed to extent possible • Shoring trenches sides as per contract specifications	Community meeting minutes Visual inspections of project information boards, Grievance records	Project Site	Check meeting minutes	Contractor /DSC/Grievance Redress Committee/PID	During construction (Daily/Weekly)	Cost in BoQ Items

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
		• Avoid full street closure to fullest extent possible • Businesses losing income due to disturbance, are compensated as per the resettlement plan. • Avoid involuntary displacement • Temporary sites to be restored to natural and stable conditions as per agreement with land owner • Proponent report in writing that temporary areas have been vacated and restored to pre-project conditions before acceptance of the works • Provide employment opportunity to the affected people to extent possible • Assist vendors in shifting prior to construction and to return to original location when construction is complete in relevant sections • Avoid disturbance to tourist areas						
Reinstatement of damaged community services and infrastructures	Reinstatement of community services and infrastructures	• Compensate or reinstate/relocate community assets that are disturbed such as irrigation canals, electricity poles, telephone lines, drinking water pipes, sewerage lines, roads, etc. to the satisfaction of the people.	Reinstatement of damaged infrastructures	Project Site	Field observation to visually assess if disturbed community assets are reinstated.	Contractor/DSC	Once construction in the area/ stretch is over.	Cost in BoQ Items

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
		• Avoid disturbance to any culturally significant buildings or structures by taking necessary precautions (work away from any culturally significant buildings, hand digging, no heavy equipment, etc.)						
Influx of outside workforce, money and unwanted activities	Increase in crime and community stress	Prohibit gambling and alcohol consumption in contractors' campsites. Instruct the outside workforce to respect the local cultures, traditions, rights etc. Provide security in contractors' camps.	Situation of social disharmony awareness program	Project Site	Crime records and causes; camp issues; enforcement of remedies; security situation in camps.	Contractor /SGU/DSC	Once a month	No additional cost required
Health and Safety issues at work areas	Health and hygiene (Unsafe working conditions, accidents, fire hazard, transmission of communicable diseases etc.)	Ensure protective measures (fencing and/or barriers) to protect public from construction site Provide regular health check-ups, proper sanitation and hygiene at labor campsite, and control of epidemic diseases to the workforce. Launch awareness programs concerning human trafficking and the possibility of spread of STDs and HIV/AIDS using brochures, posters, and signboards	The use of safety equipment by workforce The provision of health measures and training Awareness program, Signs and posters, Compensation for health	Project Site	Health records; records of outbreak of diseases; maintenance of health clinic; health complaints; number of awareness programs launched; number of persons trained.	Contractor /SGU/DSC	Annually	Payment will be on cost basis from PS

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
		Make available first aid kits, and fire extinguishers in campsites Provide insurance to the workers and training in OHS and community health and safety. Ensure all work areas are clearly demarcated and marked and protect public from getting near to the trenches. Provide alternate potable water supply during maintenance works and notify the public in advance. Coordinate with local authorities (police, local area committees, etc.) to manage traffic during construction period. Employ sufficient staff to monitor OHS issues at site Prepare safety management plan as per ADB's safeguards policy statement/guideline Conduct training on health and safety and environmental mitigation measures						
Project activities relating to health and safety issues at work areas	Health and hygiene (Unsafe working conditions, accidents, fire hazard, transmission of communicable diseases etc.)	Provide regular health checkups, proper sanitation and hygiene, health care, and control of epidemic diseases to the workforce. Make available first aid kits, and fire extinguishers in work site	The use of safety equipment by workforce The provision of health measures and training	Project Site	Health records; records of outbreak of diseases; maintenance of health clinic; health complaints;	Contractor /SGU/DSC	Annually	Payment will be on cost basis from Provisional Sum

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
		Make available protection gears (PPEs) to all workers/supervisors and compensate for the loss of life or any type of injuries. Provide insurance to the workers and training in OHS on Health and Safety. Provide alternate potable water supply during maintenance works and notify the public in advance.	Awareness program, Signs and posters, Compensation for health		number of awareness programs launched; number of persons trained.			
Work in archaeological and/or heritage areas	Loss of archaeological and cultural sites; Finding of any archaeological artefact during excavation works. Heritage buildings and character of heritage areas;	• Obtain permit from DoA, if required.	Letter of approval, permits and submitted to DSC for information/action	Project Site	Approvals received from authorities or not	Contractor/ DSC/PID	Once	Archaeological project Required
System Stabilization Services								
Project activities relating to health and safety issues at work areas	Health and hygiene (Unsafe working conditions, accidents, fire hazard, transmission of communicable diseases etc.)	• Provide regular health check-up, proper sanitation and hygiene, health care, and control of epidemic diseases to each workforce. • Make available first aid kits, and fire extinguishers in work site • Make available protection gears (PPEs) to all workers/supervisors and	• The use of safety equipment by workforce • The provision of health measures and training • Awareness program, Signs and posters, Compensation for health	Project Site	Health records; records of outbreak of diseases; maintenance of health clinic; health complaints; number of awareness programs launched; number of	Contractor/DSC	Annually	No additional cost. Cost included in overall BOQ prices.

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
		compensate for the loss of life or any type of injuries. • Provide insurance to the workers and training in OHS on Health and Safety. • Provide alternate potable water supply during maintenance works and notify the public in advance.			persons trained.			
Water quality	Water quality does not meet national drinking quality standards	Conduct regular monitoring of water quality from treatment plants and service reservoirs to ensure water delivered to public meets national standards • Provide safe drinking water to public	• Water quality analysis	Project site	Baseline water quality of receiving water	Contractor/DSC	Regularly	Operation Cost KUKL/DNI System maintenance by the contractor
Operational phase								
Project activities relating to health and safety issues at work areas	Health and hygiene (Unsafe working conditions, accidents, fire hazard, transmission of communicable diseases etc.)	• Provide regular health check-up, proper sanitation and hygiene, health care, and control of epidemic diseases to each workforce. • Make available first aid kits, and fire extinguishers in work site • Make available protection gears (PPEs) to all workers/supervisors and compensate for the loss of life or any type of injuries. • Provide insurance to the workers and training in OHS on Health and Safety.	• The use of safety equipment by workforce • The provision of health measures and training Awareness program, Signs and posters, Compensation for health	Project Site	Health records; records of outbreak of diseases; maintenance of health clinic; health complaints; number of awareness programs launched; number of persons trained.	KUKL	Annually	Operation Cost KUKL

Project Activity	Environmental Impacts	Mitigation Measures	Parameters to be monitored	Location	Measurement	Responsibility	Frequency	Mitigation Cost (NRs)
		• Provide alternate potable water supply during maintenance works and notify the public in advance.						
Water quality	Water quality does not meet national drinking quality standards	Conduct regular monitoring of water quality from treatment plants and service reservoirs to ensure water delivered to public meets national standards Provide safe drinking water to public	Water quality analysis	Project site	Baseline water quality of receiving water	KUKL	Regularly	Operation Cost KUKL

Table 2: Safety, Environment and Social Safeguard (SESS) Checklist

Table 2.1: DNI CONTRACTS EMP MONITORING CHECKLIST

Purpose:	Review contractor's EMP/SEMP compliance performance during work implementation
Frequency:	Daily/Once a week (as required) when work is on-going
Stage:	Construction Stage and when work is on-going at the particular site
Responsible:	Project Staff/Environment Expert of Engineer and Contractor's staff (PM, safeguard, and safety staff)- Jointly

Project Detail			
Contract Package:		Weather (√):	
Name of Contractor:			
Name of Site In-charge:		Municipality:	
Name of Safeguard/Safety Staff and others with contact no:		Ward No:	Tole:
1.	3.		
2,	4.		
Workers			
Number of workers (number):	Female:	Male:	Child:

SN		Activities	Yes (√)	No (√)	Full Mark	Score	Corrective Action Agreed with Deadline
1	Occupational Health and Safety	Work implemented only when the site engineer/ supervisor and safety officer is present at site			2		
		Camp structure constructed, and facilities is provided as per the PID standard attached to CA. No tarpaulin tents are used			4		
		Few readymade tents at stock to use for isolation in case of emergency such as COVID infection			2		
		Health of workers screened during intake, and periodic health check-up (2 times a year)			2		
		% of workers using full set of PPEs (hard hat, reflective jacket, gloves, goggles, boot, face mask, safety belt etc.			3		
		Camp site fenced and guarded			2		
		Work site hard barricaded and unauthorized people prevented from getting close to work area			4		
		First Aid Box at site at all time. Group leader trained in using the First Aid.			2		
		Medical Room with fulltime health worker arranged. Required emergency supplies and sick bed available. Standby vehicle in case of emergency			4		
		Emergency contact person name and number available with workers			1		
		Clean drinking water is available at work site			2		
		Mobile and moveable PVC toilet provided at site. Toilet of local residents shall not be used.			2		

SN		Activities	Yes (√)	No (√)	Full Mark	Score	Corrective Action Agreed with Deadline
		Shoring done in trenches as per design?			3		
2	Noise, Air, Water Quality	Water spraying at regular intervals (3 times a day) to suppress dust but not create water pool and mud as instructed by the Engineer and apply temporary sealing			4		
		Noise level measurement near sensitive receptors at agreed frequency			2		
		Tested and clean water supplied to work sites			3		
3	Access without obstruction; Housekeeping in work area	Steel plate to cross trench of BDS & DNI Pipeline by public is available at site			4		
		Depending on road/lane width, half portion is left clean & open for traffic during construction			4		
		Keep trench length not more than a pipe length or 30m and backfilled on the same day			3		
		Are pipes stored and properly stacked at designated location near the site and not at the work location causing visual nuisance? Safety during loading and unloading properly followed?			3		
		Are construction materials covered while transporting and storing?			3		
		Standby truck or tractor carries the excavated and excess soil immediately upon excavation for proper storage & disposal at approved location (Zero Soil Concept)			5		
		Wheelbarrow used to carry the excavated and excess soil at the site in narrow lanes where no access to trucks			5		
		Is the material stored safely without causing load on trench wall and make them cave or material falling in the trench?			2		
		Construction materials (aggregates, unused & damaged pipes, signage board) removed after laying pipe, backfilling and compaction			5		
		Excess soil is not disposed at the waterbodies			3		
4	Signage	Standard signboard for safety, SOP information used as per PID standard and placed at required locations			3		
		Proper traffic diversion signboard used as per PID standard and placed at required location with priority at entry and exit points of a lane			3		
5	GRM	Safety Desk at site and operational			3		
		Grievance register kept at site and office			3		
6	Damaged Utilities Repairs	Availability of record keeping system for damages in private and community infrastructure services/utilities			2		
		Repair of damaged social utilities (within agreed period- generally 2 days). Alternative arrangement made			4		

SN		Activities	Yes (√)	No (√)	Full Mark	Score	Corrective Action Agreed with Deadline
		Backfilling and compacting of trench the same day after completion of work. Temporary sealing of blacktop or concrete road within 2 days			3		
TOTAL					100		
TOTAL (%)							

Note: Assign points of high importance to certain "Activities" and if even half score is not met for those points, the total scoring could be considered as not met the requirement even if all the other points are met.

Monitored by: DSC/CASSC/PID:	Contractor Representative:
Name:	Name:
Signature:	Signature:
Date:	Date:
Mobile no.:	Mobile No

Table 2.2: SRT CONTRACTS EMP MONITORING CHECKLIST

Service Reservoir Tank

(Confined area)

Purpose:	Review contractor's EMP/SEMP compliance performance during work implementation
Frequency:	Daily/Once a week (as required) when work is on-going
Stage:	Construction Stage and when work is on-going at the particular site
Responsible:	Project Staff/Environment Expert of Engineer and Contractor's staff (PM, safeguard, and safety staff)- Jointly

Date: Time:

Project Detail			
Contract Package:		Weather (√):	
Name of Contractor:			
Name of Site In-charge:		Municipality: Ward No: Tole:	
Name of Safeguard/Safety Staff and others with contact no:			
1.		3.	
2,		4.	
Workers			
Number of workers (number):	Female:	Male:	Child:

SN	Item	Activities	Yes (√)	No (√)	Full Score	Score Card	Corrective Action Agreed with Deadline
1	Occupational Health and Safety	Work implemented only when the site engineer/ supervisor and safety officer is present at site			2		
		Camp structure constructed, and facilities is provided as per the PID standard attached to CA. No tarpaulin tents are used			6		
		Few readymade tents at stock to use for isolation in case of emergency such as COVID infection			1		
		% of workers using full set of PPEs (hard hat, reflective jacket, gloves, goggles, boot, face mask, safety belt etc.			3		
		Site fenced, guarded, people registered at entry in camp.			2		
		Site landscaped with proper drainage system. No water pools in the site			2		
		Separate movement path for people and vehicles clearly demarked inside the site			2		
		First Aid Box at site at all time. Group leader trained in using the First Aid			2		
		Medical Room with fulltime health worker arranged. Required emergency supplies and sick bed available. Standby vehicle in case of emergency			4		
		Emergency contact person name and number pasted in the camp and available with workers			1		
		Emergency assembly point demarcated?			1		

SN	Item	Activities	Yes (√)	No (√)	Full Score	Score Card	Corrective Action Agreed with Deadline
		Health of workers screened during intake, and periodic health check-up (2 times a year)			2		
		Fire extinguisher available at site & camp and workers trained to use them			2		
		Double insulated wire used at work areas and camp			3		
		Clean and hard safety barricades used at site			5		
		Shoring done in trenches trench >1m depth?			5		
		Construction material kept at minimum 2m distance away from trench			2		
		Guard rail and three board working platform arranged during work at height?			5		
		Construction materials (cement, aggregate, rebar, scaffolding, formwork, fuel & lubricant) and waste stockpiled properly at designated location			3		
		Operational procedure for use of construction equipment is prepared and provided to worker			2		
		Site area/path is clean of nail, rods, bricks, and other sharp materials for safety of workers			3		
		Chemical and fuel stored properly (impervious platform with drain/sump well, spill kit available)			2		
		Cement slurry, chemicals, oils is not discharged over the ground			2		
2	Noise, Air and Water Quality	Noise level monitored at agreed frequency			2		
		Earplug used by workers at noisy area			2		
		Drinking water supplied at camp and work site tested at agreed frequency			2		
		Water reserved for 48 hours at all time			2		
		Volumetric air sampler placed near sensitive receptor and measured at required intervals			2		
		Proper water sprinkling done to suppress dust			4		
3	Signage	Standard signboard for safety, SOP, traffic prepared as per PID standards and placed at right location			2		
4	Community Safety	Safety Desk at site and operational			3		
		Grievance register kept at site and office			2		
		Common access road kept clean of potholes and dust if used by project vehicle			2		
5	Solid Waste	Solid waste at camp and work area properly segregated and disposed. Burning is restricted			3		

SN	Item	Activities	Yes (√)	No (√)	Full Score	Score Card	Corrective Action Agreed with Deadline
6	Sanitation Facilities	Sufficient number of toilet and bath with water arranged			2		
		Separate toilet for male/female			2		
		Toilet wastes discharged into septic tank			2		
		Bathing/washing/cooking water discharged into sewer or septic tank after storing in collection pit			2		
		Separate kitchen and dining provided. No cooking and eating inside cabins			2		
		Drainage management at the site			2		
TOTAL					100		
TOTAL (%)							

Notes:

- If the work is being done in confined space, then confined space checklist needs to be filled.
- Assign points of high importance to certain “Activities” and if even half score is not met for those points, the total scoring could be considered as not met the requirement even if all the other points are met

DSC……/CASSC/PID	**On behalf of contractor**
Name & Position:	Name & Position:
Signature:	Signature:
Date:	Date:

Annex 1: National Ambient Air Quality Standards for Nepal

Parameters	Units	Averaging Time	Concentration max	Test Methods
TSP	µg/m^3	Annual	-	High volume sampling and gravimetric analysis
		24-hour	230	
PM_{10}	µg/m^3	Annual	-	High volume sampling and gravimetric analysis, TOEM, Beta Attenuation
		24-hour	120	
$PM_{2.5}$	µg/m3	24-hour	40	PM 2.5 sampling gravimetric analysis
Sulfur Dioxide	µg/m^3	Annual	50	Ultraviolet fluorescence, west and Gaeke method
		24-hour	70	
Nitrogen Dioxide	µg/m^3	1-year	40	Chemiluminescence
		24-hour	80	
Carbon Monoxide	µg/m3	8-hour	10,000	Non dispersive infra-red spectrophotometer (NDIR)
Benzene	µg/m3	Annual	5	Gas chromatographic technique
Ozone	µg/m3	8-hours	20	UV spectrophotometer
Lead	µg/m3	Annual	0.5	High volume sampling, followed by atomic absorption spectrometry

*Note: 24 hourly values shall be met 95% of the time in a year. 18 days per calendar year the standard may be exceeded but not on two consecutive days

**Note: 24 hourly standards for NO2 and SO2 and 8 hours standard for CO are not to be controlled before MOPE has recommended appropriate test methodologies. This will be done before2005

***Note: Control by spot sampling at roadside locations: Minimum one sample per week taken over 15 minutes during peak traffic hours, i.e. in the period 8am - 10am or 3pm - 6pm on a workday. This test method will be re-evaluated by 2005

****Note: If representativeness can be proven, yearly averages can be calculated from PM10 samples from selected weekdays from each month of the year.

Annex 2: Recommended noise exposure limits for the work environment

Noise Exposure for Workers (adopted from Occupational Safety and Health Administration OSHA)

SN	Noise Exposure (dBA)	Permissible exposure (Hours and Minutes)
1.	85	16 hrs.
2.	87	12 hrs. –18 min.
3.	90	8 hrs.
4.	93	5 hrs. – 18 min.
5.	96	3 hrs.-30 min.
6.	99	2 hrs. – 18 min.
7.	102	1 hr. – 30 min.
8.	105	1 hr.
9.	108	40 min.
10.	111	26 min.
11.	114	17 min.
12.	115	15 min.
13.	118	10 min.
14.	121	6.6 min.
15.	124	4 min.
16.	127	3 min.
17.	130	1 min.

Noise Level Standards

Receptor/ Source	National Noise Standard Guidelines, 2012 (dB)	
	Day	Night
Industrial area	75	70
Commercial area	65	55
Rural residential area	45	40
Urban residential area	55	50
Mixed residential area	63	55
Quiet area	50	40
Water Pump	65	
Diesel generator	90	

Note: Leq (24) = Measure in Equivalent Sound Level in decibels for 24 hours.

Annex 3: Minimum topics to include in OHS Plan

S.N	Section	Sub-section
1	Project Information	Management and review Principal contractor and Employer/Engineer details Key staff contact details Project background and scope of work
2	Roles and Responsibilities	Principal contractor Contractors Workers People with specific OHS roles and responsibilities
3	General OHS Information	Applicable legislation Codes of Practice and other standards/guidance applicable OHS policy Other policies Insurances OHS document management
4	Risk Management	Identifying hazards and managing risks Hierarchy of control
5	OHS Performance Monitoring and Reporting	Workplace inspections and audits Weekly/Monthly OHS reports Incident reporting and investigation
6	Emergency and Incident Response	Emergency preparedness Incident procedure Notifiable incidents Combined mock drills First aid
7	Induction and Training	Staff induction Training need analysis Staff training
8	Consultation and Communication	Consultation Communication Disciplinary procedures Grievance mechanism Collective bargaining system
9	Site Safety Procedures	Site rules Site amenities Site security Site signage Personal protective equipment Work permit system Work stoppage Asbestos Hand operated and power tool use Poisonous and harmful substances Demolition work Excavation work/trenching Concrete & masonry works Work at height Welding & Cutting operations Working in closed/confined spaces Underground Services

S.N	Section	Sub-section
		Overhead Utility Lines Electrical work Crane operations Hot work Fall prevention & protection: Scaffolds and ladders Material Handling Operation: Lifting Operation and Manual Handling Operations Sun safety Vehicle movement Refueling Equipment Poisonous and harmful substances Material storage Use of radioactive material Driving / Equipment operation authorization Equipment maintenance and certification Removing property from site Compressed gas cylinders Work environment and health Surveillance Any other construction issue / hazard at your workplace Clinical and psychological assessments
10	Safe Work Method Statements (SWMS)	Development of SWMS Approval of SWMS

Annex 4: OHS Audit Content

Component	Rating	Considerations	Comments
OHS policy		Authorized by top management.	
		Clearly states overall OHS objectives.	
		Appropriate to nature and scale of organization's risks.	
		Commitment includes establishing measurable objectives and targets to ensure continued improvement aimed at eliminating work related injury and illness.	
		Commitment includes complying with relevant OHS legislation and other requirements placed on the organization or to which the organization subscribes.	
		Documented, implemented, maintained and communicated to all employees.	
		Available to all interested parties.	
Planning	☐	Periodically reviewed to ensure it remains relevant and appropriate to the organization.	
	☐	Methodology for hazard identification, hazard/risk assessment and control of hazards/risks, is it appropriate to the nature and scale of the job?	
	☐	Procedures established, implemented and maintained to identify and provide access to all legal and other requirements that are directly applicable to the OHS issues related to its activities, products or services, including relevant relationships with contractors or suppliers.	
	☐	Documented OHS objectives and targets established, implemented and maintained at each relevant function and level within the organization.	
	☐	Management plans established and maintained for achieving objectives and targets. i.e. SMART objectives	
		Procedures established to ensure that current plans are reviewed and amended to address changes at regular and planned intervals and whenever changes to activities, procedures or services of the organization or significant changes in operating conditions occur.	
		Contractor Management	
		Planning for contractor work includes OHS considerations?	
	☐	ToR developed for OHS aspects for contractors? And being followed?	
	☐	Procedures established to evaluate the OHS competence of the proposed contractor? And being followed?	
	☐	Contract document includes binding clauses related to fulfilling applicable OHS requirements?	
		Procedure covers protocols of sub-contracting?	
		SWMS being developed by contractors and evaluated/approved by relevant personnel?	
	☐	Procedure available and being followed for monitoring the	

		OHS performance of the contractors?	
	☐	Procedure available and being followed to review the contractor work to learn lessons and improve where required?	
Implementation	☐	Management has identified and provided resources (human resources, specialized skills, technology, finances) required to implement, maintain and improve the OHSMS.	
	☐	Areas of accountability and responsibility of all personnel involved in the operation of the OHSMS are defined, documented and communicated including for contractors	
	☐	A specific management representative is appointed, with defined roles, responsibilities and authority for establishing, implementing and maintaining OHSMS requirements and reporting on OHSMS performance to top management for review and improvement.	
	☐	In consultation with employees, training needs have been identified relating to performing work in safe manner?	
	☐	All personnel (including contractors and visitors) have undertaken training appropriate to identified needs.	
	☐	Training is delivered by persons with appropriate knowledge, skills and experience in OHS and training.	
	☐	Documented procedures have been agreed to by employees for employee and other interested party's involvement and consultation in OHS issues.	
	☐	Reporting procedures include incidents and system failures.	
	☐	Procedures established, implemented and maintained for controlling relevant documents and data required to be stored.	
	☐	Document control procedures ensure that current versions of relevant documents and data are available at all locations where operations essential to effective functioning of OHSMS is performed.	
	☐	Procedures and responsibilities are established and maintained concerning the creation and modification of the various types of documents and data; including data maintenance, retrieval and storage	
		The hazard identification process considers the inputs as defined in any GIIP? E.g. IFC EHS guidelines and performance standards.	
	☐	For hazard/risk assessments, control priorities are assigned and based on established risk levels.	
	☐	Hazards/risks identified through risk assessment, are controlled through the hierarchy of controls.	
	☐	All potential emergency situations are identified and emergency procedures documented for preventing and mitigating associated illness and injury.	

	☐	Emergency preparedness and response procedures are reviewed and revised where necessary, especially after the occurrence of incidents or emergency situations.	
	☐	Emergency preparedness and response procedures are periodically tested.	
		Equipment available to deal with any worksite emergency	
		Adequate welfare facilities available for staff including lighting, toilets, showers, eye wash stations, drinking area, clean drinking water	
		First aid facilities and first aider available on site?	
		Procedure available and being followed about tools and equipment testing, color coding and reporting etc.? including third party inspection where required	
		Area signage and barricades installed? Appropriate?	
		Other operational controls for noise, vibration, dust, weather monitoring, manual handling, driving, excavation, scaffold, housekeeping, work at height, chemical handling, fire and storage etc.	
		Biological hazards controls?	
		PPEs specified for different jobs?	
		Permit To Work system in place?	
		Worker accommodation (where provided) is following the applicable OHS requirements?	
	☐	Situations where employee health surveillance is required are identified, and appropriate systems are implemented.	
		Procedures are established, implemented and maintained for reporting, investigating, responding to and taking action to minimize any harm caused by incidents.	
	☐	Procedures are established, implemented and maintained for initiating and completing appropriate corrective and preventive action.	
	☐	Changes in OHSMS procedures resulting from incident investigations, and corrective and preventive action implemented, are recorded.	
	☐	Audit program and procedures established, implemented and maintained for periodic OHSMS audits to be undertaken by a competent person.	
Management review	☐	Top management undertakes OHSMS reviews at intervals to ensure its continuing suitability, adequacy and effectiveness.	
	☐	The management review process is documented and ensures that necessary information is collected to allow management to undertake the evaluation.	
	☐	Does management review include inputs like previous incidents, achievements of objectives, audit and inspection reports, feedback from workers, legal notices, workers complain, communication with relevant interested parties, etc.	

	☐	Management reviews the continued relevance of and changes where appropriate, the policy, objectives, responsibilities and other elements of the OHSMS, in light of the OHSMS audit results, changing circumstances and commitment to continual improvement.	

5 Appendix E: GIS Attributes List

1-PIPE

S. N	Alis	Field Name	Example
1	OBJECTID *	OBJECTID *	284
2	SHAPE *	SHAPE *	Polyline Z
3	Asset ID	Asset ID	PP2201348
4	Facility_Code	Fac_Code	01WR02
5	Pipe id	Pipe_id	01WR02-PP2201348
6	Upstream Asset ID	AssetID_UP	PP2300414
7	Downstream Asset	AssetID_DN	PP2200154
8	Upstream Invert Level	Level_UP	1312.173
9	Downstream Invert Level	Level_DN	1312.063
10	Material Type	Mat_Type	HDPE
11	Pipe Class	Pipe_Class	PN6
12	Nominal Pipe Diameter	Dia_Nom	110
13	Pipe Inner Diameter	Pipe_Dia	98.4
14	Pipe outter Diameter	Pipe_Odia	110
15	Upstream Node	From_Node	PV2300018
16	Downstream Node	To_Node	J106
17	Pipe Pressure Rating	Pipe_pr	6
18	Joint Type	Joint_Type	Electrofusion
19	Gasket Material	Gas_Material	Elastomeric
20	Length in Meter	Length_m	8.649003
21	Lining Material	Mat_LIning	Cement
22	Surface Level	Lev_surface	1313.073
23	Depth of Cover	Cover_dep	900
24	Manufacturer Company	Manuf_comp	Manamaiju Industries
25	Installed Date	Instal_Date	41791
26	Manufacturar Date	Manuf_Date	41730
27	Standard of Pipe	Standard	IS-4984
28	Location of drawing file	Drawing_loc	DNI-02-Z26
29	Contract Number of the work	Contract_No	KUKL/DNI/01/04
30	Street Name	Street_Name	Baburam Acharya Marg
31	Pipe_Zone	DMA	2.3
32	Pipe_SubZone	Sub_DMA	2.3.1(A)
33	Pavement Type	Pav_Type	Asphalt
34	Soil type	Soil_Type	Earthen/Gravel
35	Relining Material	Reline_Mat	N/A
36	Relining Date	Reline_Date	<Null>
37	Fitting Materials	Fit_Mat	PE100
38	Fitting Lining Internal	Fit_lin_in	PE
39	Fit_Lin_out	Fit_Lin_out	Epoxy, Bitumen, Zinc
40	Fitting Class	Fit_Class	PN10
41	Location of Photo 1	Photo1	<Null>
42	X coordínate	X coordinate	336353.2357
43	Y coordínate	Y coordínate	3065242.097

S. N	Alis	Field Name	Example
44	SHAPE Length	SHAPE Length	8.649003

2-NODE

S.N	Alis	Field Name	Example
1	OBJECTID *	OBJECTID *	279
2	SHAPE *	SHAPE *	Point Z
3	Node ID taken from Epanet	Node_ID	J106
4	Pipe ID	Pipe_ID	01WR02-PP2300302
5	Lat	Latitue	27.701553
6	Long	Longitude	85.340212
7	Elevation	Elevation	1312.063
8	X coordinate	X coordinate	336344.98
9	Y coordinate	Y coordinate	3065244.675
10	Node_Zone	DMA	2.3
11	Node_SZone	Sub_DMA	2.3.1(A)
12	Photo1	Photo1	<Null>
13	Photo2	Photo2	<Null>

3-HOUSE CONNECTION END

S.N	Alis	Field Name	Example
1	OBJECTID *	OBJECTID *	4038
2	SHAPE *	SHAPE *	Point Z
3	Asset ID	AssetID	PC2200001
4	Facility_Code	Fac_Code	01WH02
5	Flow meter ID	Meter_No	01WH02-PP2200276
6	Up Stream Asset ID	AssetID_UP	PP2200276
7	X coordínate	X coordinate	336348.9757
8	Y coordínate	Y coordinate	3065257.273
9	Invert Level	Elv	1313.484
10	House Connection Meter Type	HC_Type	Volumetric Rotary Piston Dry Type
11	Node_id	Node_id	1313
12	Suface Level	Lev_Suface	1313.384
13	Mat_Type	Mat_Type	BRONZE
14	Class	Class	PN16
15	Nominal Diameter	HC_Size	20
16	Seal Material	Mat_Seal	Sealing Tape
17	Joint_type	Joint_type	Thread
18	Gas_Material	Gas_Material	Rubber (Type)
19	Linining Material Inside	Lin_Inside	N/A
20	Lining Material Outside	Lin_Outside	N/A
21	Manufacturer Company	Manuf_comp	George Kent
22	Make	Make	Malasiya
23	Model	Model	GKM PSM-T

S.N	Alis	Field Name	Example
24	Serial_no	Serial_no	<Null>
25	Installed date	Instal_date	45140
26	Manufacturer date	Manuf_date	42826
27	Standard	Standard	ISO 4064; 2005
28	Drawing_Loc	Drawing_Loc	DNI-02-Z26
29	Contract_no	Contract_no	KUKL/DNI/01/04
30	Location and Name	Street_Name	Battisputalisadak
31	Pav_type	Pav_Type	N/A
32	House Connection Initial Reading	HC_Ini_Rd	0.182
33	Photo1	Photo1	<Null>
34	Suvery_Id	Suvery_Id	1313
35	DMA No	DMA	2.3
36	Sub DMA Number	Sub_DMA	2.3.1(A)
37	Lat	Lat	27.701667
38	Long	Long	85.340251
39	Node_From	Node_From	J106A
40	Node_To	Node_To	J106
41	KUKL_Meter_Num	KUKL_Meter_Num	KUKL17A036596A
42	Owner_Name	Owner_Name	SurendraJoshi
43	Customer_ID	Customer_ID	1112012959
44	Area_Num	Area_Num	9C-19-42
45	Contact_Number	Contact_Number	9841538490
46	Remarks	Remarks	Meter Connected

4-HOUSE CONNECTION IN PIPE

S.N	Alis	Field Name	Example
1	OBJECTID *	OBJECTID *	4313
2	SHAPE *	SHAPE *	Point Z
3	Suvery_Id	Suvery_Id	1321
4	Pipe ID	Pipe_ID	01WR02-PP2200028
5	Lat	Lat	27.701664
6	Long	Long	85.340264
7	Elevation	Elevation	1312.217
8	X coordinate	X coordinate	336350.2758
9	Y coordinate	Y coordinate	3065256.938
10	Connection Pipe Type	Conn_Ptype	HDPE
11	Connection Pipe Size	Conn_Psize	20
12	Photo1	Photo1	<Null>
13	Photo2	Photo2	<Null>
14	DMA	DMA	2.3
15	Sub DMA Number	Sub_DMA	2.3.1(A)

5-BULK FLOW METER

S.N	Alis	Field Name	Example
1	OBJECTID *	OBJECTID *	22
2	SHAPE *	SHAPE *	Point Z
3	Asset ID	AssetID	PM2200001
4	Facility_Code	Fac_Code	01WD03
5	Flowmeter ID	FM_Id	01WD03-PM2200001
6	Up Stream Asset ID	AssetID_UP	PP2201381
7	Down stream Asset	AssetID_DN	PP2200003
8	X coordínate	X coordínate	336632.769
9	Y coordínate	Y coordínate	3065931.033
10	Invertí Leve	Elv	1320.66
11	Flowmeter Type	FM_Type	Itron (Woltmantype)
12	Node_id	Node_id	PM2200001
13	Suface Leve	Lev_Suface	1321.71
14	Material Type	Mat_Type	DI
15	Class	Class	PN10
16	Nominal Diameter	FM_Size	150
17	Seal Material	Mat_Seal	Rubber Gasket
18	Joint_type	Joint_type	Flanged
19	Gasket Material	Gas_Material	Rubber (Type)
20	Linining Material Inside	Lin_Inside	Epoxy
21	Lining Material Outside	Lin_Outside	Epoxy
22	Manufacturer Company	Manuf_comp	Itron (Woltmantype)
23	Make	Make	France
24	Model	Model	<Null>
25	Serial_no	Serial_no	<Null>
26	Installed date	Instal_date	44013
27	Manufacturer date	Manuf_date	43344
28	Standard	Standard	ISO 4060 1;1993 Class B
29	Drawing_Loc	Drawing_Loc	DNI-02-W27
30	Contract_no	Contract_no	KUKL/DNI/01/04
31	Location and Name	Street_Name	Battisputalisadak
32	Pavimenta Type	Pav_Type	BT
33	Flow meter initial reading	FM_Ini_Rd	0
34	Photo1	Photo1	<Null>
35	DMA No	DMA	2.3
36	Sub DMA Number	Sub_DMA	2.3.1

6-HYDRANT

S.N	Alis	Field Name	Example
1	OBJECTID *	OBJECTID *	25
2	SHAPE *	SHAPE *	Point Z
3	Asset ID	AssetID	PH2200001
4	Facility_Code	Fac_Code	01WR02
5	Hydrant ID	Hyd_Id	01WR02-PH2200001
6	Up Stream Asset ID	AssetID_UP	PP2200009
7	Down stream Asset	AssetID_DN	PP2200110
8	X coordínate	X coordínate	336055.9022
9	Y coordínate	Y coordínate	3065955.694
10	Invertí Leve	Elv	1298.039
11	Hydrant type	Hyd_Type	BS 750:1984 Type 2
12	Node_id	Node_id	PH2200001
13	Suface Leve	Lev_Suface	1299.089
14	Material Type	Mat_Type	DI, SS
15	Class	Class	PN16
16	Nominal Diameter	HYD_Size	100
17	Seal Material	Mat_Seal	Resilient Seated
18	Joint_type	Joint_type	FL-FL
19	Gasket Material	Gas_Material	Rubber (Type)
20	Linining Material Inside	Lin_Inside	Fire Red Epoxy
21	Lining Material Outside	Lin_Outside	Fire Red Epoxy
22	Manufacturar Company	Manuf_comp	Kejriwal casting Kolkata
23	Make	Make	India
24	Model	Model	Underground
25	Serial_no	Serial_no	<Null>
26	Installed date	Instal_date	44013
27	Manufacturar date	Manuf_date	42278
28	Standard	Standard	<Null>
29	Drawing_Loc	Drawing_Loc	DNI-02-W26
30	Contract_no	Contract_no	KUKL/DNI/01/04
31	Location and Name	Street_Name	Pasupati Marg
32	Pavment type	Pav_Type	Asphalt
33	Photo Directory/File Location	Photo1	<Null>
34	DMA Number	DMA	2.3
35	Sub_DMA	Sub_DMA	2.3.1(B)

7-VALVE

S.N	Alis	Field Name	Example
1	OBJECTID *	OBJECTID *	82
2	SHAPE *	SHAPE *	Point Z
3	Asset ID	AssetID	PV2200002
4	Facility_Code	Fac_Code	01WR02
5	Valve ID	Valve_Id	01WR02-PV2200002
6	Up Stream Asset ID	AssetID_UP	PP2200267
7	Down stream Asset	AssetID_DN	PP2200241
8	X coordínate	X coordínate	336352.1286
9	Y coordínate	Y coordínate	3065804.685
10	InvertLevel	Elv	1318.468
11	Val_Type	Val_Type	Air Valve
12	Node_id	Node_id	PV2200002
13	Suface Level	Lev_Suface	1319.478
14	Material Type	Mat_Type	DI
15	Class	Class	PN16
16	Nominal Diameter	Val_Size	50
17	Seal Material	Mat_Seal	ResilientSeated
18	Joint_type	Joint_type	Flanged
19	Gasket _Material	Gas_Material	Rubber (Type)
20	Linining Material Inside	Lin_Inside	Cement, Epoxy
21	Lining Material Outside	Lin_Outside	Epoxy
22	Manufacturar Company	Manuf_comp	Sigma Flow control India Ltd
23	Make	Make	India
24	Model	Model	<Null>
25	Serial_no	Serial_no	<Null>
26	Installed date	Instal_date	44044
27	Manufacturar date	Manuf_date	43070
28	Standard	Standard	AWWAC502
29	Drawing_Loc	Drawing_Loc	DNI-2-X26
30	Contract_no	Contract_no	KUKL/DNI/01/04
31	Location and Name	Street_Name	Ramdarsan Marg
32	Pavement type	Pav_Type	Blacktop
33	Valve setting (0,1)	Val_Set	0
34	Valve ChamberType	Val_Cham	RCC
35	Photo1	Photo1	<Null>
36	DMA Number	DMA	2.3
37	Sub DMA Number	Sub_DMA	2.3.1(B)

6 Appendix F: Bench Mark Details

Benchmark details are provided in the **SECTION VI-E: DRAWINGS** document.

7 Appendix G: Approved Reputable International Vendors for Supply Items

Contractors have to provide details (Name of manufacturers, makes, and specifications) of the following equipment (Plants and Materials) to be supplied for installation under Section IV. Bidding Forms of the Technical Proposal and considering the requirements specified in Section: III (Evaluation and Qualification Criteria), para. 2.7 Equipment – Manufacturers of Plant and Materials:

a) Pipes (DI)

b) Fittings (DI)

c) Valves (Gate/Sluice valves, Butterfly valves, actuators, ball valves, Air valves and Pressure Reducing Valves)

d) Electro-magnetic flowmeter

e) Dataloggers and ICT equipment for generation, storage, sending and receiving data/signals for SCADA integration and control

f) Other specials such as hydrants, dismantling joints, mechanical couplings, etc.

The details provided must be sufficient to arrive at a determination of whether the pipes, fittings appurtenances and other specials proposed by the contractor in his bid meet the functional requirements and technical specifications. The Contractor shall include all common information requested in the specification in particular the following for Butterfly Valves, ball valves, Gate/Sluice Valves,) and Air Valves:

- Width of the body
- Discharge Coefficient Value (Kv) in fully open position
- Standard (e.g. ISO, others)
- PN Pressure Nominal))
- Corrosion protection (if relevant)
- Quantity and size of Bolts and Nuts needed for each appurtenance

The list of approved vendors is the following:

SN	Item	Brands
1.	Gate Valves	Bermad/AVK/HAWLE/KSB/PAM
2.	Butterfly Valves	Bermad/AVK/HAWLE/KSB/PAM
3.	Control Valves	Cla-Val/Bermad/AVK
4.	Air Valves	Bermad/AVK/Apco
5.	Volumetric Type Revenue Water Meter	Diehl/ Honeywell/Itron/Zenner/Sensus
6.	Electromagnetic Type Bulk Flow Meter	Siemens/ABB/Isomag
7.	Data Loggers	Ovarro/Ijinus
8.	Fire Hydrants	Bayard/VAG/Singer/AVK

SN	Item	Brands
9.	Centrifugal pumps	KSB, ABB, Wilo, Grundfos, Sulzer
10.	Transformer, LV Switchgears, PLC, etc.	ABB, Siemens, Schneider Electric

The contractor shall provide the name of the manufacturers as stated in the table above or shall propose equivalent and or better manufacturers in Section IV: Technical Proposal under the heading 'Others', the above-named pipes, fittings appurtenances and other specials being critical for the success of the functional operation of implemented system under this contract.

The proposed manufacturers shall fulfill all the employer requirements and should obtain approval from Engineer prior to placing any order with the Manufacturer/ supplier.

8 Appendix H: Personnel Requirements

The Contractor shall deploy sufficient staff to carry out installation, maintenance and repair work efficiently and satisfactorily at their own cost.

The Contractor shall deploy a suitably qualified and experienced Contractor's Representative responsible to perform overall contractual obligations including but not limiting to project planning, management and resource mobilization on behalf of the Contractor.

The Contractor shall undertake to comply with applicable legislation and the code of labour law on matters of health, hygiene and safety, and shall assume responsibility for works required in the event of any change in applicable regulations. The Contractor shall provide all necessary superintendence during the execution of works and during maintenance. The Contractor's staff shall include adequate and competent persons with proven suitable, previous experience on similar contracts to supervise the works and sufficient skilled, semi-skilled and unskilled labour to ensure completion of works in time. The Contractor shall not remove any representative or skilled labour from the site without prior approval of the Employer for the proper fulfilling of the Contractor's obligations under the contract. The Contractor or a competent and authorized agent or representative approved in writing by Employer on the basis of qualification and experience to be furnished by the Contractor, which approval may at any time be withdrawn, is to be constantly on the works and shall give his whole time to the superintendence of the work. If the Contractor fails to deploy any of his proposed expert, the Employer's will mobilize such expert at the cost of the Contractor. The payment for such expert will be paid by the Employer's and will be deducted from contractor's upcoming IPCs.

The Contractor's Representative must be A Full-time Employee being continuously salaried by the Contractor (in the case of Joint Ventures, the lead partner) for not less than the immediately preceding one year.

Using Form PER-1 and PER-2 in Section 4 (Bidding Forms), and considering the qualification of the key required personnel (para. 2.5. of Section III), the Bidder must demonstrate it shall deploy at site the Key personnel having the following qualifications:

Table 3: Contractor's Personnel Requirement

SN	Position	Minimum Qualification	Total Work Experience [years]	Experience in Similar Work [years]
1	Contractor's Representative	Bachelor's degree in engineering/ management or related field. A full-time Employee being continuously salaried by the Contractor (in the case of Joint Ventures, the lead partner) for not less than the immediately preceding one year.	7	5
2	**Key Personnel**			
2.1	Contract Manager	Bachelor's degree in civil engineering/ construction management. Registered in Nepal Engineering Council.	10	5
2.2	QAQC Engineer	Bachelor's degree in civil / mechanical / Geotechnical engineering.	5	3

SN	Position	Minimum Qualification	Total Work Experience [years]	Experience in Similar Work [years]
		Registered in Nepal Engineering Council.		
2.3	Public Relation Officer	Bachelor's degree in any discipline	5	3
2.4	Civil Engineer	Bachelor's degree in civil engineering. Registered in Nepal Engineering Council.	3	1
2.5	CAD Engineer	Bachelor's degree in civil/ geomatics engineering. Registered in Nepal Engineering Council.	3	1
2.6	Foreman (2 Nos)	Experience in Site supervision of Water Supply Construction Project.	7	5
3	**Others Technical Personnel**			
3.1	Structural Engineer	Master's degree in civil/ Structural Engineering. Registered in Nepal Engineering Council.	7	5
3.2	Mechanical Engineer	Bachelor's degree in mechanical engineering. Registered in Nepal Engineering Council.	7	5
3.3	ICT Engineer (during periods of installation and testing of ICT equipment)	Bachelor's Degree in ICT field with experience/training in SCADA	5	3
3.4	Water Supply Operation Engineer (during testing and commissioning)	Bachelor's degree in civil engineering with experience in water supply operation/ commissioning.	5	3
4	**Environmental, Health and Safety Dedicated Personnel**			
4.1	Environmental, Health and Safety (EHS) Officer (Minimum Time On-site: 60% Full Time Equivalent)	Bachelor's degree in environmental science/ environmental engineering or related field.	5	3
4.2	Occupational Safety Assistant	Experience in Occupational Safety related field.	3	1

9 Appendix I: Equipment Requirements

Using Form EQU in Section 4 (Bidding Forms), the Bidder must demonstrate it has the key equipment listed below:

Table 4: Equipment Requirement

No.	Equipment Type and Characteristics	Min. Number Requirement
1.	Excavator Min. 15 Tons	2
2.	Concrete Mixer (RMC) or Modern Batching plant	1
3.	Concrete pump	1
4.	Truck Mounted Crane or hydra >10t (Pipe storage area & pipe and fittings laying)	1
5.	Vibrator	4
6.	Complete Scaffolding set	2
7.	Mobile Generator (min. 50 kVA)	2
8.	Dewatering System: Submersible high flow pumps. Min 100m3/h	3 pumps
9.	Water Tanker (15-20 Tons) for sprinkling water	3
10.	Vibrating Roller (Min. 5 Ton)	1
11.	Mechanical Hand Compactors: Vibratory Plate Rammer Type	 2 2
12.	HDD Machine and supporting accessories minimum 15 Ton	1

10 Appendix J: Method Statement

The Contractor shall submit a Method statement to address all requirements specified in this Section VI: Works Requirements. and should set out the construction methods and how the Works Program efficiencies will be achieved with them. This document is linked to the Works Program, as is the explanation of this output.

The Method Statement recommended content for each construction activity in the Works Program is the following:

- Scope of the works
- Site preparation and access
- Construction method: activities, methods and their phase sequence (with explanatory drawings if possible)
- Construction team responsible persons
- Other Resources (Materials, equipment, etc.) needed
- Special measures with third parties: administration permits, road closure, night working, resettlement issues, private property provisional occupancy, etc.

The expected Method Statements to be submitted by the Contractor for the following activities:

- Topographical Survey and setting out
- Clearance works
- Trench Excavation method including shoring works,
- Trench Backfilling and compaction
- Pipe laying
- Surface/road reinstatement
- Service connections including water meter installation
- Chamber Concrete work and finishing
- Appurtenances electro-mechanical and ICT installation
- Sectional Pressure Tests
- Functional Guarantee Tests
- ICT/SCADA equipment Tests

SECTION VI-C: TECHNICAL SPECIFICATIONS

1 CIVIL ENGINEERING WORK

1.1 SITE CLEARANCE

1.1.1 Scope

This specification covers the removal of vegetation, boulders or concrete block of size up to 0.2 m3, surface obstructions, and the demolition and removal of structures including their basements (if any) not directly associated with or incidental to any excavation.

1.1.2 Interpretations

1.1.2.1 Supporting Specifications

This specification contains stipulations that are generally and particularly applicable to site clearance

a. General

b. Earthworks, as applicable

1.1.2.2 Application

This specification contains stipulations that are generally and particularly applicable to site clearance.

1.1.2.3 Definitions

The purpose of this specification the following definitions shall apply:

Cleared surface - The natural surface of the ground after clearing of surface vegetation has been completed.

Designated area - An area the position of which in relation to the work to be carried out is shown on the drawing or is described in the specification and is therefore known to the Contractor at the time of tendering.

Finished level - The level of the finished earthworks as shown on the drawings or stated in the project specification.

Grubbing - The operation of digging out the roots of vegetation.

Original ground level - The level of the surface of an area before the commencement of clearing.

1.1.3 Materials

Material obtained from clearing and grubbing and from the demolition of structures shall be disposed of in tipping areas or other suitable places indicated by the Engineer and shall be covered with soil or gravel. Where no such place is indicated by the Engineer, the Contractor shall make his own arrangements for the provision of a suitable place. Such disposal places shall be subject to Environmental Mitigation Plan and approved by the Engineer.

The Contractor shall not clear the Site of or damage any living tree situated on the parts of the Site not subsequently to be occupied by the Works. All trunks and branches of cleared trees shall be stripped of secondary branches, sawn into transportable lengths and stacked at designated areas. Such timber shall be the property of the Employer and shall remain the property of the Employer.

Fencing wire shall be neatly wound into rolls or coils and all such wire, together with all fence posts and other re-usable material from walls, etc., shall be stacked at designated areas.

1.1.4 Construction Equipment

The Contractor shall provide saws for cutting of trees and branches as ordered, and plant that is suitable for grubbing roots and for digging out and removing other obstructions on the Site.

1.1.5 Construction and Workmanship

1.1.5.1 Areas to be Cleared and Grubbed

Prior to the start of any work, the Contractor should lay-out the right-of-way, working areas, clearing, and pavement cuts to insure a proper recognition and protection of the adjacent properties.

All lay-out work must be approved by the Engineer before any demolition, rehabilitation or construction begins.

The Contractor shall clear the parts of the Site subsequently to be occupied by the Works and shall maintain them clear of vegetation. Areas cleared shall include but not be limited to, portions of the Site where excavations are to be carried out and embankments and structures constructed, however, the Contractor shall not commence clearing and grubbing until the Engineer has designated, in writing and in detail, the exact areas to be cleared or grubbed and the time at which the work is to be started.

The Contractor shall ensure that the general shape, profile, and levels of the area are not materially altered during clearing and grubbing operations.

In order to avoid re-clearing or to control dust or erosion the Contractor may have to clear and grub at the latest practicable stage of construction.

1.1.5.2 Clearing

Clearing shall consist of:

a. the removal of all trees and bushes (complete with roots), other vegetation, rubbish, fences, and all other material that may interfere with the construction of the Works

b. the disposal of all materials resulting from the clearing

c. the removal of all rocks and boulders of size up to 0.2 m^3 that are lying on the surface to be cleared or exposed during the clearing operation.

d. where fences have to take down, the sorting, coiling, and stacking of the material, and e) the removal and stacking of other re-usable materials.

The moving of a certain amount of soil or gravel may be inherent in or unavoidable during the process of clearing.

1.1.5.3 Measurement and Payment

Unless otherwise provided in the Contract, no separate measurements and/or payment shall be made for all materials and works required under this section. All the cost associated under this section is deemed to be included in the item rates of the Bill of Quantities related to earthworks and excavation.

1.2 EARTHWORKS

1.2.1 Scope

This specification covers earthworks carried out with light or heavy equipment or by hand, for general excavations, terracing, landscaping etc. excluding pipeline trench excavation. It covers the requirements for site-works, excavations for foundations for reservoirs, buildings, bridges and general structures and reinstatement of surfaces.

1.2.2 Interpretations

1.2.2.1 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a. General

b. Site Clearance

1.2.2.2 Definitions

For the purpose of this specification the following definitions shall apply:

Backfill - Approved material placed in an excavation after specified operations have been performed and compacted to specified density.

Borrow - Material obtained from various sources such as borrow pits.

Borrow pit - An excavation made for the purpose of procurement of material.

Specified density - The ratio of field density to laboratory-determined modified AASHTO maximum density.

Spoil - Unsuitable or excess material removed to waste dumping sites or reclamation sites.

Stockpile - A pile of material that has been selected, loaded, transported and unloaded in a heap outside the confines of a borrow pit or of an excavation that forms part of the Works.

Suitable material - That material which is acceptable in accordance with the Contract for use in the Works and which is capable of being compacted, in the manner specified, to form a stable fill having side slopes as indicated on the Drawings.

Topsoil - The top layer of soil shall contain organic components that can support vegetation.

Unsuitable material - Unsuitable material shall mean other than suitable material and shall include:

a. material from swamps, marshes or bogs;

b. organic and perishable material.

c. material susceptible to spontaneous combustion.

d. clay of liquid limit exceeding 80 and/or plasticity index exceeding 55.

1.2.3 Construction Equipment

Equipment shall be suitable for obtaining the end result required under the conditions applicable to the Site. Compaction equipment used for applying the dynamic load, controlling the moisture content, and grading or mixing, shall be capable of achieving the compaction specified with the material available.

Any vehicle or item of equipment provided by the Contractor for the transport of materials shall conform to the requirements of the applicable road traffic ordinance if the vehicle or equipment is required to operate on any public road, street, or area that has been surfaced.

Where any of the Contractor's operations or the movement of any of the Contractor's vehicles or equipment has caused damage to the surface of any area normally open to the public, the Contractor shall repair such surface as a matter of urgency, and at his own expense.

The Contractor shall provide and use, where applicable, equipment that is suitable for the detection and location of underground service pipes and cables.

Construction traffic shall not use the surface of the bottom of mass excavations unless the excavation is in rock or the Contractor maintains the level of the bottom surface at least 30 cm from formation level. Any damage to the formation arising from such use of the surface shall be made good by the Contractor at his own expense, with material having the same characteristics as the material which has been damaged.

1.2.4 Construction and Workmanship

1.2.4.1 Road Cutting Permit

The Contractor shall be responsible for applying for and obtaining a Road Cutting Permits (RCPs) from the Roads Department prior to carrying out excavations in public roads. The Employer will support the Contractor as far as possible.

The Provisional Sum includes an allocation for deposits required to obtain road cutting permissions from the Department of Road (DOR) or other relevant authorities, if so, required by such authorities. The Contractor shall deposit the required amounts to the relevant authorities on behalf of the Employer from the Provisional Sum. These payments will be reimbursed to the Contractor through the next Interim Payment Certificate (IPC).

If any deposited amount is forfeited by the authority, or is not released to the Employer because the Contractor failed to perform the road reinstatement works to the required standard or within the specified time period, the Employer shall be entitled to recover this amount from the Contractor. The Engineer shall include such amount as a deduction in any Payment Certificate issued under Clause 14 [Contract Price and Payment].

1.2.4.2 Precautions: Safety and safeguarding

Every excavation that is accessible to the public shall be adequately protected by barriers or fences, provided with lighting at night and watched to ensure that barricades and lights are effective at all times. Reference shall be made to Construction Safety/Safeguard/Traffic Control Equipment of SECTION VI-A.

The Contractor shall suitably safeguard excavations if the depth of an excavation or the nature of the material excavated renders the sides of the excavation liable to movement that might endanger the Works or the workmen engaged on the excavation.

This safeguarding may consist of supports by timber or sheeting adequately strutted and braced, or, if approved by the Engineer, by a reduction of the slope of the excavated face or faces so that any danger to the Works or the said workmen is eliminated.

The Contractor shall make good any fall of earth or rock due to insufficient safeguarding at his own expense, as directed and by approved means.

Without relieving the Contractor in any way of his responsibility, the Engineer may order additional lateral support for, or the sloping or reduction of the slope of, the sides of any excavation. During the progress of each excavation, the Contractor shall report to the Engineer the presence of bedding planes inclined towards the excavation, seepage water and any other feature that may affect the stability of the excavation, as soon as the presence of such feature or features is known. All timbering and sheeting shall be removed from the excavation at the completion of the work, unless the written permission of the Engineer allowing any portion to remain is obtained.

Should blasting be necessary, the Contractor shall obtain the permission from the Engineer and the local authority well in advance and in writing and shall take every precaution to protect the Works and persons, animals and property in the vicinity of the Site. The Contractor will be held responsible for any injury or damage caused by any blasting operations and shall, at his own expense, make good such damage. A copy of the blasting permit(s) issued to the Contractor to cover the purchase, storage, and handling of explosives, shall be handed over to the Engineer.

When blasting to specified profiles, the Contractor shall so arrange the holes and charges that the resulting exposed surfaces are as sound and stable as the nature of the material permits. The Contractor shall make good at his own expense any additional excavation necessitated by the shattering of rock in excess of a 150mm over break allowance.

1.2.4.3 Site preparation

Before carrying out any work at any location, the location shall be inspected where necessary together with the Engineer.

The Contractor shall request in writing such inspections where in his opinion the situation shown in the Drawings has changed and/or is different from actual conditions.

After clearing, the location shall be surveyed in conjunction with the Engineer's representative to establish original ground levels, and these agreed ground levels shall form the basis for the calculation of quantities of any subsequent excavation and filling.

Should work commence in the absence of this joint survey, the Engineer's statement shall be final.

Prior to the start of excavation proper, if and as scheduled, all areas in which excavation is to take place or that are to be covered by banks, structures etc., shall be cleared as specified or directed by the Engineer.

Where so ordered, the Contractor shall remove and conserve the topsoil for later use in a manner approved by the Engineer. The Contractor will not be required to remove topsoil from any area in which the average depth of topsoil is less than 150 mm.

The Contractor is responsible for the transfer of line and grade from control points established by the Engineer. The preservation of stakes or other line and grade references provided by the Engineer is the responsibility of the Contractor.

The Contractor’s method for setting the line and grade for the activities shall be approved by the Engineer.

1.2.4.4 Excavation of structures

Excavation shall be carried out to the depth indicated or to such greater depths as may be required by the Engineer to ensure a satisfactory foundation.

Except where otherwise specified, shown on the Drawings, ordered or dictated by the requirements for safeguarding, excavation shall be so carried out and so trimmed to the outline of the concrete work shown on the Drawings that the excavated surfaces will act as forms for the concrete works. Such surfaces as well as the bottom of excavations shall be cleaned by hand, air or other effective means to remove all loose, soft or otherwise unsuitable material and as required by the Engineer.

Should the Contractor excavate to dimensions in excess of those stipulated or permitted, he shall fill in the excess at his own expense in the manner specified or approved by the Engineer. Excavated surfaces that will remain permanently exposed shall be finished off in a neat and workmanlike manner and shall be graded to provide adequate drainage.

When the Contractor is required by the Engineer to open up borrow pits, he shall maintain them so that they do not become a danger to persons and livestock. On completion of borrowing, the sides of the pits, if not filled with unused material, shall be graded 1V:2H, or as the Engineer may direct. The Contractor shall not spoil, stockpile, or waste any material without approval. He shall dispose of surplus and unsuitable material in areas designated by him and approved by the Engineer. Spoil heaps shall be flattened to present a neat level or graded surface with no danger of erosion.

All excavations in driveways, gardens and the like, private and/or enclosed lands, and premises shall be made by hand unless the consent of the owner to the use of (small) mechanical plant has been obtained by the Contractor.

Immediately at the start of each section of excavation the Contractor will request the Engineer to attend the site to determine and instruct which levels or layers of existing soil is suitable and to be used for backfilling. The Contractor shall separate and store suitable soil during excavation for reuse as backfill. Unsuitable soil shall be immediately removed from site and disposed of by the Contractor.

The Contractor shall not sell any materials arising from excavations, demolitions and the like carried out on the Site unless permission is obtained from the Engineer.

1.2.4.5 Protection and support of excavation for structures slopes

Adequate vertical sheeting shall be used until completion of the work to protect employees, to avoid subsidence and to prevent damage to adjacent ground and structures. All sheeting and bracing used in structural excavation shall be removed upon completion of the work.

The Contractor shall be responsible for the protection of slopes formed during the initial earthmoving stage, from subsequent erosion or damage throughout the period of the Contract, caused either by natural means or as a result of subsequent construction operations, or by construction traffic or any traffic.

All excavation slopes in this contract are expected to be protected with some shoring method, due to the fact that the adjacent available ground is not enough for battered slope solutions.

The protection and supporting shoring systems that may be used in the contract are described in the following paragraphs.

Before starting any earthmoving, the Contractor shall submit his own proposals for the protection of the excavation slopes, including adequate calculations for bracings and/ or anchors at different levels. The type of protection to be used shall be to the approval of the Engineer. No subsequent construction activity will be permitted until the type of slope protection has been approved.

1.2.4.5.1 Protection of Slopes Using Interlocked Sheet Piling

For depths below 3mand if the layer below the foundation excavation elevation is soil (even hard soil) and no rock, layer where the piles are inserted, protection of slopes using interlocked sheet piling is recommended. When the below layer is rock, sheet piles can also be used, but the machinery needed is special and scarce to find.

Generally U-shaped sheet pile is widely used. The advantages of U-shaped piles are multiple:

- Wide range of sections forming several series with various geometrical characteristics, enabling the choice of technically and economically optimized sections for each specific project.
- Symmetrical form of single elements resulting in great aptitude for re-use.
- Possibility of assembling and fixing piles into pairs at the mill providing better installation quality and performance

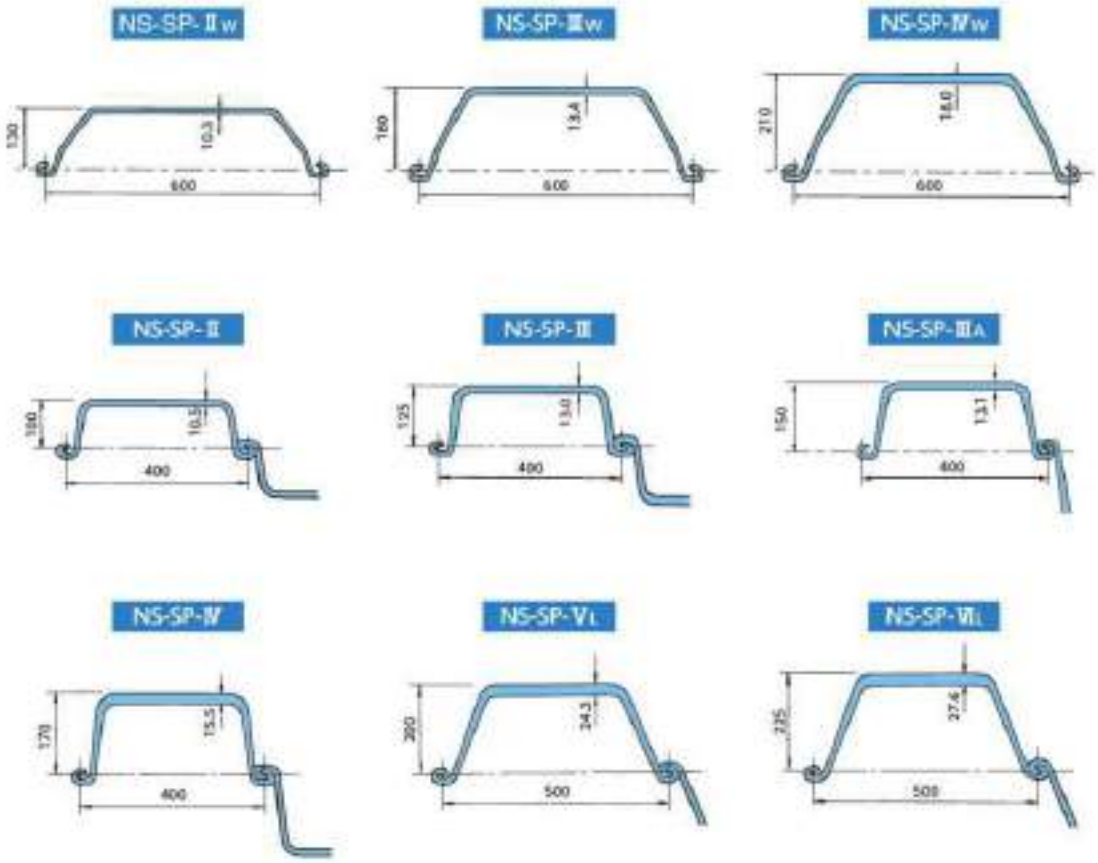
General information about U-shaped sheet pile is given below. Usually, the section adopted for the BoQ item referring to sheet piling is 400 x 150 x 13.1 (length x width x thickness). Contractor is free to choose and propose equivalent or better section for the approval of the Engineer.

U Profile Sheet Piling

Cold rolled sheet pile or cold formed sheet pile are produced in this way: Steel plates go through various roller to form shapes, in most sheet piling factory, the interlocks should be formed at first, then other profiles. The whole rolling process is done at normal temperatures; cold water will be poured at the sheet piling machines to cool down. The cold rolling process increases the yield strength and hardness of steel. Previously sheet piles were only light gauge profiles, but gradually as technology develops, now the thickest cold rolled sheet piling is 16mm. Width can be over 1500mm. Cold rolled sheet piles are lighter and easier to transport and delivery.

U type sheet piles- U profile sheet piles are available not only narrow sections for hard ground conditions, also have very wide sheet pile sections when the grounds are easy to drive. Sheet pile can be supplied in single pile, double piles or even triple piles. Steel sheet pile contractors choose U profiles mainly because the interlocks are located on the neutral axis. For different ground conditions, the dimensions of the sheet piles can be adjusted to suit exactly the projects requirements.

Table 5: Sheet Pile Dimensions and Weights (Nippon Steel)



Sectional properties

Type	Dimension			Per pile				Per 1 m of pile wall width			
	Effective width W mm	Effective height h mm	Thickness t mm	Sectional area cm²	Moment of inertia cm⁴	Section modulus cm³	Unit mass kg/m	Sectional area cm²/m	Moment of inertia cm⁴/m	Section modulus cm³/m	Unit mass kg/m²
NS-SP-Ⅱ	400	100	10.5	61.18	1,240	152	48.0	153.0	8,740	874	120
NS-SP-Ⅲ	400	125	13.0	76.42	2,220	223	60.0	191.0	16,800	1,340	150
NS-SP-ⅢA	400	150	13.1	74.40	2,790	250	58.4	186.0	22,800	1,520	146
NS-SP-Ⅳ	400	170	15.5	96.99	4,670	362	76.1	242.5	38,600	2,270	190
NS-SP-Ⅴ	500	200	24.3	133.8	7,960	520	105	267.6	63,000	3,150	210
NS-SP-Ⅵ	500	225	27.6	153.0	11,400	680	120	306.0	86,000	3,820	240
NS-SP-Ⅱw	600	130	10.3	78.70	2,110	203	61.8	131.2	13,000	1,000	103
NS-SP-Ⅲw	600	180	13.4	103.9	5,220	376	81.6	173.2	32,400	1,800	136
NS-SP-Ⅳw	600	210	18.0	135.3	8,630	539	106	225.5	56,700	2,700	177

1.2.4.5.2 Protection with conventional sheeting and bracing

When the layer below the foundation excavation elevation is rock, or even when the more superficial layers of the excavation are soil and then the excavation enters deeper rock layers, the sheet piling solution is difficult to execute, as the piles cannot be properly inserted in the substrate layer.

In this case instead of interlocked sheet piling, the conventional sheeting and bracing may be of application: vertical mild steel (MS) poles (6 meters high) separated less than 1 meter and MS plates located behind the poles, all braced with horizontal U profiles welded at every 2 meters' depth so that all poles work jointly and not independently while supporting the soil slope.

If the depth of the excavation is deeper than 3 meters, then the open excavation (which needs to be executed before the vertical poles) cannot be executed to the total width under risk of sliding, but phased in small width alternate segments (2 meters)

1. Phase 1: Excavate alternate segments total excavation height and width 2 meters.
2. Phase 2: Execute the conventional shoring protection in these small segments for the soil layers.
3. Phase 3: Excavate the segments between the already shored ones.
4. Phase 4: Execute the conventional shoring protection in the remaining segments for the soil layers.

1.2.4.6 Excavation of Foundation Pits

Excavations shall be taken out to the least dimensions required to accommodate the several parts of the Works and shall provide any working space necessary for their excavation.

Excavations shall be carried out in such lengths, widths and depth at one time and in the sequence as approved by the Engineer and in such manner as to avoid any damage to the ground and adjacent property.

Excavations shall be timbered, sheeted and piled or otherwise supported to the extent necessary to support the surrounding ground and to ensure the safety of the Works and adjacent structures. Alternatively, where specifically permitted they may be suitably battered.

Unless otherwise required by the Contract no timber or other supports shall be left in excavations without consent of the Engineer.

All proposed measures for the shoring and supporting of excavations or trenches shall be to the approval of the Engineer. Calculations showing the adequacy of any temporary works shall when required be submitted to the Engineer for approval.

1.2.4.7 Excavation for pipelines trenches

See appropriate Clause in Pipelines and Related Activities

1.2.4.8 Excavations to be Kept Free of Water

The Contractor shall provide and maintain and operate dewatering or other pumping equipment, and shall construct such drains, sumps and catch waters as may be necessary to remove water from the excavations or to prevent its entrance thereto. Water in the excavations shall be dealt with in such manner as will prevent the surfaces on or against which foundations or other work will be constructed from any deterioration of their natural condition, or from such condition as improved by work executed under the Contract.

The method of pumping shall be approved by Engineer, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least 24 (twenty-four) hours after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering. Alternatively, or complementary to pumping, well points arrangement may be instructed by the Engineer to lower the static level of water table during pipe excavation and laying works. When there is a continuous inflow of water and the quantum of water to be handled is considered in the opinion of Engineer, to be large, a well point system-single stage or multistage, shall be adopted. The Contractor shall submit to the Engineer, details of his well point system including the stages, the spacing, number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Engineer to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Engineer. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a buildup of water in the opinion of the Engineer obstructs the progress of the work, leads to insanitary conditions by stagnation,

retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

1.2.4.9 Rainwater Drainage

Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Engineer.

1.2.4.10 Foundation Levels and Preparation of Foundations

Formation levels shall be at the levels shown in the Drawings or at such other levels as may be directed. When approaching foundation levels in excavations in material other than rock, the final trimming to these levels, whether for actual foundations or for any blinding concrete required by the Contract shall not take place until placing of the blinding concrete or of concrete in the foundation is about to commence.

In the event of the Contractor requiring trimming the foundations in advance of readiness to place concrete, the trimmed foundations shall be protected against the ingress of moisture or the evaporation of soil moisture.

In the case where blinding concrete is required by the Contract no trimming of side faces of excavations shall be carried out for 24 hours after the placing thereof.

Where foundations are in rock, as the excavations approach finished level, the Contractor may be directed to continue excavating without the use of explosives or with limited use thereof by shallow holes and light charges. The final trimming of the foundations shall be executed without explosives by approved hand tools.

Immediately before placing concrete against rock surface, all loose and soft material shall be removed from surface by the use of stiff brooms, hammers, picks and air/water jets. Before the placing of concrete all water shall be removed from depressions and the Contractor shall take all measures necessary to keep all rock faces, against which concrete is to be deposited, and properly drained.

1.2.4.11 Backfilling of structure excavation

All structures shall be backfilled in accordance with these requirements. Only approved materials that will produce a dense, well compacted backfill shall be used for backfilling. Materials such as sod, debris, and soil containing organic matter shall not be used. The Contractor shall remove all debris, spoil and waste construction materials from excavations prior to placing backfill.

Any deficiency of backfill material from trench excavations because of removal of organic or other unsuitable material shall be made up from suitable surplus material from other excavations on the Site. If insufficient or suitable material is not available for this purpose from such excavations, the Contractor shall import sufficient suitable material to the approval of the Engineer. The Contractor shall so arrange his work that the importation of backfill material is kept to a minimum.

No backfill shall be placed against any structure without the permission of the Engineer.

In general, no structure, or cast in place culvert shall be subjected to the pressures of backfilling or to live loads for a period of 14 days or until the minimum required concrete compressive strength specified for the structure has been achieved. Special care shall be taken to prevent any wedging action against the structure. The slopes bounding the excavation shall be stepped when necessary, to prevent such wedge action.

Jetting of fills, or other hydraulic methods involving or likely to involve liquid or semi liquid pressure, shall be prohibited.

The fill material shall be placed in horizontal layers of uniform thickness and compacted by means of suitable equipment, or by tamping with mechanical tampers acceptable to the Engineer. Each layer shall be compacted to 95% of Modified Proctor Compaction Test. The loose thickness of each successive layer when placed shall be such as to ensure that proper compaction is obtained. In no case shall the loose thickness of

a layer be greater than 200 mm. The moisture content of backfilling material shall be uniform, and shall be within the moisture range designated by the Engineer. Unless otherwise approved by the Engineer, hand tamping will not be accepted.

Water shall be drained from the areas to be backfilled whenever practicable. In cases where, in the opinion of the Engineer, it is not practicable to drain the areas to be back filled, the backfill material shall be free draining material and shall be deposited in the water in thin layers. Compaction shall be by method approved by the Engineer.

1.2.4.12 Free Draining Structural Backfill

Where shown on the Drawings or required by the Engineer, free draining structural backfill layer adjacent to structures shall be provided.

To reduce and control the horizontal earth pressure, free draining structural backfill shall be placed behind abutments and structure walls within the limits indicated on the Drawings or directed by the Engineer.

In no case shall any abutment, structure wall or wing wall have less than 300 mm thickness (measured perpendicular to the rear face) of free draining structural backfill behind the rear face.

The free draining backfill material shall be covered by at least 300mm of general fill material or better to inhibit entry of surface water runoff into structural backfill.

Free draining structural backfill material shall consist of gravel, crushed gravel, crushed rock, natural sands, or combinations thereof. The material shall conform to following grading requirements unless otherwise approved by the Engineer:

AASHTO Sieve	Percentage Passing
(mm)	(by weight)
50	80 100
25.0	30 60
9.5	12 30
2.00	7 15
0.425	2 10
0.075	0 5

Free draining structural backfill material shall be placed in layers as the other structure backfilling. Compaction shall be to 95% MDD to AASHTO T 99 Method D. The maximum loose thickness of the layer is to be 150 mm and the moisture content is to be adjusted as required to achieve satisfactory compaction.

Any material excavated to enable the placing of structural backfill material shall be at the cost of the Contractor.

1.2.4.13 Landscaping

On completion of earthworks to the finished level, the whole surface shall be graded, shaped and compacted to final grades and levels. The surface shall be lightly watered as the Engineer may direct.

If ordered by the Engineer, topsoil shall be placed on level and slightly graded areas and shall be lightly compacted by tamping, and trimmed neatly to required lines, grades, and levels. The final thickness of topsoil after compaction shall be at least 200 mm.

If ordered by the Engineer, grass or other vegetation shall be planted after top soiling has been completed. Such planted areas shall be neatly trimmed and well-watered, and the Contractor shall ensure that planted areas are not permitted to dry out. Any grass or vegetation planted that fails to grow shall be replaced by the Contractor, at his expense.

All land drains, like irrigation channels, culverts, etc. which have been severed during excavation work shall be carefully reinstated by the Contractor at his cost in either similar or approved equivalent material and construction.

Particular attention shall be paid to the support of reinstated drains in filled ground.

1.2.5 Tolerances

1.2.5.1 Positions, dimensions, levels, etc.

The work shall be finished to and within the limits (permissible deviation = PD) given below:

a. Excavations ±50 mm (iv) level (other than foundation level), i.e. PD from designed levels with reference to nearest transferred bench-mark: ±15 mm

b. Embankments, terraces, etc.

(i)position of top edge, i.e., PD from designated position of any point, measured from nearest grid line: ±300 mm

(ii)alignment of top edge, i.e., PD from a line joining any two points 30 m apart on top edge of embankment: ±100 mm

(iii) finished levels, i.e., PD from designated levels with reference to nearest transferred bench-mark: ± (iv) 50 mm

(v) slopes of top surfaces, i.e., PD from rate of fall: ± 5 % i.e., if fall 10% tolerance 9.5 to 10.5%

1.2.5.2 Moisture content and density

The permissible deviations (PD) shall be as given below:

a. OMC in field during compaction: +1% and -2%

b. Specified density: +(no top limit) and -0

1.2.6 Testing and Acceptance

To determine founding conditions or for other purposes, the Engineer may require the Contractor to drill, auger or excavate bore holes in advance of the start of construction. When so requested by the Engineer, the Contractor shall provide labour, tools, machinery, and equipment for sinking such exploratory holes and for refilling them. Such operations will be paid as day work.

The Contractor shall carry out sufficient tests including field density test to satisfy himself about the consistency of material placed in embankments and as backfill and submit a test report to the Engineer.

The Engineer may carry out check tests as he deems necessary, at any depth or at any layer. Where these tests reveal that the material used does not comply with the applicable requirements of the specification, or that the compaction specified has not been attained, the Contractor shall rectify the work to the satisfaction of the Engineer.

1.2.7 Measurement and Payment

Measurement of the excavation shall be, unless otherwise specified in BOQ, the net volume of excavation, will be computed from the measurements net to the dimensions shown on the drawings.

Rates for excavation shall cover the cost of excavating, forming embankments, terraces and supporting excavations, provision for existing services, dealing with storm and ground water dewatering, and disposal of any surplus and unsuitable material at a safe location or as instructed and approved by the Engineer. Excavation shall be restricted to limits of excavation as provided in drawings. No additional payment will be made for the required backfilling work. The cost of backfilling shall include in the rate of correspondence items.

1.3 CEMENT CONCRETE WORKS

1.3.1 Scope

This specification covers the requirements for plain and reinforced concrete, either cast-in-situ or precast, for civil engineering and building construction applicable to this project.

1.3.2 Interpretations

1.3.2.1 Supporting specifications

The following specifications shall, inter alia, form part of and be read in conjunction with this specification:

a. General

b. Earthworks, as applicable

1.3.2.2 Application

This specification contains clauses that are generally applicable to concrete and structural precast concrete work.

1.3.2.3 Definitions

Consistency - The extent, as measured by the slump test, to which fresh concrete resists flow or deformation.

Grade of concrete - An identification number for the concrete, the number being numerically equal to the characteristic compressive strength at 28 d expressed in MPa.

Workability - The property of fresh concrete that determines the ease with which it can be placed and compacted without segregation of the constituent materials.

Specified strength - The required concrete strength (or the strength corresponding to the required concrete grade) stated on the Drawings or in the Technical Specification, and which in all cases represents the strength below which not more than 5% of valid 28 d test results obtained on cubes of concrete of the same grade can be expected to fall.

Designed Mix - A design mix is designated by its specified strength followed by the size of aggregate used in its manufacture, e.g. Class 35A/20 Concrete refers to a Grade 35 mix using aggregate with a maximum size of 20 mm.

Target strength - An average value of the strength of concrete that is higher than the characteristic strength and is aimed at to ensure that the characteristic strength is attained. (Note: If the standard deviation can be determined, the value of the target strength is at least equal to the specified strength plus 1.64 times the standard deviation of valid 28 d test results.)

Valid test result - The average result obtained from the testing of two/three test cubes of concrete as defined in BS 5328 Part 4.

1.3.2.3.1 Exposure conditions

Exposure conditions are as defined in BS 8110 Table 3.2

1.3.2.3.2 Joints

The location of joints is controlled by design requirements and construction limitations. Joints shown on the Drawings are “designated construction joints” and are required for design requirements and cover “movement joints”, “contraction joints” and “expansion joints”. The Engineer may, at the request of the Contractor, give his consent to further joints before the casting of concrete to suit the Contractor’s method of construction. These shall be defined as “construction joints”. In the event that the placing of concrete has to be halted due to equipment failure, inclement weather, movement of shutters or some other event, which are not the Employer’s risk, which requires the halting of concreting, and “unforeseen construction joint”

shall be formed. Where they are to the Employer's risk they shall be defined as "unforeseen designated joints".

1.3.2.4 Abbreviations

For the purpose of this specification, the abbreviation for reinforced cement concrete shall be RCC and the abbreviation for plain cement concrete shall be PCC.

1.3.3 Materials

1.3.3.1 Approval of materials

The Contractor shall supply in good time to the Engineer for his approval, samples of the aggregates and, if so ordered, of the water, that he proposes to use for the concrete and shall furnish evidence that the water and aggregates comply with the requirements of the Contract. Evidence shall be in the form of a statement from an approved laboratory of the results of tests, or an authoritative report or record of previous experience.

1.3.3.2 Cement

Unless otherwise specified the cement used in the Works shall be Ordinary Portland Cement (OPC) complying with BS12 or IS 8113. The Contractor shall require the manufacturer to provide a certificate for each consignment of cement received at the Site confirming that the cement complies with the requirements of BS12 or IS 8113. The Contractor shall maintain a record available for inspection by the Engineer of the locations of cement from each consignment.

Within eight weeks of the award of the Contract a report on proposed cement sources shall be submitted to the Engineer. The report shall propose primary and secondary sources of supply and shall give each manufacturer's full analysis of chemical composition and physical properties determined in accordance with BS EN 196 / IS4031.

The report on cement sources shall be submitted at least four weeks in advance of the commencement of work on trial concrete mixes.

The Contractor shall supply samples of cement, when requested by the Engineer both from any store on Site and the place of manufacture.

The Contractor shall conduct preliminary and works tests as required by the Engineer to determine fineness, compressive strength (mortar cube) at 3 days and 28 days, initial and final setting time and soundness of the cement, as described in BS EN 196 / IS4031.

Separate storage facilities shall be provided on the Site for each type of cement used. Cement shall be fresh when delivered to Site and the consignments shall be used in the order of their delivery. The Contractor shall mark the date of delivery on each consignment and each consignment shall be stored separately in such manner as to be easily accessible and identifiable. No cement in bags or other container shall be used unless these and the manufacturer's seals are intact at the time of mixing. If the cement is delivered in bags it shall be stored under cover and on elevated floors that provide proper protection against moisture and other factors that may promote deterioration. Bulk cement may be used providing it is stored in approved weather-proof silos or similar containers provided that the cement drawn for use is measured by mass and not by volume.

The Contractor shall not use cement which has hardened into lumps, but subject to removal of the lumps by screening, the Engineer may allow such cement to be used in non-structural concrete mixes.

1.3.3.3 Water

The water used for making and curing concrete, grout and mortar shall comply with BS 5328/IS456 and shall be from a source approved by the Engineer and at the time of use shall be free from polluting matter in any quantity which:

a. affects the initial setting time of the cement by more than 30 minutes or reduces the compressive strength of test cubes by more than 20% when tested in accordance with BS 3148/ IS 456.

b. prevents the achievement of the specified test cube strengths at 28 days for the appropriate grade of concrete.

c. produces discoloration or efflorescence on the surface of the hardened concrete.

The water shall be free from hydrocarbons and from suspended organic matter. Inorganic matter in solution shall not exceed 500 mg/l by weight and in suspension shall not exceed 50 mg/l by weight.

The water which the Contractor proposes shall be tested by the Contractor to the approval of the Engineer before use in the Permanent Works.

Regular tests of the water shall be made by the Contractor during construction of the Works as instructed by the Engineer. The water shall be sampled at the point of discharge into the mix. The Contractor shall supply two copies of each test result to the Engineer.

1.3.3.4 Aggregates

All aggregates shall comply with the requirements of BS 882 or IS 383 Specification for aggregates from natural sources for concrete and the additional requirements of this Specification. The Contractor shall undertake all necessary testing to demonstrate compliance with BS 882 or IS 383.

Fine aggregate shall consist of natural sand. The Engineer will permit the addition of suitable crushed rock fine aggregate, as necessary, to the sand where in his opinion it is impracticable to obtain the specified grading of the combined aggregates otherwise than by such addition. The maximum quantities of clay, silt and fine dust shall, in any event, not exceed 3% by weight when the sample is tested to BS 812: Part 103.

Coarse aggregate shall comply with the requirements in Table 3 of BS 882/ IS 383 for graded aggregates to the nominal maximum size specified for the appropriate grade of concrete and shall be made up of the following gratings:

a. 40 mm – 5 mm sized

b. 20 mm – 5 mm sized

c. 14 mm – 5 mm sized.

The acid soluble chloride levels of the aggregate as determined in accordance with BS 812: Part 117: 1988 shall not exceed the following values:

a. 0.06% by weight of fine aggregate

b. 0.03% by weight of coarse aggregate.

The acid soluble sulphate content of the aggregate when determined in accordance with BS 812: Part 118: 1988 shall not exceed the following values:

a. 0.40% by weight of fine aggregate

b. 0.40% by weight of coarse aggregate.

The drying shrinkage of the aggregate when determined in accordance with BS 812: Part 120: 1989 shall be less than 0.05%.

The water absorption of the combined aggregate shall not exceed 3% when determined in accordance with BS 812: Part 2: 1975.

The aggregate shall be fully protected from contamination and loss of fines prior to its incorporation into the concrete.

The soundness of the aggregate, as determined in accordance with ASTM C 88 using magnesium sulphate with 5 cycles, shall not show a loss of greater than 15% for fine aggregate and 18% for coarse aggregate.

Immediately after commencement of the Works, the Contractor shall supply samples of proposed aggregates and also carry out preliminary testing on proposed aggregates for compliance with the Specification. The results of such tests shall be to the satisfaction of the Engineer before the Engineer will give approval to the source of aggregates proposed by the Contractor. Alternatively, and subject to the approval of the Engineer, the Contractor may submit certified results of tests on the aggregate carried out by an independent laboratory for the Engineer's approval of the source of aggregate.

During the performance of the Contract, the Contractor shall supply samples of aggregates when required by the Engineer for testing (the samples shall be taken in accordance with BS 812). Testing of all aggregates in accordance with BS 812 and BS 4550 for compliance with all specified requirements shall be performed by the Contractor weekly for each source of aggregate at each grading, unless otherwise instructed by the Engineer. Any rejected aggregate shall be promptly removed from Site.

1.3.3.5 Admixtures

Admixtures shall not be used in any concrete without the approval of the Engineer. Admixtures may require tests to be made before they are used. To facilitate approval, the Contractor shall provide the following information:

a. the trade name of the admixture, its source, and the manufacturer's recommended method of use

b. typical dosage rates and possible detrimental effects of under-dosage and over-dosage

c. whether compounds (such as those containing chloride in any form as an active ingredient) likely to cause corrosion of the reinforcing steel or deterioration of the concrete are present, and, if so, the chloride content (expressed as chloride ions or as anhydrous chloride) by mass of admixture

d. the average expected air content of freshly mixed concrete containing an admixture which causes air to be entrained when used at the manufacturer's recommended rate of dosage.

If the use of air-entraining agent is permitted by the Engineer, test measurements shall be carried out on Site by the Contractor, as and when required by the Engineer, to determine

a. the percentage of air entrained in the concrete, and b) the density of concrete.

The Contractor shall provide equipment to permit measurement of entrained air at such frequencies as are required by the Engineer.

1.3.3.6 Reinforcement

Unless otherwise stated in drawing reinforcement shall be Reinforcement Steel of grade Fe500D. All reinforcement shall comply with latest version of BS 4449 or IS 1786.

The Contractor shall supply the Engineer with certificates from the manufacturer issued in accordance with BS 4449 and BS 4483. For other reinforced bars stated in drawings, test certificate of relevant standard shall be submitted. For all the required tests including the re-bend test in respect of each consignment delivered to Site.

The reinforcement at the time of incorporation in the permanent works shall be clean and free from damage, oil or grease, loose mill scale and loose rust. Bars which have become bent shall not be straightened or re-bent for incorporation in the Works without the approval of the Engineer.

Steel reinforcement shall be stored clear of the ground and supported to prevent distortion. The Contractor shall supply samples of reinforcement from the stocks on Site when required by the Engineer.

It shall be the Contractor's responsibility to check Bending Schedules against reinforcement details shown on the drawings. Any discrepancy or inaccuracy shall be brought to the attention of the Engineer immediately.

Before assembling or fixing the reinforcement, the dimensions to which it has been bent shall be checked by the Contractor against the bar schedules.

When installed, if the reinforcement is left exposed for extended periods of time, it shall be thoroughly cleaned and painted with cement grout.

Bars shall not be permitted to be straightened. The bended reinforcement bars shall be discarded and shall not be used in construction. Bar bending shall be carried out using appropriate bending die.

1.3.3.7 Storage capacity

The storage capacity provided, and the amount of material stored (whether cement, aggregates, steel, or water) shall be sufficient to ensure that no interruption to the progress of the work is occasioned by lack of materials.

1.3.3.8 Deteriorated material

Material that has deteriorated, or that has been contaminated or otherwise damaged, shall not be used in the concrete. Such material shall be removed from the Site without delay.

1.3.4 Construction Equipment

1.3.4.1 Mixing equipment

The type and capacity of mixing machines shall be such that the rate of output of concrete is suitable for the rate of concreting. Each machine shall be capable of producing a uniform distribution of the ingredients throughout the batch and shall comply with the specification to which the manufacturer claims it has been manufactured. Worn or bend blades and paddles shall be replaced. The inner surfaces of the mixer shall be clean and free from hardened concrete. The mixers used shall be specially suited to the production of low slump concrete.

1.3.4.2 Vibrators

Vibrators shall be capable of fully compact each layer of concrete. At least one standby vibrator shall be available at all times during concreting for every three vibrators necessary to maintain the rate of placing.

Vibrating equipment used for the production of precast elements, whether in the form of a vibrating table, an external vibrator attached to the mold, or an immersion vibrator, shall have the frequency that is suitable for the compaction of low slump concrete.

The concrete that is to be compacted by vibration should appear anything from earth dry to slightly glistening. The mix should have the appearance of lacking in fines.

1.3.4.3 Formwork

Scaffolding / formwork shall be so designed and constructed that the concrete can be properly placed and compacted and that, subject to the tolerances specified, the required shapes, finishes, positions, levels, and dimensions shown on the drawings are maintained. The formwork and joints shall be capable of resisting the dead load, including the pressure exerted by the wet concrete, wind forces, and all other superimposed loads and forces

The types of ties used and their position shall be such that the required finish is achieved and will not be marred by subsequent corrosion of the ties.

Unless otherwise shown or directed, formwork shall be such that exterior corners of finished concrete are provided with 25-mm chamfers and re-entrant corners without fillets.

A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. Whenever, in the opinion of the Engineer, additional forms are necessary to maintain the progress scheduled, such additional forms shall be provided by the Contractor at his own expenses.

When concrete is cast in high lifts (maximum permitted lift height is 1.5 m), adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number and location of such clean out holes shall be subject to the approval of the Engineer.

Beam soffits shall be erected with an upward chamfer of 8 mm for each 1 m of span, if not otherwise directed by the Engineer.

Opening for inspection of the inside of beam, wall, column and similar shuttering and for cleaning-out purposes shall be formed so that they can conveniently be closed before the placing of concrete.

Shuttering, which as a result of prolonged use or general deterioration, does not, in the opinion of the Engineer, conform to the particular requirements as specified, shall not be reused.

Sawn shuttering shall produce an ordinary standard of finish consistent with normal good practice for use where the face of the finished concrete will not be exposed. The face in contact with the concrete shall consist of sawn timber boards, sheet metal or other approved material.

Wrought shuttering for use where the face of the finished concrete is to be exposed shall produce a high standard of finish consistent with the best practice. The face in contact with the concrete shall consist of smooth boards of not less than 35 mm finished thickness, of framed plywood or metal panels or other approved material. Joints between boards and/or panels shall be arranged in a uniform pattern.

Special wrought shuttering shall provide the highest standard of finish where the face of the finished concrete is to form a particular feature. The face in contact with the concrete shall consist of large smooth sheets, unless otherwise ordered, arranged in an approved uniform pattern, with joints coinciding with possible architectural features, sills, window heads, or changes in direction or surface. Accurate alignment of all joints shall be maintained. Wrought boarding and standard steel panels shall not be used unless specially faced.

1.3.4.4 Scaffolding and ladders

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required at his own cost.

1.3.4.5 Casting beds and moulds

All casting beds for precast concrete shall be properly aligned and levelled. Adequate weather protection shall be provided should this be necessary to achieve the standards specified below.

1.3.4.6 Construction Equipment for handling, lifting and stacking

The Contractor shall provide adequate equipment for handling, lifting, and stacking precast units that they do not become discolored and are protected from permanent damage due to stresses induced during handling or stacking or due to the use of slings, chains, and hooks.

1.3.5 Construction and Workmanship

1.3.5.1 Reinforcement

Reinforcing bars shall be bent to the shapes and dimensions shown on the drawings and bending schedules to BS 4466. All bars shall be bent cold around an appropriate former. Bending shall be done slowly, a steady, even pressure being used without jerk or impact.

Steel shall, at the time of the placing of the concrete, be free from loose or powdery rust, scale, oil, or other coatings that may reduce the bond between steel and surrounding concrete, affect the durability of the concrete, or initiate corrosion of the reinforcement. If any substance other than water is used for lubricating the formwork, every precaution shall be taken to avoid contamination of the reinforcing steel by such substance.

Reinforcing steel shall be positioned as shown on the drawings or as directed and maintained in those positions within the tolerances specified. It shall be secured against displacement by tying at intersections with annealed wire of nominal diameter 1.25 or 1.6 mm, or by the use of acceptable clips or, if permitted by the Engineer, by welding. Reinforcing bars shall be supported and aligned in their correct position by means of hangers, chairs, spacers or saddles of approved design.

Unless otherwise shown on the drawing or directed by the Engineer, the minimum cover of concrete over reinforcing bars, measured from the outside of the most outer bar or stirrup, shall be 25 mm for mild exposure conditions, 35 mm for moderate exposure conditions, and 50 mm for severe exposure conditions or the diameter of the bar to which the cover is measured, whichever is greater. Cover shall be maintained by the use of plastic spacers

The Contractor shall ensure that reinforcement including stirrups, links, and tying wire does not encroach into the specified cover. Splices or joints in reinforcing bars shall be made only as and where shown on the drawings or as otherwise approved.

If left exposed for future bonding of extensions to the Works, reinforcing steel shall be protected from corrosion as directed. For precast units, reinforcement shall, where practicable, be performed into rigid cages. For this purpose, spot welding of bars shall be carried out only by skilled and experienced welders.

1.3.5.2 Formwork

Formwork will be classified in accordance with the surface conditions required on the finished concrete, as shown on the drawings or as directed. Such finishes will be as follows:

a. **Class F1 -** Rough. No treatment of the surface of the concrete will be required after the striking of the formwork. The finish of the concrete need not be more accurate than Degree of Accuracy III as defined in terms of Clause 1.3.6.

b. **Class F2 -** Smooth. Imperfections such as small fins, bulges, irregularities, surface honeycombing, and slight surface discolorations shall be made good and repaired by approved methods. The finish of the concrete shall be accurate to Degree of Accuracy II.

c. **Class F3 -** Special. Special finishes shall be as indicated on the drawings.

If no Class of Finishes is specified in the BOQ or Technical Drawing, Class of finishes Class F2 shall apply.

All formwork for concrete work shall be mostly of M.S. Plates. The plates shall be free from wrinkles, lumps or other imperfections. Steel plates shall have sufficient thickness to withstand the construction loads and the pressure exerted by the wet concrete as well as vibration during placing of concrete. Normally the thickness shall not be less than 18 gauge for M.S. Plates.

The formwork may also be constructed of timber, or other approved material. It shall be firmly supported, adequately strutted, braced and tied to withstand the placing and vibrating of concrete and the effects of weather. One copy of the Contractors shoring and formwork drawings shall be submitted to the Corporation for record purpose only and not for review or approval. Forms, shoring and false work shall be adequate for imposed live and dead loads including equipment and men, height of concrete drop, concrete and foundation pressures and stresses, wind pressures, lateral stability, and other safety factors during construction. The Contractor shall be responsible for the calculations and designs for the formwork. The Contractor shall be held solely responsible for any failure and for the safety of work and workmen. He shall pay necessary compensation, if need be, for damages to work, property and injuries to persons. The scaffolding, hoisting arrangements and ladders shall have easy approach to work spot and afford easy inspection.

Where no special finish is desired and where form finish is acceptable, the formwork may be prepared out of water proof black board, which shall give a good finish to the concrete surface and thus there will be no necessity of providing cement plaster finish. For work, which are of repetitive nature, such as column footings, pedestals for pipes, pedestal footings; the formwork shall be fabricated out of steel plates and structural to obtain uniform finish throughout the work. In all cases the formwork shall be inspected and approved by the Engineer, before any concreting is started. The Contractor shall, however, be solely responsible for the proper design, adequacy, and stability of the formwork. If at any time, in the opinion of the Engineer, the formwork provided is not considered sufficiently rigid and / or is defective, the Contractor shall improve or strengthen the same in such manner as the Engineer may direct.

Forms shall be erected with joints tight enough to prevent leakage of cement mortar.

Surfaces of forms (regardless of the material of which they are made) that are to be in contact with fresh (wet) concrete shall be treated with a coat of non-staining mineral oil or other approved material, or, in the case of timber forms, by thorough wetting of the surfaces with water, so as to ensure easy release and prevent adhesion of the formwork during stripping.

All formworks shall conform to the shape, lines, and dimensions as shown on the plans of the concrete members. The formwork shall include all wedging, bracing, the rod, clamps; stop off boards and other devices necessary to mold the concrete to the desired shape. The formwork shall be constructed as to remain sufficiently rigid during the placing and compacting of the concrete and shall withstand the necessary pressure, ramming and vibrations without any deflection from the prescribed lines and curves. It shall be properly strutted and braced in at least two directions. It shall be sufficiently tight to prevent loss of liquid slurry from the concrete. It shall be strongly and firmly erected. The molds shall be free from holes, open joints, and other imperfections. The formwork shall be so arranged as to permit easy erection initially and easy removal without jarring or disturbing the concrete finally. Wedges and clamps shall be used wherever practicable instead of nails. Where the depth of formwork exceeds 1.5 meters, the Contractors shall keep one side partly open, from which the concrete could be placed and the planking on the open side could be raised as the work proceeds. This will avoid segregation of material in concrete and also facilitate its proper vibration.

Before concrete is placed, all rubbish shall be removed from the interior of the form and the surfaces of the formwork in contact with concrete shall be cleaned and thoroughly wetted. The inside surface of the formwork shall be treated with a coat of lime, oil or any other material approved by the Engineer. Care shall be taken to see that the above approved composition is kept out of contact with the reinforcement. The slab centering shall be covered with “Double Wax” water proofing paper or tar paper or polythene sheet as directed by the Engineer.

Before re-use, all formworks shall be reconditioned, and all form surfaces that are to be in contact with the concrete shall be thoroughly cleaned.

Where necessary for the proper placing of the concrete, temporary openings for cleaning, inspection, or placing and compaction purposes shall be provided and, subsequently, so closed as to provide the finish specified and to conform to the applicable tolerances specified.

Formwork shall not be removed before the concrete has attained sufficient strength to support its own weight and any loads that may be imposed on it. The Engineer’s approval shall be obtained before formwork is removed. In cool weather, stripping times shall be determined by interpolation between the periods specified for normal and cold weather.

If the Contractor can prove to the satisfaction of the Engineer that a period shorter than the appropriate minimum given above is sufficient to enable the concrete to comply with its requirements, the formwork may be removed after such shorter period.

Formwork shall be removed carefully so that shock and damage to the concrete are avoided. All formwork shall be removed without such shock or vibration as would damage the concrete. Before the soffit and the struts are removed, the concrete surface shall be exposed where necessary in order to ascertain that the concrete has hardened sufficiently. The responsibility for the removal of the formwork whether whole or part, shall rest, entirely with the Contractor who must nevertheless be guided by the opinion of the Engineer in this regard. The work of striking and the removal of formwork shall be conducted in the presence of the Engineer and under personal supervision of a competent foreman in the employment of the Contractor.

Notwithstanding the provisions above, the Contractor shall be responsible for making good any damage to the concrete arising from the removal of formwork and its supports.

1.3.5.3 Holes, chases, and fixing blocks

No holes or chases, other than those shown on the drawings or approved by the Engineer, shall be cut or otherwise formed in the concrete. The manner of attaching fixtures to be embedded in the concrete shall be subject to approval by the Engineer.

Boxes for forming holes shall be constructed so as to be easily removable without damaging the concrete during removal. They shall be properly vented to permit the escape of entrapped air and shall be capable of being sealed, subsequently, to prevent the loss of grout.

1.3.5.4 Crossing Pipes and conduits

No pipes or conduits, other than those shown on the drawings or approved by the Engineer, shall be permanently embedded in the concrete. Crossing pipes shall be puddle flanges.

1.3.5.5 Water Stops

Provision of water stops embedded in concrete and spanning control, expansion, and/or construction joints to create a continuous diaphragm to prevent liquid migration.

Non-metallic water stops for use in concrete joints subjected to chlorinated water, seawater, and many waterborne chemicals. Provide flexible PVC (polyvinyl chloride) water stop, that shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment.

Minimum total width of the water stop shall be 240mm, and minimum width of expansion part shall be 80mm. When used in expansion joints, the water stop profile shall incorporate a center bulb, otherwise for construction joints center bulb is not necessary.

Performance Requirements as per US Corps of Engineers: CRD-C 572-74: Tensile Strength > 15 N/mm2 and Elongation at break in excess of 300%, tested as per ISO 527 or ASTM D 638.

Water stops in joints of waterproof structures shall be carefully maintained in the position shown on the drawings and properly protected from damage and the harmful effects of light and heat during all stages of construction.

Provide factory made water stop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field. Field butt splices shall be heat fused welded using a Teflon coated thermostatically controlled water stop welding iron at approximately 380 degrees F. Follow approved water stop manufacturer recommendations. Lapping of water stop, use of adhesives, or solvents shall not be allowed.

Center water stop in joint and secure water stop in correct position using grommets, pre-punched holes, or hog rings (installed by others) spaced at 12 inches on center along the length of the water stop and wire tie to adjacent reinforcing steel.

The stop-boards on each side of the water stop shall be accurately wrought to match the profile of the water stop. The concrete shall be carefully compacted under and around the water stop so as to leave no cavities.

Joint filler material of the thickness specified shall be cut to shape and fixed to fill the whole space between the concrete faces of the joint which is not otherwise filled by water stop and joint sealer. Abutting pieces shall be placed in close contact and the joints covered on each side to prevent the passage of cement grout.

1.3.5.6 Concrete

1.3.5.6.1 Quality

Concrete shall comply with the requirements for a designed mix to BS 8110 and BS 8007

The Contractor shall determine to the approval of the Engineer the actual proportions of ingredients for each grade of concrete to be used in the Permanent Works. The concrete shall meet the requirements given in the following table 6.

Table 6: Grades of Concrete

Grade	Cement content (kg/m^3)		Maximum W/ C ratio	Workability
	Minimum	Maximum		
M15	240	450	0.60	Medium
M20	300	450	0.55	Medium
M25	300	450	0.50	Medium
M30	320	450	0.45	Medium
M35	340	450	0.45	Medium
M40	360	450	0.40	Medium

Notes:

1. Water cement ratio is the ratio of free water to cement in the mix based on aggregates being in a saturated surface dry condition.
2. The specified characteristic compressive strengths for the minimum individual test result and the mean of four consecutive test results are derived from Table above and Table 1 of BS 5328: Part 4 1990.
3. Nominal maximum size of aggregate 20mm.
4. Medium workability: slump 50 to 100mm

1.3.5.6.2 Trial Mix

The Contractor shall submit details of the source of all material and the proposed quantities of each ingredient per cubic meter of fully compacted concrete. The Contractor shall then make trial mixes for each grade of concrete using the same type of Constructional Equipment and the same materials as are proposed for the Permanent Works. The Contractor shall give one week notice of such trials to enable the Engineer's Representative to attend. For each trial mix, three separate batches of concrete shall be made by the Contractor and will be tested at 28 days all in accordance with BS 1881: Part 116. Such trial mixes shall not be the first batch through the equipment in any one sequence of concrete production.

The Contractor shall not commence concreting in the Permanent Works until details of trial mixes and test results for each grade of concrete have been submitted to, and approved by, the Engineer.

A trial mix design will be approved by the Engineer with respect to strength if the average compressive strength of the nine cubes so tested is more than the target means strength appropriate to the grade as given in Table 6.

The Contractor shall not alter the approved mix proportions nor the approved source of supply of any of the ingredients without having previously obtained the approval of the Engineer.

During production the Engineer may require trial mixes to be made before a substantial change is made in the materials or in the proportions of the materials to be used.

1.3.5.6.3 Batching

1.3.5.6.3.1 Weight Batching

In normal circumstances weight batching shall be used. The mass of cement supplied in a standard sack shall not be less than 50 kg. All cement taken from bulk storage containers and from partly used sacks shall be batched by mass with additional 2 % of mass required.

Mixing water for each batch shall be measured. The amount of water measured shall be adjusted to allow for the moisture content of the aggregates.

The mass of the aggregate of each size shall be determined and a correction made for the moisture content of the aggregates. (See 1.3.5.5.1)

1.3.5.6.3.2 Volume Batching

In special circumstances, and at the sole discretion of the Engineer, proportioning of materials by volume may be approved. If batching is by volume, the fine and the coarse aggregates shall be measured separately in suitable measuring boxes of known volume and of such capacity that the quantities of aggregates for each batch are suitable for direct transfer into the mixer. Bulking tests on the fine aggregate shall be conducted regularly and the results used for adjustment of the batch volume of the fine aggregate to give the true volume required.

Volume-batching of cement will in no case be accepted. The Contractor may, however, so proportion the mix that each batch shall use a whole bag or bags of cement, the weight of which is known precisely. All gauge boxes shall be accurate and strongly constructed and due allowance shall be made for bulking of the aggregates in assessing the correct volume to be used. The aggregates and the cement shall be thoroughly mixed in a clean mechanical mixer for a period of time agreed with the Engineer and the water added on the basis of the approved mix.

1.3.5.6.4 Mixing

The following requirements shall apply to the mixing of concrete at the construction location:

a. Mixing of materials for concrete shall be conducted by an experienced operator.

b. The sequence of charging the mixing equipment shall have been approved before mixing commences and, unless otherwise directed, the approved sequence shall be maintained.

c. The total volume of material per batch shall not exceed the rated capacity of the mixer.

d. Before any concrete is mixed, the inner surfaces of the mixer shall be cleaned, and all hardened concrete shall be removed. A slurry of cement, sand, and water containing cement and sand in a ratio of 1:2 and in sufficient quantity to cover the entire inside surface of the mixer shall be produced in the clean mixer and discharged immediately before the charging of the mixer with materials at the commencement of each concrete production run.

e. The period of mixing shall be measured from the time when all the materials are in the drum or pan to the commencement of discharge. Subject to the provisions of (f) below, the mixing period for each batch of 1.5 m3 or less shall be at least 1.5 min and 1 min for drum-type and pan-type mixers respectively, and shall be increased by 20 secs and 15 secs respectively for each additional cubic meter or part thereof. During this period, the drum or pan shall be rotated at the speed recommended by the manufacturer of the mixer. The maximum continuous mixing times at the recommended mixing speed shall not exceed 10 min and 6 min per batch for drum-type and pan-type mixers respectively.

f. In the event of delay in the concreting operations, concrete may be retained in the mixer for a maximum period of 2 h provided that the slump is checked frequently and that only enough water to maintain the target slump is added to the mixer. During this period the mixer shall be restarted and run for about 2 min every 15 min. The Engineer may order that the period of 2 h be reduced if, in his opinion, the ambient temperature, or any other factor, will tend to produce early setting.

g. Discharge shall be so carried out that there is no segregation of the materials in the mix. The mixer shall be emptied completely before it is recharged. If the mixer has been out of use for longer than 30 min, it shall be thoroughly cleaned out, particular attention being paid to the removal of any built-up of materials in the drum, in the loader, and around the blades or paddles.

h. The Engineer will advise whether the production of concrete at a central concrete production facility other than on the construction location is permitted and whether the test results obtained by such a production facility as part of its quality control system are acceptable.

1.3.5.6.5 Transportation

Mixed concrete shall be discharged from the mixer and transported to its final position in such a manner that segregation, loss of ingredients, and adulteration are prevented and that the mix is of the required workability at the point and time of placing.

1.3.5.6.6 Placing

The Contractor shall give the Engineer 24 h notice of his intention to place concrete. The concrete shall be placed within 1 h of the time of its discharge from the mixer. Concrete shall not be re-tempered by the addition of water or any other material. The forms to be filled shall be clean internally. All excavations and other surfaces of an absorbent nature that are to come into contact with the concrete shall be dampened with water. There shall be no free water on the surfaces against which concrete is to be placed.

Wherever possible, the concrete shall be deposited vertically into its final position to avoid segregation and displacement of reinforcement and other items that are to be embedded.

Deposited concrete shall not be so worked (whether by means of vibrators or otherwise) as to cause it to flow laterally in such a way that segregation occurs. Where possible, the concrete shall be brought up in horizontal layers of compacted thickness not exceeding 450 mm and heaping shall be avoided.

Where a chute is used to convey the concrete, its slope shall be such as will not cause segregation, and a suitable spout or baffles shall be provided for the discharge of the concrete.

Concrete shall not be allowed to fall freely through a height of more than 3 m, unless otherwise approved. Placing of concrete under water will be permitted only under exceptional circumstances when it is, in the opinion of the Engineer, not practicable to dewater before placing. No concrete shall be placed in flowing water. When the placing of concrete under water is permitted, it shall be placed by means of a tremie. During placing, the lower end of the tremie shall be continuously immersed in the concrete being deposited. To maintain the desired properties of the concrete the quantity of cement in the concrete mix shall be increased by 20%. Full details of the method proposed and of the adjusted concrete mix proportions shall be submitted to the Engineer for his approval before placing commences. During and after concreting under water, pumping or dewatering operations in the immediate vicinity shall be suspended.

Recesses at movement joints on both faces of the concrete work except on the underside of continuously supported work and on faces backfilled with earth shall be accurately formed to the lines and dimensions shown on the drawings. The Contractor shall prepare the surfaces of the recesses and shall supply a joint sealer and fill or caulk the recess completely with-it, all-in accordance with the manufacturer's instructions.

The placing of concrete by pumping in any section of the Works shall be subject to the approval of the Engineer. The Contractor shall furnish the Engineer with full details regarding the mix proportions of concrete that he intends to place by pumping. The Contractor shall not place concrete in the Permanent Works:

i. During heavy rains or dust storms.

ii. When the air temperature is more than 43^{o} C.

iii. When the air temperature is less than 2^{o} C.

iv. If the temperature of the concrete on discharge from the mixer is less than 4^{o}C or more than 32^{o}C.

v. When the air temperature exceeds 25^{o}C without taking precautions and demonstrating to the approval of the Engineer that the maximum internal temperature of the concrete within 24 hours after casting in place is unlikely to be more than 30^{o}C in excess of the ambient temperature or more than 60^{o}C.

vi. Without the Engineer’s approval if the temperature of the shutters or reinforcement exceeds 30o C.

To keep within these limits the Contractor may, among other means, spray aggregates with water, and use chilled mixing water, or add ice direct to the mixer provided that no ice is present in the mix when discharged from the mixer.

When concreting in hot weather all material used shall be kept in the shade. Water tanks, mixers and chutes should be shaded, but where this is not possible, they shall be painted white and kept white.

1.3.5.6.7 Compaction

The Contractor shall regard the compaction of the concrete as work of fundamental importance and shall produce a watertight concrete of maximum density compatible with the approved mix. Compaction shall be assisted by the use of mechanical vibrators of the immersion type but shall not involve the vibration of reinforcement or shutters except that vibration of shutters may be allowed, with the approval of the

Engineer. Vibrators shall be inserted at least to the full depth of the newly deposited concrete and then slowly withdrawn to prevent the formation of voids. The procedure shall be continuous with points of insertion 150 to 225 mm apart. The number and type of vibrators available for use during each period of concreting shall be to the approval of the Engineer, which will not be given if sufficient stand-by vibrators in good working order are not readily available. If concreting is in the dark, ample lighting shall be provided at the mixing stations and at every place where concrete is being deposited.

Compaction shall be carried out by mechanical vibration or (if approved) by spading, rodding, or forking. Over-vibration resulting in segregation, surface laitance, or leakage, or any combination of these, shall not be permitted. The rate of concrete placing shall be commensurate with the available compaction equipment and only skilled operators shall be permitted to undertake compaction by vibration.

Concrete for precast elements shall be so placed in moulds and vibrated that concrete surfaces are smooth and even and all arises are true and clean.

Where precast units having architectural finishes are required, the Contractor shall ensure that duplicate samples are submitted to and approved by the Engineer with regard to both colour and quality before full scale production is commenced. One sample will be retained by the Engineer and the other shall be retained by the Contractor at the place of manufacture. The Contractor shall not commence manufacture until acceptable samples have been lodged.

1.3.5.6.8 Designated and Construction joints

Concreting shall be carried out continuously up to the locations where joints are shown on the Contractor's working drawings or up to approved or directed locations. The method adopted for forming such joints and unforeseen joints shall be one of the following:

1.3.5.6.8.1 General Preparation

a. Joints when concrete is less than 24 h old. The surface of the concrete shall be water jetted to expose the aggregate.

b. Joints when concrete is more than 24 h but not more than 3 d old. The surface of the concrete shall be sandblasted or chipped with a light hammer to expose the aggregate.

c. Joints when concrete is more than 3 d old. The procedure specified in (b) above shall be followed.

1.3.5.6.8.2 Preparation before placing concrete

a. Joints when concrete is less than 24 h old. The surface of the concrete shall be swept clean and immediately before placing the concrete wetted but without pools of water.

b. Joints when concrete is more than 24 h but not more than 3 d old. The surface of the concrete shall be swept clean, and thoroughly wetted but without pools of water.

c. Joints when concrete is more than 3 d old. The procedure specified in (b) above shall be followed, except that the old surface shall be kept continuously wet for at least 24 h before the new concrete is placed.

1.3.5.6.8.3 Curing and Protection of Concrete

The Contractor shall, until it has thoroughly hardened and for not less than 7 days, protect the concrete from the harmful effects of frosts, wind, sun, high or low temperature, variation or reversal of temperature gradient, premature loading, deflection or impact, and aggressive groundwater. The protruding steel shall be kept cool.

Unless otherwise approved by the Engineer, exposed concrete surfaces shall be kept continuously moist for not less than 7 days after casting in the case of Portland and Sulphate resisting cement concretes. Immediately upon exposure, surfaces shall be covered with a thick layer of hessian or sand or other material as may be approved by the Engineer, which shall be in continuous contact with the concrete and kept wet to the satisfaction of the Engineer; the Contractor shall make special provision to the satisfaction of the Engineer for the supervision of wetting concrete which incorporates other authorized types of cement.

If curing membranes are proposed by the Contractor and approved by the Engineer, they shall be applied in conformity with the manufacturer’s instructions. They shall be applied to un-shuttered surfaces within one

hour of concrete deposition and shall incorporate aluminum or other approved reflecting agent. Surfaces with applied curing membrane shall be shaded from the sun, unless otherwise approved.

Curing membranes shall not be applied to construction joints.

Concrete curing compound for structures shall be a liquid resin or wax resin base membrane curing compound of a proprietary brand and shall contain a fugitive dye.

Test certificates, prepared by an approved testing laboratory, shall be supplied by the Contractor to show that the compound complies with the curing efficiency.

1.3.5.6.9 Concrete surfaces

Surfaces of concrete not finished against forms or ground surfaces shall be finished to the following classes.
Type U1 - This finish is for surfaces where a superior finish is not required. It is also the first stage for finishes U2 and U3. The finishing operations shall consist of grading, tamping, and screeding the concrete to produce a uniform, plain, or ridged surface.

Type U2 - This is a smooth matt finish such as may be achieved by a wood trowel, as required, inter alia, to receive mastic paving, block or tile paving bedded in mastic or screeds. Smoothing shall be done only after the concrete has hardened sufficiently and may be by hand or machine. Care shall be taken that the concrete is worked no more than is necessary to produce a uniform surface free from marks.

Type U3 - This is a smooth steel-troweled finish for surfaces of concrete paving, tops of walls, copings and other members exposed to weathering or water, surfaces to receive thin flexible sheet, tile paving bedded in adhesive, and seatings for bearing plates and the like where the metal is in direct contact with the concrete. Troweling shall not commence until the moisture film has disappeared and the concrete hardened sufficiently to prevent excess laitance from being worked to the surface. The surfaces shall be troweled by hand or machine under firm pressure and left free from trowel marks.

If no Class of Finishes has been specified in the BOQ or Technical Drawing, Class of finishes U2 shall apply.

1.3.5.6.10 Concrete in wet ground

The Contractor is to provide a dewatering system on own cost, which ensures when concrete is placed there is not surface water, and the ground provides suitable working condition.

1.3.5.6.11 Defects

The concrete shall be homogeneous and free from honeycombing, inclusions, and planes of weakness. If, after removal of the forms, the concrete shows any defect, the Contractor shall immediately report such defect to the Engineer, and he shall not carry out any patching or remedial work until authorized to do so by the Engineer.

After thorough inspection and investigation of the quality and strength of the defective work and after due consideration of the possible consequences of such defect, the Engineer will either specify the extent and method of repair or order the demolition and reconstruction of the whole of the defective work to the extent that he considers necessary.

The cost of all such investigation, repair, and remedial work and of any demolition and reconstruction of defective work shall be borne by the Contractor and all repair, remedial, and reconstruction work shall be executed to the satisfaction of the Engineer.

Finished concrete shall have a neat, smooth, even, and uniform finish free from any honeycombing. If the finish of any formed or floated concrete surface is, to the opinion of the Engineer, unsatisfactory and does not conform to that specified, the Contractor will be required, at his own expense, to rub down such surface while it is still green, or, alternatively, to grind it down with Carborundum or other suitable material when it has hardened or to take other approved measures to give the specified finish.

For precast elements, moulds shall be removed without any shock or vibration that might damage the concrete or have any other detrimental effect on the units and on their surfaces.

1.3.5.6.12 Handling and erection of precast units

The Contractor shall ensure that lugs, slots, holes, etc., provided for handling units and moving them from the point of manufacture to the place where they are erected, are adequate, and are so arranged that excessive stresses do not occur in any unit during handling, movement, or erection. Without the Contractor's responsibility being limited in any respect, the position of lifting and supporting points, the method of lifting, and the type of equipment and transport used shall be subject to approval by the Engineer.

The Contractor shall place indelible identity, location, and orientation marks on each unit, as and where necessary. Packing pieces shall be such that they do not discolor or otherwise permanently damage the units.

Precast units shall be so stacked that the accumulation of trapped water and dirt is prevented, that, in the case of small units, deformation is minimized during the curing process, and that large units have complete freedom of movement during the curing process.

The method of assembly and erection agreed to with the Engineer shall be adhered to on the Site. Immediately after the unit is in position and before the lifting equipment is removed temporary supports or temporary connections between units shall be provided as necessary. The final structural connections shall be completed as soon as is practicable.

1.3.5.6.13 Joint Sealers

The Contractor shall construct recesses at all joints and on both faces of the concrete work except on the underside of ground slabs. The recesses shall be accurately formed to the lines and dimensions shown on the Drawings or as agreed with the Engineer.

The Contractor shall prepare the surfaces of the recess, prime if necessary and shall apply a joint sealer and fill or caulk the recess completely with it.

Joint sealing shall not be commenced without the approval of the Engineer. In reservoir joints the sealer shall be applied after the construction of the reservoir roof.

Sealants shall be installed in strict accordance with the manufacturer’s instructions. De-bonding strip shall be used in conjunction with the sealers as indicated on the Drawings. The de-bonding strip shall be compatible with the joint sealer and shall be resistant to attack from the primer used to bond the sealer to the concrete.

Polysulphide and polyurethane sealers shall not abut bituminous sealers. Surfaces to receive polysulphide and polyurethane sealers shall be kept free from bituminous paints.

All sealers shall be appropriate for the prevailing climatic conditions.

1.3.5.6.14 Concrete for Benching

Concrete for benching in manholes and similar structures shall consist of Grade M15 concrete unless otherwise specified. It shall be placed with low workability to the approximate shape required, and, while still green, shall be finished with not less than an average of 20 mm of cement screed to a steel troweled finish and to the contours indicated on the drawings.

1.3.5.6.15 Records

The Contractor shall maintain written records that provide the following information:

a. the date on which each section was concreted
b. the position of the section within the Works
c. the time taken to place the concrete
d. the daily weather conditions
e. the nature of samples taken and the dates they were taken
f. the curing history
g. the date of removal of formwork
h. the grade of concrete

A written record of the concrete works shall be made each day by the Contractor and kept available for inspection by the Engineer. The diary shall contain notes and records of:

1. The names of the Contractor's engineers who are responsible for the different phases of the concrete work, and also the names of their assistants.
2. The temperatures of air, water, cement, aggregates and concrete, together with the air humidity and type of weather.
3. Deliveries to the Site of concrete materials (quantity, brand of cement, etc).
4. Inspections carried out, tests performed, etc and their results.
5. Times of commencement and completion of different parts of the concrete works, and times of erection and striking of forms.
6. Quantity of cement, fine and coarse aggregate and admixture used for each section of work, and the number and kind of test samples taken on these ingredients and water.

1.3.6 Tolerances

Permissible deviations (PD) appropriate to the degree of accuracy will be applied to linear dimensions, position, plumb (verticality), level, squareness, and bow.

Where precast units are to fit on between cast-in-situ concrete units, the tolerances applicable to the cast-in-situ concrete shall be compatible with the tolerances applicable to the precast units.

The Degree of Accuracy may be one of the following:

a. Degree of Accuracy III for use where a high degree of accuracy is unnecessary, e.g. mass foundations, Finish classes F1 and U1.

b. Degree of Accuracy II for what is normally considered "good work" Finishes F2 and U2.

c. Degree of Accuracy I where the use of special, as opposed to normal, methods or materials (or both) is warranted, e.g. prefabricated units or where such are to fit in. Finishes classes F3 and U3.

Deviations will be measured as set out below:

a. Any deviation from flatness of a plane surface will be measured as the maximum deviation of the surface from any straight line of length 3 m joining two points on the surface, determined by means of a straight edge the ends of which are supported on identical blocks of suitable thickness placed over each of the points.

b. Any abrupt change in a continuous surface, including a local depression or peak in a floor or wall and any abrupt change caused by a joint in formwork will be measured as specified in (a) above.

c. Out-of-squareness of a corner or an opening or an element such as a column will be measured by taking the longer of two adjacent sides as the base line and determining any departure from the perpendicular of the side at either end of the base line.

1.3.7 Tests and Acceptance

1.3.7.1 Facilities and frequencies of sampling

For the purposes of taking samples and carrying out tests, the Engineer shall have free access to the Works and the Contractor shall provide all equipment required for the sampling (e.g. cones and moulds) as specified and render any assistance necessary. If so required, the Contractor shall provide storage and protection for such samples on the Site.

While concrete of a particular grade is being placed under the same conditions, sets of samples (each sample being sufficient for 3 cubes) shall be taken.

The sets of samples shall be taken as close as is practicable to the start of placing and at appropriate intervals thereafter, or from one particular batch and then from subsequent batches chosen at appropriate intervals.

At least one set of samples shall be taken from each day's casting and from at least every 50 m3 of concrete of each grade placed.

Only one sample shall be drawn from any one batch of concrete, and, except where otherwise ordered, no sample shall be taken of any grade until at least 3 batches of such grade have been mixed and discharged.

1.3.7.2 Testing

All testing shall be carried out in accordance with the relevant applicable standards or as directed by the Engineer.

The Contractor shall ensure that Site testing is carried out by a competent technician or by a person deemed by the Engineer to be sufficiently experienced.

The Contractor shall ensure that laboratory testing is carried out by a recognized testing institution or an approved laboratory or a firm approved by the Engineer.

Where early-strength testing is desired by the Contractor (e.g. for determination of the seven day strength), plans for such testing and interpretation of results shall be as agreed between the Contractor and the Engineer. As a general guide the seven day strength may be considered to be the 28 day strength divided by 1.4.

1.3.7.3 Acceptance criteria for designed mix concrete

Of the three cubes made from each sample of fresh concrete in accordance with BS 1881, one will be crushed at 7 days and the other two at 28 days. The average of the two 28-day strengths will be taken as the test result. Compliance with the specified strength requirements shall always be judged on the 28-days' test results.

Concrete shall be considered to have failed to comply with the Specification:

1. if a test result is less than the minimum specified in BS 5328 for that grade of concrete, in which case the concrete which it represents shall be broken out and disposed of away from the Site by the Contractor unless at his sole discretion the Engineer approves otherwise (Ref Table 5.2(a)).
2. if the average of four consecutive test results for that grade of concrete shall have failed to exceed the minimum mean of 4 as specified in BS 5328 in which case no further concrete of that grade shall be placed in the Permanent Works until the Contractor shall have discovered the cause of such failure and rectified it to the satisfaction of the Engineer (Ref Table 5.2(a)).

If a mix fails to achieve the requirements for fresh concrete the batch shall be rejected and no further concrete of that grade shall be placed in the Permanent Works until the cause of failure has been rectified.

If test results for strength of concrete of any grade are consistently and significantly in excess of the target mean strength the Engineer may on the application of the Contractor agree to a reduction in the cement content in the mix for that grade, provided the cement content is not lowered below the minimum specified for that grade, nor the maximum water/cement ratio exceeded.

If, after evaluation of the test results an examination of the concrete in the structure is indicated, one or more of the procedures in the sequence given below may be adopted at the discretion of the Engineer to determine the acceptability or otherwise of concrete in particular sections of the structure:

a. An assessment of the stress level in the structure concerned in relation to the test result obtained
b. non-destructive testing, subject to similar concrete of proved acceptable quality being available in comparable members in the same construction as a reference (impact hammers and ultrasonic testing are two examples of such test techniques that may be used, provided the apparatus has been previously calibrated)
c. the testing of drilled cores in accordance with relevant applicable standards under terms and conditions agreed upon between the Engineer and the Contractor.

Where load tests are, in the opinion of the Engineer, unsuitable or impractical, and if an examination described above does not show the concrete strength to be acceptable, or if a portion of the structure fails to pass the test, the Contractor shall, on the instructions and directions of the Engineer, either replace or strengthen by approved means: each section of the structure that failed or contains concrete that failed, as relevant; and any section, irrespective of strength, the functional purpose of which is affected by the a failed section or failed concrete.

The Contractor shall bear the cost of any replacement or strengthening referred to above as well as any other remedial measures that may be ordered to restore the durability of the concrete to that achievable by concrete of the strength required in terms of the specification.

1.3.7.4 Individual Load Tests on Precast Units

If so directed by the Engineer, the unit to be tested shall be supported at its designed points of support and loaded for 5 min with a load equal to the sum of the characteristic dead load plus 1.25 times the characteristic imposed load, and the deflection shall then be recorded. The maximum deflection measured after application of the load shall be checked for compliance with the applicable requirements of the relevant applicable standards.

The recovery shall be measured 5 min after the removal of the applied load and the load shall then be re-imposed. The percentage recovery after the second loading shall be at least equal to that determined after the first loading and at least

90 % of the deflection recorded during the second loading. At no time during the test shall there be, in the opinion of the Engineer and in the light of a reasonable interpretation of the relevant data, any sign of weakness or faulty construction in the unit under test.

If destructive tests for beam units are ordered, the unit to be tested shall be supported at its design points of support and loaded to its ultimate design load. The unit shall not fail within 15 min after the application of the test load. A deflection exceeding 1/40 of the span shall be regarded as failure of the unit.

For units not amenable to the tests described above, details of the testing arrangements shall be agreed between the Engineer and the Contractor before such units are cast.

1.3.8 Measurement and Payment

1.3.8.1 Formwork

Unless otherwise specified in the BOQ, formwork will be measured as the net area of the face of the concrete. No deduction will be made for fillets and splays of size up to 100 x 100 mm or for openings of diameter up to 0.7 m or of area up to 0.5m2. No payment will be made for formwork used in forming designated and construction joints.

1.3.8.2 Reinforcement

Unless otherwise specified in the BOQ, steel for reinforcement will be measured net by mass of all bars, including supporting steel detailed on the bending schedules. No allowance will be made for cutting, waste, spacer devices, laps, or binding wire.

Steel offcuts resulting from the cutting and bending of reinforcing steel in accordance with the bending schedule shall be deemed to be the property of the Contractor.

1.3.8.3 Concrete

Unless otherwise specified in the BOQ, the volume or area of concrete, in which unit the payment is intended, will be computed from the measurements net to the dimensions shown on the drawings or to the dimensions cast, whichever is the smaller. Structural elements that are undersized will be measured for payment only if they are accepted by the Engineer.

Precast slab shall be measured in the net surface area for defined thickness of the slab. The rate of precast slab includes rate of concrete, formwork, reinforcement, underlying material and other incidentals required to complete the works.

No allowance will be made for concrete required to make up overbreak in soft excavation, but payment will be made for additional concrete or formwork, ordered in writing by the Engineer to replace unsuitable material or overbreak in hard rock or in intermediate excavation.

Sub-foundation carpets and blinding layers will be measured to the plan size of the concrete structure resting on it and the thickness shown on the drawings, and measured on the mean thickness as cast, provided that the Engineer is satisfied that the excavation has not at any point been taken deeper or wider than necessary.

Separate items will be scheduled, as applicable, for each type and each grade of concrete, for each unit or element in the structure (where these would materially influence the pricing), such as

a. slabs that are horizontal, sloping, conical or of different thickness
b. concrete deposited under water
c. small quantities each less than 0.20 m3 of formed surfaces, and
d. different surface finishes, other than just striking-off and levelling.

No separate payment will be made for curing, sampling of testing.

1.4 BRICKWORKS

1.4.1 Scope

This specification covers the general construction requirements for brickwork in general Masonry, Pavement, Drain Section, Manholes, Chambers, Buildings, Reinstate of Brickwork, Walls, and other brick structures.

1.4.2 Interpretations

1.4.2.1 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

1.4.2.2 Application

This specification contains clauses that are generally applicable to brickwork construction and associated work.

1.4.3 Materials

1.4.3.1 Bricks

Unless otherwise specified, burnt-clay bricks shall be first class quality (Class `A').

Bricks should be obtained from an approved manufacturer and should be approved by the Engineer. The Contractor shall submit to the Engineer samples of the bricks that he intends using in the construction of the different sections of the Works. The samples of the bricks that are approved will be retained by the Engineer.

Bricks shall be free from defects affecting strength and durability. The amount and extent of manufacture cracks or cracks and chips due to handling shall not be to such a degree as to give an unsightly appearance to exposed brick surfaces and all face brick to be used on the Work shall match with the samples approved by the Engineer.

All bricks shall be machine made, of good quality brick earth and thoroughly burnt, and shall be of deep cherry red or copper colour. The bricks when dried shall emit a clear ringing sound when struck together and

shall not break when thrown on the ground or against other bricks from a height of 1 m. The bricks shall not absorb water more than one sixth of their weight after one hour of soaking by immersion in water.

The bricks shall be wholly clean and free from flaws, cracks, and under-burnt lumps of any kind. They shall be uniform in size and regular in shape and have square, straight, and sharp edges and even surfaces.

Bricks shall be carefully handled at all stages in delivery, stockpiling, transportation on Site and construction to prevent breakage or surface damage. Bricks shall be carefully unloaded by hand and shall not be dumped or thrown. They shall be stocked in regular layers even as they are unloaded. The supply of bricks shall be arranged so that at least one-week requirement of bricks is available at the site at any time.

1.4.3.2 Cement for mortar

Cement for masonry mortar and grout shall be ordinary Portland cement in accordance with the requirements of Clause 1.3.3.2. All cement for mortar for exposed face work shall be of a uniform colour as approved by the Engineer.

1.4.3.3 Sand for mortar

Sand (fine aggregate) for masonry mortar and grout shall be in accordance with the requirements of IS 460-1962. For exposed face work shall be of a uniform colour as approved by the Engineer. The particle size grading of sand for use in mortars for masonry work shall be within the limits specified in Table below.

Table 7: Grading Sands for Masonry Work

IS Sieve Designation (IS460-1962)	Percentage of Weight Passing IS Sieve
4.75mm	100
2.36 mm	90-100
1.18 mm	70-100
600 Micron	40-100
300 Micron	5-70
150 Micron	0-15

Sand shall be clean pit sand and shall be free from clay and other impurities and, if so directed, shall be properly screened and washed.

1.4.3.4 Water for mortar

The water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that maybe deleterious to concrete or steel. Portable water shall be generally considered satisfactory for mixing of mortars. The quality of water shall correspond to IS: 456-1978.

1.4.3.5 Construction Equipment

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required.

The type and capacity of mixing machines shall be such that the rate of output of mortar is suitable for the rate of brickwork. Each machine shall be capable of producing a uniform distribution of the ingredients throughout the batch and shall comply with the specification to which the manufacturer claims it has been manufactured. Worn or bend blades and paddles shall be replaced. The inner surfaces of the mixer shall be clean and free from hardened mortars. The mixers used shall be specially suited to the production of low slump mortars.

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required at his own cost.

1.4.4 Construction and Workmanship

1.4.4.1 Mortar

Cement and sand shall be mixed in specified proportions given on the drawings or BOQ. Cement shall be proportioned only by weight, by taking its unit weight as 1440 kg per cubic meter and the sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added, and the mortar mixed to produce workable consistency.

Necessary tests to determine compressive strength of the mortar, for consistency of the mortar and its water retentivity shall be carried out in accordance with IS: 2250. The frequency of testing shall be one cube for every 2 cubic meter of mortar prepared subject to a minimum of 3 cubes for a day's work.

1.4.4.2 Workability of mortar

The mortar shall be of a readily workable consistency with only enough water to obtain a plastic condition suitable for troweling.

1.4.4.3 Workability of grout

Grout shall be of pourable consistency with a slump of 120 mm when tested in accordance with the standard slump test for mortar and grout.

1.4.4.4 Cement mortar mixing and using period

All cementing material and aggregates shall be mixed for a minimum of 2 min in a mechanical batch mixer. Only so much water shall be added as is compatible with convenience in using the mortar. If mortar begins to stiffen from evaporation or absorption of a part of the mixing water, the mortar shall be re-tempered by adding water and remixed. All mortar and grout shall be used within 2.5 h of the initial mixing and no mortar or grout shall be used after it has begun to set.

1.4.4.5 Mixing of mortar

The mixing shall be done intimately in a mechanical mixer unless hand-mixing is specifically permitted by the Engineer. If hand-mixing is done, the operation shall be carried out on a clean watertight platform, and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed for at least two minutes after addition of water.

In case of cement mortar, that has stiffened because of evaporation of water, it shall re-tempered by adding water as frequently as needed to restore the requisite consistency, but this retempering shall be permitted only within thirty minutes from the time of addition of water at the time of initial mixing.

Necessary tests to determine compressive strength of the mortar, for consistency of the mortar and its water retentivity shall be carried out in accordance with IS: 2250. The frequency of testing shall be one cube for every 2 cubic meter of mortar prepared subject to a minimum of 3 cubes for a day's work.

1.4.4.6 Brick laying

All brickwork shall be placed only after the foundation surfaces have been prepared to the satisfaction of the Engineer.

Bricks shall be well soaked in water for a minimum of 3 h immediately before being laid or as required so that the rate of absorption when laid does not exceed acceptable limits approved by the Engineer. The method of wetting shall be such that each brick shall be nearly saturated but the surface appears dry when laid.

Bricks shall be laid in running bond with head joints in each course centered over the bricks in the course below and shall be plumb, level & true to line with full head and bed joints. The ends of brick shall be buttered with sufficient mortar to fill the head joints.

Joints in brickwork shall be uniform and generally 10 mm thick for horizontal and 6 mm wide for vertical joints. Joints shall be tooled to produce a dense V-shaped joint or as otherwise ordered by the Engineer or

shown on the drawings. Defective joints shall be cut out and repointed with mortar as directed by the Engineer.

The colour and texture of all exposed mortar joints shall be subject to the approval of the Engineer and shall be kept uniform throughout the particular contract by strict adherence to the approved mixes and samples.

Extreme care shall be taken to prevent any concrete, grout, or mortar from staining the face of masonry. If any grout or mortar does contact the face it shall be immediately removed and the surface cleaned with clean water. Masonry work shall be protected against staining, tops of walls shall be covered with waterproof coverings as required, and when work is interrupted.

All walls shall, to the extent possible and as practicable, be built up at the same time. In no case shall any walls be advanced more than 1.5 m above another. If it is necessary to stop off a horizontal run of masonry, the end shall be stepped or as otherwise approved by the Engineer.

Where mortar on joints has partially or totally set, the exposed surface shall be cleaned and thoroughly wetted so as to obtain the best possible bond with the new work. All loose masonry and mortar shall be removed prior to the commencement of the work.

Brickwork shall be taken up truly plumb and each set of four bricklayers shall be provided with a plumb bob and straight edge.

Bricks on the 'fair face' shall be the best available, care being taken that they are not chipped or stained as work proceeds. Bricks shall be laid so as to give a perfectly flat face as tested with a straight edge, and no chipping or rubbing back will be permitted to remedy bad laying.

In the event of fair faced brickwork not being finished with struck joints whilst the mortar is still damp, pointing may be carried out with the approval of the Engineer. In this case all joints shall be raked out to a depth of 20 mm, cleaned free from all loose material and any putlogs filled in. The area to be pointed shall then be thoroughly soaked before pointing takes place, the mortar used to be to the satisfaction of the Engineer.

Care shall be taken to keep all brickwork free from mud splashing, mortar, bitumen droppings, etc., and it shall be well cleaned down before being handed over.

If, after the completion of brickwork construction, any of it is found to be out of alignment or level or otherwise not conforming with the permissible deviations specified or otherwise defective, it shall be removed and replaced or repaired by the Contractor, at his own expense, and to the satisfaction of the Engineer.

1.4.4.7 Half brick thick walls and Curtain Walls

Two bars of 6 mm diameter shall be used longitudinally at every 5th course of half brick thick wall brick work. The first reinforcement shall be placed on the top of the bottommost course. The bars shall be fully embedded in the mortar and the ends shall be properly bonded in the vertical joints of brick work or to the main wall as directed by the Engineer. Laps for the reinforcement shall be provided of minimum length of 45 times the diameter of bar.

Top and ends of full height partition walls (half brick or single brick) shall be securely fastened to beams, slabs, columns, and walls, as applicable, with pre-fixed metal fasteners or holdfasts spaced not greater than 75cm apart unless otherwise indicated. Clearance between top and ends of partition wall and beams, slabs, columns, and walls shall be caulked as indicated or as directed by the Engineer to form a closed continuous joint.

1.4.4.8 Brick soling

All the excavated materials shall be cleaned out properly and the base shall be rammed properly before the soling work is proceeded. Foundation shall be checked so that it is in exact line and dimensions.

Unless specified elsewhere or otherwise directed, dry brick soling in foundations and under flooring shall be laid flat or edge over a compacted surface as required, and be made of machine-made bricks as specified

above or as directed by the Engineer. The dry brick soling shall be laid over a cushion of sand of 25 mm thickness unless otherwise shown on the drawings or directed by the Engineer. All joints shall be completely filled with fine sand.

1.4.5 Tolerances

The dimensions of brickwork wall and structures such as manholes shall conform to the tolerances laid down for concrete structures (as per Clause 1.3.6), as applicable, or as directed by the Engineer.

1.4.6 Measurement and Payment

All Brickwork (half or full brick) will be measured as the net volume, for the different types and thickness applicable. No deductions will be made for openings of area up to 0.2 m^2.

Unless and otherwise mentioned in BOQ, Brick soling and Brick pavement works will be measured as the net area.

1.5 STONE MASONRY WORKS

1.5.1 Scope

This specification covers the general construction requirements for Stone Masonry Work, Stone Pitching work, reinstate of Stone Work, Walls and other stone masonry related works.

1.5.2 Interpretations

1.5.2.1 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

- 1 General
- 2.1 Site Clearance
- 2.2 Earthworks
- 2.3 Concrete Works, as applicable

1.5.2.2 Application

This specification contains clauses that are generally applicable to stonework construction and associated work.

1.5.3 Materials

1.5.3.1 Stone

Building stones to be used in the masonry shall be granite, quartzite, gneiss laterite or any other type of good stones that may be specified in the item. In the absence of mention of a special type in the item or the special provision, good granite, quartzite or gneiss stones in that order available and known to be satisfactory in use, in view shall be used. The stone shall stand weathering well and when immersed in water for 24 hours shall not absorb water more than 5 percent of its dry weight, when tested according to IS:1124-1974. The stone of the required quality shall be obtained from the quarries approved by the Engineer. All stones shall generally be freshly quarried.

Rubble stones for hearting shall be of approved quality, sound, hard, dense and durable, free from segregation, seams, scrams, cracks, weathered- portion and other structural defects or imperfections tending to affect their soundness and strength. Stones shall be freshly quarried with sharp edges and clean faces. They shall be free from rounded, worn or weathered surfaces or skin or coating which prevents the adherence of mortar. Size and shape of stones shall be as per requirements of each item.

Stones to be used as headers, pin headers, quoin, copings etc. shall comply with the requirements of facing and hearting stones as may be relevant and shall further comply with the requirements of size and shape stipulated under the relevant item.

Samples of the stone intended for use in the work shall be submitted for the Engineer's prior approval. Mortar: Mortar shall comply with IS 2250-1965 Code of Practice for Preparation and Use of Masonry Mortars.

1.5.3.2 Cement for mortar

Cement for masonry mortar shall be ordinary Portland cement in accordance with the requirements of Clause 1.4.3. All cement for mortar for exposed face work shall be of a uniform colour as approved by the Engineer.

1.5.3.3 Sand for mortar

Sand shall be in accordance with the Clause 1.4.3.

1.5.3.4 Water for mortar

The water used for mixing and curing shall be according to Clause 1.4.3.

1.5.4 Construction Equipment

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required. The type and capacity of mixing machines shall be such that the rate of output of mortar is suitable for the rate of stone masonry work and should be as per the Clause 1.4.

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required at his own cost.

1.5.5 General Construction and Workmanship

The dressing of stone shall be as specified for individual type of masonry work and it shall also conform to the general requirements for dressing of stone covered in IS: 1129. Other specific requirements are covered separately with respect to particular types of rubble stone work.

Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar. The bed which is to receive the stones shall be cleaned, wetted, and covered with layer of fresh mortar. All stones shall be laid full in mortar both in bed and in vertical joints and settled carefully in place with a wooden mallet immediately on placement so that it is solidly bedded in mortar before the has set. Clean ships and spalls shall be wedged into the mortar joints and beds wherever necessary, to avoid thick beds or joints of mortar. Whenever foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into the rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar.

Courses of the masonry shall ordinarily be predetermined. They shall generally be of the same height. Where there is variation in the height of courses, larger courses shall be placed at lower levels, with height of courses decreasing gradually towards the top.

Vertical joints shall be staggered as far as possible.

All necessary chases for joggles, dowels and cramps shall be formed in the stones beforehand.

Sufficient transverse bond shall be provided by the use of bond stones extending from the front to the back of the masonry. In case of thick walls bond stones shall overlap each other in their arrangement.

Bell shaped bond stones or headers shall not be used.

At all angular junction's stones at each alternate course shall be well bonded into the respective course of the adjacent wall.

All connected masonry in structure shall be carried up at one uniform level throughout as far as possible, but when breaks, are unavoidable, the masonry shall be raked in sufficient long steps to facilitate jointing of new work with old. The stepping of ranking shall not be more than 45^{o} with the horizontal. Wing walls, abutments are piers, etc., shall be carried up truly plumb or to the specified batter.

Face work and hearing shall be brought up evenly. The top of each course, however, shall not be leveled up by use of flat chips.

1.5.6 Random Rubble Masonry (Un-coursed and Coursed)

1.5.6.1 Dressing:

Stone shall be hammer dressed on the face, the sides, and beds to enable it to come in proximity with the neighboring stone. The bushing on the face shall not be more than 4 cm on exposed face.

1.5.6.2 Insertion of Chips

Chips and spalls of stone may be used wherever necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearting stones to bring these up to the level of face stones. Use of chips shall be restricted to filling of interstices between the adjacent stones in hearting and they shall not exceed 20 percent of the quantity of stone masonry.

1.5.6.3 Hearting Stones:

The hearting or interior filling of wall face shall consist of rubble stones not less than 15 cm in any direction, carefully laid, hammered down with a wooden mallet into position, and solidly bedded in mortar. The hearting should be laid nearly level with facing and backing.

1.5.6.4 Bond Stones

Through bond stones shall be provided in masonry up to 60 cm thickness and in case of masonry above 60 cm thickness, a set of two or more stones overlapping each other at least by 15 cm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous limestone and sandstones, etc.) the bond stone shall extend only about two-third into the wall, as through stones in such cases may give rise to penetration of dampness and, therefore, for all thicknesses of such masonry a set of two or more bond stones overlapping each other by at least 15 cm shall be provided. One bond stone or a set of bond stones shall be provided for every 0.50 square meters of the masonry surface.

1.5.6.5 Quoin Stone

Quoin stone, i.e., the stone specially selected and neatly dressed for forming an internal angle in masonry work, shall not be less than 0.03 cubic meters in volume.

1.5.6.6 Plum Stone

The plum stones are selected long stones embedded vertically in the interior of masonry to form a bond between successive courses and shall be provided at about 90 cm intervals.

1.5.6.7 Wet Foundation

In wet foundation, or other situation where water is met with the work space shall be kept free of water by the Contractor while the masonry is in progress and until the Engineer consider the mortar has sufficiently set. Dewatering shall be carried out in such a way as not to injure the concrete or masonry in any way. Dewatering shall also be done when required for taking/checking measurements, approved foundations etc. Dewatering shall be included in the rate of masonry unless separate provision is made in the contract.

1.5.6.8 Laying

The masonry shall be laid to lines, levels, curves, and shapes shown in the drawing. Fixtures, plugs, frames etc. if any shall be built in at places shown on the drawing or directed by the Engineer while laying the masonry and not later by removing the stones already laid.

a) Stones in the hearting shall be laid on their broadest face which gives better opportunity to fill the space between stones.

b) Stratified stones must be laid on their natural beds. All bed joints shall be normal to the pressure upon them.

c) In weathered walls, the beds of stone and the plane of course should be at right angles to the latter.

d) The courses of masonry shall ordinarily be predetermined. They shall generally be of the same height.

Where there is to be variation in height of courses, larger courses are to be placed at the lower levels, the height of courses decreasing gradually towards the top of the wall, unless to architectural requirements.

e) The stones shall be wetted before laying in mortar. Each mason shall be supplied by the Contractor with a vessel full of water and a tumbler for wetting stones, care being taken not to spill any water on green masonry. The bed which is to receive the stone shall be cleaned, wetted and covered with layer of fresh mortar. All stones shall be laid full in mortar both in place with a wooden mallet immediately on placement and solidly bedded in mortar before it has set. Clean chips and spalls, carefully selected to fit in the spaces shall be wedged into the mortar joints and beds wherever necessary to avoid thick beds or joints of mortar. When the foundation masonry is laid directly on rock the face stones of the first course shall be dressed to fit into the rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar. If a portion of masonry is dismantled, every stone must be found with mortar adhering fast to all its embedded surfaces and there shall be no hollows. This will be one of the tests in deciding if the masonry is good or bad if need arises. Where hollows or other defects are suspected a stone here there may be removed for confirmation. If these are confirmed such portion shall be dismantled and rebuilt at the cost of the Contractor.

f) Face work and hearting shall be brought up evenly but the top of each course shall not be leveled up by use of flat chips.

g) In case any stone already set in mortar is disturbed or the joint broken, the stone shall be taken out without disturbing the adjoining stones and joints, the mortar thoroughly cleaned from the joints and the stone reset in fresh mortar. Attempts must never be made to slide one stone over another already laid.

h) Shaping and dressing shall be done before the stone is laid in the work. No dressing and hammering which will loosen the masonry shall be permitted after it is once placed.

i) There shall be an adequate collection of stones and spalls within easy reach of the mason to enable proper selection of stones for individual location while laying. The stones shall be continuously replenished.

j) Bond

To give sufficient lateral bond, a stone in any course shall break joint with the stone in the course below or above about half the height of the course and generally not less than 7.5 cm.

To give sufficient transverse bond, the prescribed number of headers shall extend from front to back of thin walls up to a width of 60 cms or prescribed number of lines of overlapping headers from face to back of walls over 60 cm thick. Over laps shall be 15 cm at each end. To ensure provision of full number of headers of the required size, they shall be kept at specified intervals in each course in advance of starting masonry and then embedded in mortar. Their position in each course shall be staggered, so that each will be near about the middle of the two in the courses below and above. Their faces shall be marked with a distinguishing sign to identify them.

To bond work at all, angle junctions of walls, the stones at each alternate course shall be so carried into each of the respective walls as to join the work thoroughly. Quoin shall be laid header and stretch wise when seen on each side of the wall.

When new work has to be started on the old or one completed a long while ago or in the previous working season, the surface shall be roughened and cleaned satisfactorily without disturbing the masonry before laying the new. It shall be wetted before laying the bedding mortar.

Where practicable the whole of the masonry in any structure shall be carried up to a uniform level throughout. But where breaks are unavoidable in carrying up the work continuously in horizontal courses, sufficiently long step shall be left to join the courses to be laid later. All junctions of walls shall be formed at the time the walls are being built; cross-walls should be carefully bonded into the main walls.

The practice of building two thin faces tied with occasional through-stones and filling up middle with dry packing and putting mortar on top must be strictly guarded against putting dry chips in the joints of stones before filling them with mortar shall not be allowed.

For ensuring good bond masonry shall be left uneven at the top of each course.

k) The face stones shall be laid absolutely without any pinning on the exposed faces. In each course the headers or lines of headers as the case may be, shall be kept in position at specified intervals and with specified laps where such laps are required before the masonry of the layer is commenced to ensure that they are being laid properly and in required numbers and intervals. They shall be embedded in mortar as masonry in that layer progresses.

l) Joints: No face joints shall exceed 8 mm in thickness. Stones shall be arranged to break joint as much as possible and long vertical lines of jointing shall be avoided.

m) Striking Joints: The face joints should be properly struck while the mortar is fresh. Joints which cannot be struck at the time of laying, shall be prepared for it by raking joints to a depth of not less than 6 mm when the mortar is fresh. These joints should be properly cleaned of loose particles, wetted thoroughly and filled with good fresh cement mortar 1:3 and finished off by being troweled smooth.

n) Rate of raising masonry: The rate of raising random rubble masonry brought up in uniform levels may be limited to a height of 60 cm per day in cement mortar. No fresh course shall be laid over masonry previously laid within 4 hours of its laying for cement mortar.

1.5.6.9 Items to Include in the unit rate

a) Masonry built in any position to any height or depth and to lines, levels, curves and batters, shown on drawing as ordered by the Engineer with headers, quoin etc. including striking joints and curing, cutting, grooves holes etc. for fixing frames, fixtures etc. are also included in the rate.

b) Erecting and removing all scaffolding, ladders and use of plant required for execution of the item, safety of the labour and inspection of the work including compensation for any injury, damage etc.

c) Watering to allow construction in the dry and proper setting of masonry unless separately provided in the contract.

d) Clearing the site round the masonry and back filling so as to restore it to the original condition.

e) All labour, use of tools, materials and other items incidental to satisfactory completion of the item. f) Curing of the work and protection of fresh work from dust, rain etc.

1.5.6.10 Joints

The face joints shall not be more than 20 mm thick, but shall be sufficiently thick to prevent stone-to-stone contact and shall be completely filled with mortar.

1.5.7 Dry Rubble Masonry for Retaining structures

This work shall conform to Clause 1.5.6 of Random Masonry (Un-coursed) except that:

a) the masonry shall be dry without mortar;

b) the spaces between large stones shall be filled with spalls at tightly as possible; and

c) the foundations shall be excavated at right angles to the face batter and not horizontally. The beds of the stones shall be laid at right angles to the face better.

1.5.8 Dry Stone Pitching/Dry Rubble masonry

Stone Pitching/Dry Rubble masonry shall be constructed generally to the requirements of un-coursed random rubble masonry as specified in elsewhere in this document but with the omission of mortar. All stones shall be carefully shaped to obtain as close as fit as possible at all beds and joints, any interstices between the stones being fitted with selected stone spalls. The exposed tops or cropping of dry rubble structures shall be formed as described in the Contract.

Activities involved will be supply of stones, dressed bond stone, cement, sand, water, tools, machine, preparation of mortar, placing and joining stones dry/with mortar, control, and removal of water, curing, collection, & testing of specimens etc. complete.

1.5.9 Stone Soling Work Blinding in Floor

The ground or earth shall be thoroughly consolidated with a 25 mm layer of coarse sand so that there are no loose pockets left anywhere in the whole area. Over such consolidated surface a layer of stone soling shall be made. Care should be taken that all stones are placed vertically. No smaller stones than 80 mm shall be provided for such work. The stone shall be thoroughly rammed as closely packed in position and interstices blinded with coarse sand, if necessary, so that a solid hard core of desired thickness is formed in position.

1.5.10 Gabion works

Work requirement under this clause shall be conformed the specification clause of DOR section 2402.

1.5.11 Rip Rap

(a) Material

Stones/rocks used shall be hard, dense, unlaminated natural stone, not liable to deterioration in water and of general quality of soundness and abrasion resistance prescribed for concrete aggregates. Broken rocks shall be of regular "cubical" shape and shall not be flaky. Flat or needle shaped rocks shall not be accepted unless the thickness of the individual piece exceeds 1/3 of their length. The specific gravity of the stone/rock shall be not less than 2.50 and when immersed in water for 24 hours, it shall not absorb water more than 5 percent of its dry weight tested in accordance with IS: 1124. The minimum size/weight of the stone/rock shall be as shown in drawing sheet URC (Under River Crossing).

(b) Construction

The surface where rip rap to be executed shall be made to the line and level as indicated in the drawing or directed by the Engineer. To achieve this necessary excavation, filling with compaction and/or leveling shall be done as per site condition. On the prepared surface stone/rocks shall be placed individually to provide minimum space among the stones. Needle like shapes and protrusions on the surfaces of stones shall be chipped off by hammer so that stones are bedded properly and voids are reduced. To avoid sliding of stones/rocks downwards, the placing of stones shall be started from the lower edge to proceed towards up per edge. By driving small stones or spalls into interstices, laid stones shall be tightly wedged so that individual stone shall not be removed easily. The top surface, the lines, levels and depth of rip rap and grade shall be as indicated on the drawing or directed by the Engineer.

(c) Tests and Standards of Acceptance

Stone shall be tested for water absorption and specific gravity. The test results shall meet the specified criteria. At least 3 set of tests shall be made for every source of material.

1.5.12 Measurement and Payment

Unless and otherwise mentioned in the BOQ, measurement shall be made to cubic meters of any type of masonry made in accordance with authorial dimensions.

Stone soling works and Stone pitching/ Rip rap will be measured as the net volume.

1.6 CEMENT PLASTER WORKS

1.6.1 Scope

This specification covers the general construction requirements for finishing works in any structure on exterior and interior surfaces including bed and side slopes of specified surfaces of stone pitching, brick wall, stone walls, reinstate work, and other surfaces.

1.6.2 Interpretations

1.6.2.1 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

1. General
2. Earthworks, as applicable
3. Concrete Works
4. Brickwork
5. Stonework

1.6.2.2 Application

This specification contains clauses that are generally applicable to finishing work and associated work.

1.6.3 Materials

1.6.3.1 Cement

Cement for finish work shall be ordinary Portland cement in accordance with the requirements of Clause 1.3.3.2. All cement for mortar for exposed face work shall be of a uniform colour as approved by the Engineer.

1.6.3.2 Sand

The particle size grading of sand for plaster work for internal as well as external walls and ceiling as analyzed by the method described in IS:2386 (Part I)-1963 shall be as specified in Table 8. Where the grading falls outside the limits of the grading zones of sieves other than 600 microns IS Sieve by a total amount not exceeding 5 percent, it shall be regarded as falling within the grading. This tolerance shall not be applied to percentage passing the 600 micron IS Sieve or to percentage passing any other sieve size on the finer limit. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass. The required grading may often be obtained by screening and or by blending together either natural sands or crushed stone screening which are by themselves unsuitable grading.

Table 8: Grading of Sand for Finishing Work

IS Sieve Designation (IS 460-1962)	Percentage of Weight Passing IS Sieve
10.0mm	100
4.75mm	95-100
2.36 mm	95-100
1.18 mm	90-100
600 Micron	80-100
300 microns	20-65
150 Micron	0-50

Notes: For crushed stone sands, the permissible limit on 150 microns IS Sieve is increased to 20 percent. This does not affect the 5 percent allowance permitted in 4.1 applying to other Sieve sizes.

1.6.3.3 Water for mortar

The water used for mixing and curing shall be according to Clause 1.4.3.

1.6.3.4 Scaffolding and ladders

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required at his own cost.

1.6.3.5 Care of Tools and Accessories

All tools shall be cleaned by scraping and washing at the end each day's work, or after use with different materials. Metal tools shall be cleaned and greased after each operation. The tools shall be examined and thoroughly cleaned before plastering is begun. Cleanliness is particularly important with cement plasters, where contamination with set material may seriously affect the performance as well as reduce the effective life of the tools.

1.6.3.6 Plastering

The surface to be plastered shall be brushed clean. Mortar joints of brick masonry or concrete walls to be plastered shall be raked to a depth of approximately 12mm, and the surface brushed down with a stiff brush and thoroughly wetted. The surface shall be free of all dust, loose materials, grease, etc.

Before starting plasterwork, the Contractor shall prepare a sample panel of plastering of a size at least 1 m2 for the approval of the Engineer. The sample shall be prepared in an area designated by the Engineer. The Contractor shall obtain approval before starting work and preserve the approved sample intact until all plastering is completed.

Plaster shall be applied in two coats. The thickness of the first coat shall be just sufficient to fill all unevenness of the surface. The first coat shall be applied with even, firm pressure to ensure good bond, shall be cross scratched and shall be moist cured. After the first coat has properly cured, and been allowed to dry thoroughly, the surface shall be dampened before applying the finish coat. The finish coat shall be steel trowel finished to a smooth, even, burnished surface, completely free from defects or trowel marks.

Unless specified elsewhere or otherwise directed, the thickness of plaster in total shall not be less than 12.5 mm. Wall plastering shall be started from top and work down to the floor. Ceiling plastering shall be completed before starting the wall plastering. To ensure uniform thickness and vertical plaster face, plumb guider strips may be applied as required.

If required to achieve the smooth, burnished finish, the surface shall be finished with lime putty of just sufficient thickness to fill in uneven surface or defects due to coarse sand in the plaster mix. Lime mortar finish shall be applied immediately after the finish has set sufficiently firm.

In order to obtain additional strength at external angled corners, the corners shall be dusted with cement during the steel trowel finishing of the finish coat.

Care shall be taken to ensure that finished plaster surfaces shall be plumb, square, straight, and true to line. All arises and corners shall be straight, clean, and sharp.

1.6.4 Preparation of Plaster

1.6.4.1 Proportioning

The material used in the preparation of plastering mixes may be measured by volume using gauge boxes. Cement shall be measured by weight. For the purpose of proportioning one cubic meter of cement shall be taken to weight 1,440 kg approximately.

1.6.4.2 Quantity of Water

For general cement plaster work with 1:3 proportion the quantity of water required is about 70 percent by weight of cement. This may, however, vary depending on the following factors, and adjustment shall be done as explained in IS: 2250-1965.

i. The nature and condition of the fine aggregate.

ii. The temperature and humidity at the time of working.

iii. Richness of the mix, namely, whether rich or leaner than 1:3;

iv. The varying quantities of lime in composite mortars; and

v. The use of admixtures added for improving the workability.

1.6.4.3 Mixing

Cement and sand shall be mixed dry in the required proportions to obtain a uniform colour. Water shall then be added to get the required consistency for the plaster.

Cement lime plaster shall be used within two hours after the addition of water to cement provided it is kept agitated or turned over at intervals of at least 20 min. Cement plasters shall be used within half an hour after the addition of water. Any mortar or plaster which is partially set shall be rejected and removed forthwith from the site.

Mixing may be done either manually or mechanically. "Hand mixing" shall be carried out on a clean, watertight platform. During mixing, the mortar shall be heed back and forth for 10 to 15 min after the water is added. In "machine mixing" the mixer shall run at least 5 min after placing all the ingredients in the drum.

Machine mixing is preferable to hand mixing for all mortars.

1.6.5 General Precaution in Plastering

1.6.5.1 Cleanliness and Protection of Existing Work

Cleanliness is essential in carrying out plaster work. Adequate protection shall be given to all existing work and fittings which are liable to be damaged, not only in the area of plastering operation, but also in the approaches thereto by covering up with boards, dust sheets, etc, as necessary.

1.6.5.2 Cleaning off on Completion

On completion, all work affected by plastering operations shall be left clean. Special care is necessary when removing set plaster from glass to avoid damaging its surface.

1.6.5.3 Suction Adjustment

The careful adjustment of suction is very necessary for good plastering and may be done either by wetting the backing suitably if it is dry, or by sprinkling with a cement-mix as in the case of a concrete surface with low suction. Without the aid of suction, plaster would creep and slide down due to its own weight. On the other hand, high rate of suction withdraws all moisture from the plaster and makes it weak porous and friable. Too much water makes it impossible to keep the mortar in position till it sets. A failure in bond due to excessive water leads to further failure as the pocket formed may hold water and break up the plaster when the water freezes; or if the water is salt laden, the same results will be produced on evaporation by crystal formation.

The wall shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry in spots, such areas shall be moistened again to restore uniform suction. A for-spray is recommended for this work.

1.6.5.4 Adjustment of Working to the Setting Properties of Plaster

Cement plasters contain materials which set when brought into contact with water, and the fullest use of their strength producing properties is not made unless the mix is applied before the setting process has started. If re-tampering of such mixes is carried out after the set has commenced an inevitable loss in strength and efficiency will result.

The commencement of the set is accompanied by a noticeable stiffening of the mix. It is essential, therefore, that mixes shall be used as soon as possible after water has been added and that working periods recommended in this code shall not be exceeded.

1.6.5.5 Control of Cracking

This is normally a structural problem, but the plaster will be able to reduce the effects of structural cracking by making a trowel cut between adjacent surfaces.

1.6.5.6 Maintenance of Proper Time Intervals

Shrinkage, partly irreversible, occurs on drying, causing stresses to be set up both in the applied coat and in the undercoat or background, and in order to avoid break down of adhesion between successive coats, it is very important that the drying shrinkage of the first coat should be materially complete before a subsequent coat is applied. The rate of drying will vary widely with conditions of temperature, humidity, and ventilation. Proper time interval serves to diminish the possibility of efflorescent salts finding their way to the final plaster surface, and also of the drying and naturing shrinkage (map crazing) of the undercoat reaching the finished plaster surface over a period of time. The surface then shall be allowed to set for at least a day or two depending upon the weather (one day in summer and two days in winter). During this period the surface of this coat shall be kept damp and shall not be allowed to dry.

1.6.6 Preliminary Programming of Work

All materials necessary for plastering shall be kept readily available at the site. An adequate supply of water suitable for mixing the plaster and for curing purposes shall be available.

In building operations, such as construction of brick and block walls, the encasement of steel walls, columns and beams with concrete, etc, requiring plastering shall be so programmed that they are sufficiently matured to receive the plaster without subsequent damage to plaster or decoration. Careful programming and avoidance of last-minute alterations in the design or in the sequence of work can avoid serious damage to the plaster finish. Where such alterations are unavoidable the permanent decoration shall be postponed.

Plastering operations shall not be started until all necessary fixing, such as door and window frames, mantle pieces are completed and all pipes and conducts to be embedded in the wall or plaster are installed.

A preliminary inspection shall be made to ensure that the surfaces are in a suitable condition for plastering, particularly as regards their planeness and dryness. If dubbing out is necessary, it should be done in advance,

so that an adequate time interval may be permitted before the application of the first undercoat. Plastering operations shall be so scheduled as to allow sufficient interval between undercoats and finishing coats.

1.6.7 Sequence of operations

The surfaces to be plastered shall first be prepared as indicated in the sub-section "General precaution of plastering".

When the preparation has been done, arrangements may be made for a constant supply of plastering material prepared as described in 7.4. The plaster coat is then applied rendering surfaces.

Sometimes, ends of scaffolding BALLIES have to be housed in the wall which is being treated with plaster. In such cases after the BALLIES are taken out, the hole or holes left in the wall shall be filled up with brick and mortar, and the patch plastered up true, even and smooth in conformity with the rest of the wall, so that no sign of any patch work shows out.

Where corners and edges have to be rounded off, such rounding off shall be completed along with the plaster finishing to prevent any joint marks showing out later.

1.6.8 Trueness of Plaster System

The finished plaster surface shall not show any deviation more than 4 mm when checked with a straight edge of 2 m length placed against the surface.

1.6.9 Curing

To develop maximum strength and density in the plaster, it is necessary to cure cement plasters properly. The plaster coat shall be kept damp continuously for a maximum period of 7 days. Moistening shall commence as soon as the plaster has hardened sufficiently and is not susceptible to injury. The water shall be applied by using a fine fog-spray. Soaking of wall shall be avoided and only as much water as can be readily absorbed shall be used. Excessive evaporation on the sunny or windward sides of buildings in hot dry weather may be prevented by hanging mattings or gunny bags on the outside of the plaster and keeping them wet.

After the completion of the finishing coat, the plaster shall be kept wet for at least 7 days, and shall be protected during that period from extremes of temperature and weather.

1.6.10 Approval by the Engineer of plaster work

All plaster work shall be subject to approval of the Engineer, and work failing to meet the requirements of the specifications or not being to the satisfaction of the Engineer shall be removed and reapplied at the Contractor's expense.

1.6.11 Plastering Defects & Remedies

It is not possible to give simple rules for the correction of all plastering defects or failures. Many serious defects may be shown to have causes outside the materials or techniques used in the plastering operations and it is often useless to repair or even replace the plaster without first having discovered and corrected the primary fault.

Thus, penetration of moisture through an external wall may cause blistering, efflorescence, flaking or complete disintegration of the plaster. To patch or to re-plaster such a wall without first taking steps to prevent further damp penetration would be useless. Again, plastered ceilings may develop cracks because the ceiling construction permits excessive deflection, and no plaster repair could be expected to be effective in preventing it. Recurrent surface dampness may be associated with the presence of deliquescent salts in the plasterwork, but it would not necessarily be effective to renew the plaster. The salts may also be in the background and would probably migrate into the new plaster and bring about a renewal of the trouble. This type of defect usually traced to the use of an unwashed estuarine or sea sand, is best corrected by battening out and erecting a new plaster base out of capillary contact with the affected area.

Defects caused by the use of unsuitable plastering material or by faulty technique may be corrected by means of an appropriate repair.

1.6.12 Measurement and Payment

All Plaster work will be measured as the net area, for the different types and thickness applicable. No deductions will be made for openings of area up to 0.2 m^2.

1.7 OTHER FINISHES

1.7.1 Scope

This specification covers the general construction requirements for finishes (except cement plaster work), such as flooring, painting, roofing, water proofing, etc., required in surface finishes of general civil construction (e.g., building, chambers, walls, manhole, etc.).

1.7.2 Interpretations

1.7.2.1 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

1. General
2. Concrete Works
3. Brickwork
4. Stonework
5. Cement Plaster Works

1.7.2.2 Application

This specification contains clauses that are generally applicable to finishes on walls, floors, ceiling of cast in situ and precast structure and associated work.

1.7.3 Materials

Cement Concrete Floor: All the materials to be used such as cement, sand, aggregates, water, and other materials shall be as have been described in the Clauses 1.3.3.4 or as directed by the Engineer. Unless specified elsewhere or otherwise directed, the thickness of cement concrete floor should not be less than 50mm thick.

Cement Floor (Cement Screed): All the materials to be used such as cement, sand, water and other materials shall be as have been described in the Clauses 1.3.3.4 or as directed by the Engineer. Unless specified elsewhere or otherwise directed, the thickness of cement screed floor should be of 1:6 proportion (Cement: Sand) and shall not be less than 12.5mm thick.

Cement Punning Finishing: All the materials to be used such as cement, sand, water and other materials shall be as have been described in the Clauses 1.3.3. or as directed by the Engineer. Color pigment shall be of superior quality conforming IS standards and as approved by the Engineer. Unless specified elsewhere or otherwise directed, the thickness of cement the finishing layer shall not less than 3mm and consist of cement-sand (Cement Punning) mixed at 1:1 (cement: fine sand). Cement punning should be also used as skirting purposes.

Pointing: All materials to be used such as cement, sand, water, and other materials shall be as have been described in the Clauses 1.3.3 or as directed by the Engineer. If not specified, it shall be carried out in cement mortar not leaner than 1:3.

Terrazzo Floor Finish: Terrazzo tiles shall be not less than 250 x 250 x 20 mm size unless otherwise shown or specified on the drawings or directed by the Engineer. Terrazzo tiles shall be free from cracks, chips, flaws, stones or lumps of any kind. Their granularity of embedded color chips should be regular and uniform

in order to add aesthetic purpose. These tiles shall sound hard, homogeneous texture and water absorption shall be minimum during soaking. All terrazzo tiles shall have to be approved by the Engineer and any terrazzo tiles not up to the specification must be removed from the site immediately at Contractor's own cost. Representative samples of the tiles to be used shall be submitted to the Engineer and his approval taken before bulk purchase. The samples shall be kept with the Engineer for future reference and comparison. All tiles supplied shall conform to these approved samples in all respects.

Ceramic Tiles: Ceramic tiles shall be not less than 200 x 200 x 6 mm size unless otherwise shown or specified on the drawings or directed by the Engineer. They shall be either ceramic vitreous tiles, with colors as selected by the Engineer, or approved glazed tiles conforming to IS 777 or equivalent. Cement, sand, and water used for tiling work shall be in accordance with the requirements of Clause 3.3.4. Granular material (e.g. marble chips) for in-situ flooring, screeds, and skirting shall be as approved by the Engineer. The Contractor shall submit samples of tiles for selection and approval by the Engineer, and all tiles used shall conform to the approved samples with regard to size, quality, texture, and color.

Painting: The materials for painting and color washing of internal and external walls and similar surfaces shall conform to the requirements of the relevant applicable standards (e.g. IS 5410 or equivalent) and shall be approved by Engineer.

Waterproofing materials: Unless and otherwise mentioned in BOQ, waterproofing material, such as waterproofing bituminous felt, other bituminous materials, specified thickness of concrete band or layer and cement sand plaster with waterproofing concrete admixture @ 2% by weight of cement or its equivalent shall be in accordance with the relevant applicable standards (e.g. IS 1322, IS 1580, IS 2645-1975 and IS 9103-1979 or equivalent).

Other items: Pigments and other necessary additives to produce colored plasters and mortars shall conform to the relevant applicable standards (e.g. IS 57 or equivalent) and shall be applied the rate of 1% by weight of cement or to produce a color and texture indicated on the drawings or as directed by the Engineer. The sample of such color plaster shall be subjected to approval of the Engineer before applying in the work.

Caulking compounds shall be of approved manufacture such as to provide a continuous waterproof barrier installed with exposed caulking smoothly recessed from the finished steel or brick surface.

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required in order execute the finishes Work at his own cost.

1.7.4 Construction Equipment

Construction Equipment shall be suitable for applying the specified flooring and coating systems and for obtaining the specified results. If, however, consistent and satisfactory results are not achieved with the equipment used by the Contractor, the Engineer may order the Contractor to obtain and use such Construction Equipment as may be necessary to achieve the required results.

1.7.5 Construction and Workmanship

Special care should be taken for draining out the water while laying the floor finishes. The slopes and position of drains shall be as shown in the detailed drawings or as directed by the engineer.

1.7.5.1 Cement Concrete Floor

In the ground floor, the cement concrete floor shall be laid on a hard surface of either cement concrete or brick soiling. If the base is made of cement concrete, the flooring work shall commence within 48 hours of laying the base. If the base consists of brick soling, the surface shall be leveled with the used of brick ballast or concrete mixture before the concrete flooring is laid. The base shall be cleaned with brushes and wetted properly before the concrete flooring is laid.

In the first floor or upper floors where cement concrete floor is to be laid on R.C.C. slabs, the surface of the R.C.C. slab shall be made rough with brushes while the concrete of the slab is still green. The bases shall be provided with the slope required for the flooring as indicated in the drawings or as directed by the engineer.

1.7.5.2 Cement Floor (Cement Screed)

In the ground floor, the cement screed floor shall be laid on a hard surface of either cement concrete or brick soiling. If the base is made of cement concrete, the flooring work shall commence within 48 hours of laying the base. If the base consists of brick soling, the surface shall be levelled with the used of brick ballast or concrete mixture before the concrete flooring is laid. The base shall be cleaned with brushes and wetted properly before the cement screed flooring is laid.

In the first floor or upper floors where cement screed floor is to be laid on R.C.C. slabs, the surface of the R.C.C. slab shall be made rough with brushes while the concrete of the slab is still green.

The bases shall be provided with the slope required for the flooring as indicated in the drawings or as directed by the engineer.

1.7.5.3 Cement Floor Finishing (Cement Punning)

One layer of at least 12.5 mm thick cement sand plaster of the specified proportion shall be applied onto the surface of the cement concrete floors before cement punning. The cement plaster shall be laid according to the dimensions of the concrete floor panels and keeping the joints above the joints between the concrete floor panels. Such plaster shall be followed by a thin layer of at least 3.5 mm thick cement punning finishes of specified mix (1:1 cement sand mixture) and shall be finished with wooden or steel floats.

After laying the cement concrete floor, the surface shall be left undisturbed for about 2 hours after which it shall be covered with wet jute bags. Curing of the concrete by flooding water on the surface for at least 7 days shall commence only after 24 hours of laying the concrete.

The same brand of cement shall be used throughout, and the same proportion is maintained strictly to have a uniform color. Junctions of the floor with wall plaster, dado and skirting shall be rounded of neatly.

Skirting work shall be of same mix and thickness of cement punning. Skirting work shall be done simultaneously with flooring work or as directed. Skirting work shall include racking, cleaning and wetting of the base as well as applying cement plaster and cement punning. The top edge of the skirting shall be chamfered to prevent dust collection.

Curing and protection of cast in situ floor shall be in accordance with the requirements of Clause 1.3.5.

1.7.5.4 Pointing

Pointing, if specified, shall be carried out in cement mortar not leaner than 1:3. The thickness of joints shall not exceed what is prescribed for each type of masonry. In the face works, the raked-out joints up to a depth of at least 20 mm shall be filled with mortar of specified mix and of required consistency and then shall be well pressed and rubbed smooth.

1.7.5.5 Waterproof Cement Paint

The contents of each fresh container of the paint shall be loosened by rolling or shaking the container before opening for the first time. To one volume of water in a clean container, an equal volume of cement paint shall be added and stirred well to achieve a uniform consistency. No further dilution will be permitted.

The cement paint powder shall be kept secured from exposure to atmosphere by properly tying up the polythene liner in the container and keeping the lid firmly closed.

The cement paint shall be used within two hours of mixing and shall be kept stirring during use.

For application, the base surface shall be cleaned by use of a stiff brush to remove loose dust and dirt. The base surface shall be thoroughly wetted, and water allowed to run off.

The first coat shall be well brushed in a manner to give a good bond of the paint with the surface. The second and subsequent coats shall be brushed or sprayed as approved. The cement paint shall be applied at the following rate:

a. on brickwork 2 kg/m²
b. on in situ concrete 3.5 kg/m²
c. on concrete blocks 2 kg/m²
d. on cement sand rendering 3.2 kg/m²

The curing of the waterproof cement paint shall be carried out by application of fine water spray at an interval of 6 to 8 h after the application of the paint for duration of at least 7d.

The finished surface shall be protected from any damages, staining, etc., by approved means.

1.7.5.6 Oil bound distemper

All plaster surfaces shall be thoroughly cleaned and shall receive 3 or more coats. The first coat shall be a prime coat. The second and third coats shall be of oil bound distemper of approved colour, shade, and quality, and shall be mixed in accordance with the manufacturer's recommendations.

After these operations, if the work is not to the satisfaction of the Engineer, one or more coats shall be applied without extra cost to the Employer until a smooth and even surface is achieved and approved by the Engineer.

1.7.5.7 Distempering

Distemper shall be dry distemper as approved by the Engineer. The distemper shall be mixed with clean water as recommended by the manufacturer and shall be stirred until the mixture attains an even consistency.

The surface shall be cleaned, cracks and holes repaired, all irregularities and inequalities sand papered smooth and wiped clean to present a fine smooth surface which shall be completely dry before distempering is started.

The mixture shall be applied evenly with a brush in long parallel strokes evenly so as not to leave any visible brush marks.

The surface of this first application shall be allowed to dry and harden. Then the second coat shall be applied on the first coat. If a uniform surface is not achieved, a third coat shall be applied.

1.7.5.8 Plastic Emulsion Paint

The surface shall be prepared as specified for oil paints. First, a priming coat of primer as specified by the manufacturer shall be applied.

The second and third coats of plastic emulsion paint of approved shade and manufacture shall be applied to achieve an even surface. If the finish is not to the satisfaction of the Engineer, more coats shall be applied at no cost to the Employer to achieve a smooth and even surface.

1.7.5.9 Ready-mixed Enamel Paint

Surfaces to be painted shall be dry, free from dust and dirt, and rubbed smooth by means of sandpaper or pumice stone to the satisfaction of the Engineer.

The paint shall be ready-mixed synthetic enamel or oil paint of approved make and manufacture. The primary coat (primer) shall be applied evenly with a brush. After the primary coat is applied and perfectly dried, all holes, cracks etc. shall be filled with putty and the surfaces sand papered (finishing touch in primary coat). A first coat of paint of approved shade and manufacture shall then be evenly applied and allowed to dry (after giving finishing touch to primer). The second coat shall be carefully applied as and when required, to achieve a smooth and even surface.

1.7.5.10 French Polish

The work shall be first cleaned and sandpapered thoroughly. It then will be painted with a `filler', composed of methylated spirit, and sandpapered.

A thin coat of French Polish shall then be applied, and sand papered. Subsequent coats of French Polish shall be applied till the proper finishing is achieved to the satisfaction of the Engineer.

1.7.5.11 Roofing

A water proofing coating on bare reinforced concrete roofs shall be bitumen based and shall be applied in two layers of primer and one layer of finishing coat in accordance with the manufacturer's instructions and recommendations.

Such coating shall be applied by brushing, spraying, or roller application and shall be placed on concrete which has been cured and has reached an age of not less than 3 months.

If not otherwise shown on the drawings or directed by the Engineer, the prime coats shall be applied at a rate of approximately 0.85 l/m² and the final coat at a rate of about 1.2 l/m².

Care shall be taken in connection with drains, gutters, etc. to achieve proper flashing and lapping with the bitumen coating.

1.7.6 Tolerances

The tolerances for flooring work shall be as described in Clause 1.3.7, as applicable, unless otherwise agreed between the Contractor and the Engineer prior to the commencement of the work.

1.7.7 Measurement and Payment

Finishing work will be measured as the net areas covered and no deductions made for openings of area up to 0.10 m² or else unit as mentioned in BOQ. Separate items will be scheduled for each type of finish, and for different location of application, if such location will substantially effect the pricing.

1.8 METALWORK

1.8.1 Scope

This specification covers metalwork for structural steelwork, buildings, and other structures, it includes sundry items such as metal doors, and windows, ladders, stairs, handrails, open grid flooring, fences, railings, grills, gates etc.

1.8.2 Interpretations

1.8.2.1 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

1.8.2.2 Application

This specification contains clauses that are generally applicable to metal work, corrosion protection, and associated work.

1.8.2.3 Definitions

For the purpose of this specification, the following definitions shall apply:

Coat - A single layer of a corrosion-protection material.

Coating system - The method and degree of surface preparation, the type of coating, the method of application of the coats and the requirements of the completed system.

Normal temperature - A temperature that exceeds 15°C but does not exceed 32°C.

Grade (of a bolt) - A strength designation consisting of two numbers (separated by a dot), the first number being approximately one-hundredth of the minimum specified tensile strength in MPa and the second one-tenth of the ratio (expressed as a percentage) between the stress at permanent set of 0.2% (yield stress) and the minimum tensile strength. (For example, Grade 10.9 indicates a nominal tensile strength of 1000

MPa and a nominal set stress (0.2%) of 900 MPa). The letter S, when added to the grade designation, denotes a metric high-strength structural bolt with a heavy series hexagon head.

1.8.2.4 Abbreviations

- DFT- Dry film thickness
- HD-bolts Holding-down bolts
- HDG Hot-dip galvanizing

1.8.3 Materials

1.8.3.1 Structural Steel

Steel generally and section profiles used in structural steelwork and in the fabrication of sundry items shall be in accordance with the requirements of the relevant applicable standards (e.g. BS 4, BS 4548, IS 808). Regardless of the standards used, the yield stress shall not exceed 450 MPa, the ratio of the tensile strength to the guaranteed yield strength shall be at least 1.2:1, and the elongation shall be at least 15%.

All steel used in the manufacture of cold-formed sections for use as structural members in buildings shall have a minimum yield strength of at least 200 MPa.

1.8.3.2 Welding Consumables

Welding electrodes shall comply with, and shall be stored and handled in accordance with, the requirements set out in the relevant applicable standards (e.g. BS 639, IS 814). Welding consumables shall be such that they produce weld metal that has a minimum yield stress and minimum tensile strength at least equal to those of the parent metals.

1.8.3.3 Coating Materials

All coating materials and constituents shall be delivered in the manufacturer's original sealed containers which bear the manufacturer's labels. Each label shall display all the information necessary to ensure correct storage and traceability, and instructions for the application of the contents of the containers. Any container showing traces of leakage shall, before use, be rejected together with its contents.

The Engineer may require that the contents of any container be subjected to sample testing. All coating materials held in storage prior to use shall be kept in an approved store which shall be dry and enclosed. Care shall be taken to avoid the accumulation of old stock.

All Site stores used for the storage of coating material shall be provided with adequate fire extinguishers placed in a prominent and accessible position outside the entrances. "No smoking" signs shall be placed inside and outside such stores. No naked flames shall be permitted inside such stores.

Stores for coating materials shall not, at any time, be used for the accommodation of personnel.

1.8.3.4 Slide Assembly

There shall be a slide assembly between the pipe support and the bridge structure.

The entire slide assembly shall be provided by one Contractor and meet the following specification:

The coefficient of friction between the stainless steel and PTFE pads shall be less than 0.1 when carrying a load and having a surface temperature of 70°C.

The Stainless-steel pad shall be highly polished grade 316 steel and the PTFE shall be Type UA/1 to BS 6564: Part 2.

1.8.4 Construction Equipment

Construction Equipment used in handling, fabrication, and erection of metalwork shall have enough capacity to ensure that metalwork is placed in its final position without distortion or undue stressing of members. The use of Construction Equipment as cranes, lifting devices, safety belts, harnesses, nets and barricades in erection of steelwork shall comply with the requirements of the relevant applicable standards and safety regulation (e.g. BS 5531).

Construction Equipment for applying the specified coating system shall be suitable for obtaining the specified result. If, however, consistent and satisfactory results are not achieved with the Construction Equipment used by the Contractor, the Engineer may order the Contractor to obtain and use such Construction Equipment as may be necessary to achieve the required results.

1.8.5 Construction and Workmanship

1.8.5.1 Shop Detail Drawings

On the basis of the Engineer's design drawings, the Contractor shall, immediately on receipt of such drawings satisfy himself that the drawings contain all the information required for the preparation of his own shop details and supporting calculations. These shop detail drawings and supporting calculations shall be submitted to the Engineer for approval a reasonable time before commencement of fabrication. The Contractor's drawings shall be complete in every respect (including welding details and shop splices). The shop drawings shall be considered Working drawings and in accordance with SECTION VI-A description.

Steel sections shall be provided as specified on the drawings except those substitutions will be permitted with the Engineer's prior approval.

1.8.5.2 Welding

Only welders who are qualified to BS EN287, Part 1, and have a proven record over the previous six months, or who have attained a similar standard, shall be employed on the Works. Proof of welders' proficiency shall be made available to the Engineer on request.

All welding procedures shall be qualified to BS EN288, and the Contractor shall submit full details of the welding procedures and electrodes, with drawings and schedules as may be necessary. Tests shall be undertaken as required by the relevant British Standard.

1.8.5.3 Fabrication

All metalwork and structural steel shall, before and after fabrication, be within the tolerances specified below, and, unless required to be formed to a particular shape, be flat, straight, and free from twist. Any necessary straightening or forming shall be carried out by methods that neither weaken nor deface the material. Cutting may be done by sawing, shearing, cropping, or machine flame cutting. Manual flame-cutting is permissible only when authorized.

Holes for fasteners shall be drilled, except that holes for HD-bolts may be flame-cut if specifically approved, and that holes for bolts other than fitting bolts, may be punched, if approved, and if the material to be punched is not thicker than the diameter of the hole.

Any punching through material thicker than 12 mm shall be done only with the prior approval. The diameter of the holes for bolts other than fitted bolts and friction-grip fasteners shall not exceed the diameter of the bolt by more than 2 mm in the case of fasteners of diameter up to 24 mm and 3 mm for larger diameters. For friction-grip fasteners, the holes shall generally be not more than 2 mm larger than the bolts, and for holes for fitted bolts, the allowable tolerance shall be +0.15 mm.

Slotted holes shall be formed by drilling, punching a pair of holes and flame-cutting between the holes, or slot punching in the case of material of thickness not exceeding 12 mm. All burrs shall be removed form holes before assembly.

For joints in compression, the abutting surfaces of a joint dependent on contact for the transmission of load shall so butt that the areas necessary to transmit the load are in full contact. A bearing face that is to be grouted direct to a foundation need not be machined but such a face shall be true and parallel to the upper face of the foundation.

Where required, the ends of hollow sections may be flattened, or otherwise formed, for welded or bolted connections provided that the method employed does not damage or deface the material, and the change of shape shall be gradual.

The interior of any hollow member, whether a structural hollow section or a fabricated member, shall be so sealed as to prevent the ingress of moisture.

1.8.5.4 Assembly

Before delivery to the construction Site, each piece of metalwork shall be distinctly marked, in accordance with the marking diagram, and shall bear such other marks as will facilitate assembly and erection.

The component parts shall be so assembled that the whole and all parts of the finished structure are within the tolerances specified, that no member is bent, twisted or otherwise damage, and that specified cambers are obtained.

All matching holes for fasteners or pins shall so register with each other that the fasteners can be inserted freely. Drifting to align holes shall be so done that the metal is not distorted, and the holes are not enlarged. Holes that cannot be aligned without enlargement shall be cause for rejection unless enlargement by reaming is specifically approved. Welding shall be carried out in accordance with the recommendations of the relevant applicable standards, in particular AWS D1.1 or BS 5135.

For bolting, other than friction-grip bolting, the parts to be jointed shall be firmly drawn together and bolts shall be tensioned by hand to the limit of the torque that can be applied by the use of a standard podgier spanner. High tensile bolts for major tension type or moment type connections and where fatigue is a consideration shall be tightened to a tension of 75% of the proof load stress of the bolt.

Except in the case of fitted bolts, washers need not be used where surfaces are flat and flanges untampered, and holes have normal clearances. On tapered flanges, tapered washers shall be used to give bolts and nuts a satisfactory bearing. The length of each bolt shall be such that after the bolt has been tightened, at least one thread projects through the nut and at least one full thread remains clear between the nut and the unthreaded shank.

Fitted bolts shall be long enough to ensure that no threaded portion is within the thickness of the connected parts required to develop the bearing load on the bolt, and shall be provided with a washer or washers, under the nut, of thickness such as to ensure that at least one full thread remains clear between the nut and the unthreaded shank. All the bolts in each group shall be re-tightened after the last bolt has been fitted.

For friction-grip fastening, the turn-of-the-nut tightening method shall be used, unless otherwise directed by the Engineer, or otherwise recommended by the manufacturer. Once friction-grip bolts of Grade 10.9S and galvanized bolts of Grade 8.8S have been tensioned, they shall not be reused, but other bolts may be re- used solely at the discretion of the Engineer.

Before delivery to the construction Site, each piece of steelwork shall be distinctly marked, in accordance with the marking diagram, and shall bear such other marks as will facilitate assembly and erection.

1.8.5.5 Setting out

Before the Contractor commences erection of metalwork/ steelwork on Site, he shall check that the setting-out and the levels of levels of HD bolts and of concrete foundations, beam faces, column and buildings are in accordance with the drawings and report any discrepancies immediately to the Engineer.

1.8.5.6 Erection

Before commencing erection of metalwork on Site, the Contractor shall submit to the Engineer, for his general scrutiny and information, full details of the erection procedure and methods of erection.

All pockets that are to receive HD-bolts, fittings or metalwork shall be cleaned out immediately before erection is commenced.

Metal wedges or packing or other levelling devices of adequate strength and rigidity shall be used to support the metalwork.

Before steel sections are embedded in concrete, the complete corrosion protection system shall be applied to each member down to at least 100 mm below the level of the concrete.

Each part of a structure shall be aligned as soon as possible after it has been erected. Members shall not be permanently connected until enough of the structure has been aligned, levelled and plumbed and adequately braced.

1.8.5.7 Grouting and Sealing

Grouting shall be done in accordance with the requirements of manufacturer. The Contractor shall ensure that all grouting has been completed before any imposed load is applied, and that no bedding or grouting is carried out by others until enough of the structure has been aligned, levelled and plumbed and adequately braced. Immediately before being grouted, the space and all pockets under the steel shall be cleared of all debris and free of water.

1.8.5.8 Sundry Items

a. Handrails - Handrails shall be of the type and shall be purpose made in the style and shapes shown on the drawings. The Contractor shall ensure, by making in-situ measurements before manufacture is started, that the handrails suit the situation in which they are to be installed. Handrails are to be supplied complete with all the necessary fixing bolts, nuts, etc.

b. Ladders - Ladders shall be manufactured in accordance with the details and general arrangements shown on the drawings. Ladders shall be supplied complete with all the necessary fixing bolts, nuts, washers for fixing, etc.

c. Open grid flooring - Open grid steel covers and floor panels shall be manufactured by an approved firm specializing in such work. They shall be pressure locked or welded (or both). They shall be so designed that the deflection of any bar under design load condition does not exceed 1/200th of the clear span, or 10 mm, whichever is the lesser. Flooring shall be made in panels of sizes that conform to the dimensions given on the drawings and shall be supplied prefabricated with cut-outs as required. Unless authorized by the Engineer to do so, the Contractor shall not cut or weld open grid floor panels on Site.

d. Floorplate floors - Floorplate shall be as shown on the drawings and shall have an approved raised pattern. Lifting key holes shall be provided as shown.

1.8.5.9 Execution of Corrosion Protection

1.8.5.9.1 Safety and General Workmanship

The Contractor shall, at all times, enforce adequate safety measures in terms of the legislation applicable to the work Site.

All work shall be carried out by competent workmen under the supervision of an experienced supervisor. No cleaning or coating shall take place when Site conditions are likely to affect these operations adversely.

Equipment nameplates and identification plates shall be protected against damage or over coating.

Any areas not required to be coated shall be masked in such a way that these surfaces are protected during all coating operations.

1.8.5.9.2 Dressing and Repair During Fabrication

All surfaces of welds shall be free from slag, slag inclusions, cracks, and holes. Weld profiles shall have a smooth contour, free from irregular projections, undercut, and sharp edges. Areas adjacent to welds shall be free from weld spatter and such spatter shall have been removed by grinding or scraping.

All burrs and sharp edges caused as a result of activities such as guillotining, flame cutting, drilling or hole punching shall be removed by chamfering or ground to a smooth radius of at least 1 mm.

1.8.5.9.3 Preparation for Coating

Prior to any other form of preparation, all obvious harmful deposits on the surface of steelwork, such as oil, grease, chemical deposit, clay, bitumen, or mud, shall be removed by a method described below.

Abrasive blast cleaning (sand blasting) shall be carried out in accordance with the methods described in the relevant applicable standards (e.g. BS 4232, SIS 05 59 00). Where sprayed metal coatings are to be applied to steelwork, angular grit shall be used. Dry abrasive blast cleaning shall be carried out on a dry surface. When air is used, it shall be oil-free, clean, and dry. Final blasting shall not be carried out if the steel temperature is less than 3oC above dew point.

All blast-cleaned surfaces that are to be coated shall be so within 4 h of blasting unless otherwise agreed to by the Engineer.

In addition to or as an alternative to dry blast cleaning, it may be necessary to apply wet blast cleaning in order to remove soluble salts from the surface of steel that have been exposed to aggressive environments. Such wet blast cleaning is subject to the approval by the Engineer.

Cleaning by hand or with power tools

Degreasing- Liquid-solvent cleaning, solvent-vapour cleaning and alkali and emulsion cleaning may be carried out at the discretion of the Engineer.

1.8.5.9.4 Latent Material Defects

Before the application of the first coat of a protective system, unacceptable defects such as cracks or laminations, that become evident after preparation of the steelwork, shall be ground out, repaired or the material rejected, as decided by the Engineer.

1.8.5.9.5 Cleaning of Surfaces about to be Coated

No coating shall be applied on a prepared surface that is contaminated with oil, grease, perspiration, rust, or chemical deposits until such surface has been adequately cleaned. Uncoated steel shall not be touched with bare hands. Where contamination has occurred, it shall be removed with an approved solution or cleaning solvent, degreasing shall be followed by rinsing with water to remove residues.

Where any coat has oxidized or become excessively hard, it shall be abraded to a matt finish and cleaned prior to the application of further coats. Unless otherwise approved, coats shall only be applied on moisture-free surfaces.

Coating System

Paint systems for the various substrates shall be as follows: Steel Doors, Pressed Mild Steel Frames. Shop applied:

1 coat high build alkyd zinc phosphate primer to a minimum dry film thickness of 75 microns followed by 1 coat alkyd based undercoat to a minimum dry film thickness of 50 microns.

Site applied:

1 coat alkyd based undercoat to a minimum dry film thickness of 50 microns followed by 1 coat decorative alkyd enamel to a minimum dry film thickness of 50 microns.

Any damaged areas to be prepared as for the shop coats and made good with the original shop coats to the specified dry film thicknesses.

Steelwork in Contact with Water

Shop applied- Hot dip galvanized. Site applied:

All damaged areas shall be thoroughly cleaned of rust and surface deposits and be painted with 1 coat of epoxy zinc phosphate to a minimum dry film thickness of 75 microns.

1 coat two pack zinc chromate etch primer followed by 1 coat of epoxy micaceous iron oxide undercoat to a minimum dry film thickness of 100 microns, followed by 2 coats of epoxy micaceous iron oxide to a minimum dry film thickness of 60 microns.

1.8.5.9.6 Application of Paint Coatings

The method of coating application shall comply with the manufacturer's recommendation and data sheets. Multi- component materials shall be applied with due care; the specified application techniques being used. All coatings shall be substantially free from tears, runs, curtaining, foreign inclusions and material surface defects and shall, in addition, be free from misses. Maximum and minimum intercoat intervals shall comply with the paint manufacturer's recommendations, taking cognizance of ambient conditions.

The colour of each coat shall be different from that of the previous coat. Surfaces that will be inaccessible for coating after fabrication or erection shall receive the full specified coating system prior to final fabrication or erection. All coating components, particularly two-component or multicomponent materials, shall be thoroughly mixed until a homogeneous mixture is achieved. The mixture shall be frequently agitated during application to keep the solids in suspension. The preparation time and pot life of these materials shall be closely adhered to.

1.8.5.9.7 Repair of Damaged Coatings

Damaged areas shall be cleaned down to a metal condition or to an undamaged coated surface.

Spot repairs shall re-instate each of the previous coats or shall be made using an approved patching material. The patch shall extend at least 25 mm over adjacent surfaces which shall have been prepared by feathering with suitable abrasive paper. The repair of metal coatings shall be to a procedure approved by the Engineer.

1.8.6 Tolerances

1.8.6.1 General

The permissible deviations (PD) on the dimensions of components (such as gusset plates, cross bracing, etc.) and on the location of bolt holes in components and elements of a structure shall be ± 2 mm. All calculated PDs shall be rounded up to the next whole millimeter. Where alternative PD are quoted the lesser shall apply.

1.8.6.2 Tolerances on Dimensions, Accuracy of Erection, etc.

The tolerances on all dimensions (other than of rolled sections), accuracy of erection, location of HD-bolts, location of column bases, levels, etc., shall be as given below:

1.	Width of flange	+ 4 mm
2.	Depth of beams	+ 3 mm
3.	Off-center of web	6 mm
4.	Tilt or warpage of flange	b/200 mm
5.	Length of a member	+ 1, - 2 mm
6.	Out of plumb	< 50 r H/500 m
7.	Straightness of members	< 25 or L/500 m
8.	Location of HD-bolts	+ 3 mm
9.	Level and position of column bas	+ 3 mm
10.	Other levels	+ 2 mm

At least 90% of all coating thickness measured shall comply with the minimum requirements. Where DFTs are less than those specified, remedial action shall be taken to build up the thickness to that specified. DFT in excess of the prescribed maxima shall not necessarily constitute a reason for rejection if the paint film is demonstrated to be sound in all respects.

The method used to measure DFT and the significance of the readings for each particular job shall be as agreed upon by all parties prior to commencement of work.

1.8.7 Testing and Acceptance

1.8.7.1 Testing of Metalwork

If requested by the Engineer, test certificates or cast analysis certificates (or both), pertaining to the steel to be used shall be supplied to the Engineer by the Contractor.

The Engineer shall have access at all reasonable times to all places where the work is being carried out and shall be provided with all the necessary facilities for inspection during all stages of fabrication. Welds shall be examined visually to check that there are no uneven leg lengths, no cracking or unacceptable undercutting or porosity and that full fusion has been achieved. Dimensional checks shall be carried out in accordance with the requirements of the relevant applicable standards (e.g. BS 5153).

Only where so required by the Engineer shall welders be tested or destructive or non-destructive tests shall be carried out.

1.8.7.2 Testing of Coatings

Testing of coatings by the Contractor and inspections by the Engineer shall be carried out in accordance with the requirements laid down in the relevant applicable standards (e.g. ISO 3233) and as directed by the Engineer.

1.8.8 Measurement and Payment

Work involving metalwork will be measured as specified in BOQ, which will include all materials, fabrication, corrosion protection, and installation.

1.9 CARPENTRY AND JOINERY WORKS

1.9.1 Scope

This specification covers the general construction requirements for timber work, carpentry and joinery, required in general building construction (e.g. guardhouse and operator's quarters at reservoir sites).

1.9.2 Interpretations

1.9.2.1 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

1.9.2.2 Application

This specification contains clauses that are generally applicable to timber works, carpentry and joinery for buildings and associated work.

1.9.3 Materials

Woodwork in doors & windows frames and shutters with good finish including fixing with necessary fixtures all complete as per drawing and instruction.

1.9.3.1 Timber

Timber for general purposes shall be approved hardwood of the best quality generally complying with IS

1326, Grade1, or similar and planed on all sides. The timbers shall be impregnated with an odourless wood preservative. It shall be uniform in substance, straight in fiber, free from large, loose, dead and cluster knots, flaws, shakes, wasp, cup spring, twist, bends, saps and defects of any kind. It should be free from spongy, brittle, flaky or brushy condition, sapwood and bore holes.

All timber shall be seasoned and be free from decay, and harmful fungi and insect attacks and from any other damage or harmful nature which will affect the strength, durability, appearances, or its usefulness for the purpose for which it is required.

The timber shall be of best quality timbers specified in the item. The samples of the timber to be used shall be submitted for the approval of the Engineer. The samples of the approved timber to be used shall be deposited in the office of Engineer for the purpose of comparison.

Treated lumber shall be accompanied by a certificate from a recognized lumber treating company, certifying the amount of treatment and the percentage of moisture after drying.

For the structural components which will be concealed after installation, e.g., in the case of built-in cupboards, wardrobes or wall linings, either the type of wood specified for the unconcealed structural components (spruce, fir, pine or a wood of at least equal quality) or an equally suitable material may be used at the Contractor's own choice, unless otherwise specified.

The timber shall be in a suitable condition so that the components made of it will neither crack, warp nor twist. The moisture content of timber assemblies when leaving the manufacturer's works shall be as follows (referred to the oven- dry weight):

a) 8 to 12% for interior finish components

b) 10 to 15% for structural parts in permanent connection with the outside air. Proof of this moisture content shall be furnished to the Engineer.

For plywood and wood chip boards, all surfaces to be veneered or seal coated shall be adequately closed. Wooden fiber boards, veneers, coating slabs and coating foils of plastics shall be suitable for their intended applications. All coating materials shall form a good bond with the base. Their surface shall be readily brush able and insensitive to wiping contact.

All polish (polishing varnish) shall be fast to light and unsuitable condition so that it provides a surface which is elastic to the greatest possible extent and resistant to scratches, water, acid and heat.

1.9.3.2 Preservatives

All timber for carpentry and joinery placed in contact with masonry or concrete shall be given a coating of coaltar or creosote before being fixed in position. Wood preservatives shall be of an officially approved type. Where subsequent painting of the timber is required, the wood preservative shall be compatible with the paint. In interior applications, the wood preservative shall be odorless. The rates quoted for woodwork shall provide for such treatments.

1.9.3.3 Cover Moulds

In areas where the door or window frame are fixed flush with wall or plaster surface, teakwood’s cover moulds of size 40 x 12mm shall be provided all round without an extra charge. The cover mould shall be given the same finish as the main frame and overlap the masonry / plaster by at least 25mm.

1.9.3.4 Rebates

All door and window frames shall have cut rebates as per the drawings. Planted rebates shall not be allowed. The unrebated edges of the frames shall be rounded or chamfered as may be shown on the drawings. When not indicated on the drawings, they shall be beaded uniformly.

1.9.3.5 Post Keys

The vertical post of doorframes in the ground floor shall be embedded 25mm. On upper floors they shall be embedded in the floor slab by chipping a receptacle 12mm deep. The frames shall be installed in position and held plumb and level with strong supports from both sides as masonry works proceed.

1.9.3.6 Hold Fast

These shall be of M.S. flat with one end split into two and turned for anchorage into cement concrete blocks 1:2:4, the holdfasts shall be fixed to an adequately sized recess in the door frames with 30mm screws. There shall be one such holdfast on each side of frames of up 76 cm height, 2 on each side of frames up to 152 cm height. The position of the holdfasts shall be as shown on the drawings with minor adjustment to suit brick coursed or as directed by the Engineer. All holdfasts with concrete blocks shall be laid as the masonry work proceeds and not fixed afterwards. This concrete block shall neither be measured separately, nor any deduction is made in brick work for these blocks.

Door frames when abutting on RCC member shall be fixed to RCC members with raw plugs 50mm long and wooden screws of required sizes. Screws heads shall be sunk into frame and plugged properly.

1.9.3.7 Paneled Shutter

The shutter shall be paneled single, double, triple or more. The design, panels and the number of panels to be used shall be as per drawing or as per the direction of the Engineer. The styles shall be continuous from top to bottom. The top, frieze, muntins or mullions shall be jointed to the styles and their muntins shall be jointed to the rail with wooden or bamboo pins or as directed by the Engineer. The thickness of the frame for the shutter varies depending upon the size of the door, situation and thickness of the panel as shown in the drawings or as directed by the Engineer. Grooves shall be made on all the inside faces of the frames to receive panels. Before fixing the panels in the grooves of styles, rails etc. plaster of white zinc shall be treated on the panel for proper adhesion.

Mortice and tenon joints between the styles and the top frienze, the muntins and rails shall be to the full width of the member. The tenon shall not be less than 12mm thick and shall be glued into the mortices in addition to being pinned with wood dowels of not less than mm diameter. If mortices are tapered, the tenons may be wedged into them.

Each panel shall be in a single width piece; the contractor shall endure that the solid panels shall have their grains running along the layer dimensions.

Grooves in stile for panel fixing shall be 12mm wide and at least 20mm deep, panel edges shall be coated with and approved glue prior to insertion into the groove. Care shall be taken to see that there is no gap between the panel face and the sides of the groove.

The clearances between the finished shutter and the door frames and between the shutters themselves (when double leafed) shall not exceed 3 mm unless otherwise specified in the drawings.

1.9.3.8 Flush Door Shutter

Unless specified elsewhere or otherwise directed, door shutters shall be of veneered plywood of thickness not less than

4.5mm or plain galvanized sheet of 18 standard wire gauge. The thickness of the frame for the shutter varies depending upon the size of the door, situation and thickness of the panel as shown in the drawings or as directed by the Engineer. Sheets shall be flushed on both sides of wooden frame as per drawings. The beading shall be of solid timber of any of the species mentioned in Table 3 of IS:2202 (Part I)-1966. The beading shall be to the full thickness of the door. The depth of beading all round shall be not less than25 mm excluding the tongue and brew joint using BWR type adhesives conforming to IS:848-1956, and the beading shall be further secured by additional screws of adequate length. The tongue shall not be less than12 mm deep and its width shall not be less than 1/3 of the finished thickness of the shutter.

The timber used for beading for flush doors with decorative face shall preferably be of the same species as the face veneers unless otherwise mentioned. Samples of such shutters shall be submitted for approval.

Each sheet on the flush door shall be in a single width piece. The clearances between the finished shutter and the door frames and between the shutters themselves (when couble leafed) shall not exceed 3 mm unless otherwise specified in the drawings.

1.9.3.9 Fixtures & Fastening

Unless specified elsewhere or otherwise directed, every leaf of door and window shutter should provide and find fixed in position with following fixtures & fastening. All fittings shall be submitted to the Engineer in good time for approval.

Table 9: Fixture and Fasteners Details

Description of Fixtures	Door Leaf	Window Leaf
Brass or mortise lock of approved size and quality	1 No	Nil
Hinges, 150mm long with screw	3 Nos. (150 mm long)	(2 Nos. 100 mm long)
Aluminum tower bolt with screw	2 Nos. (300 mm long)	2 Nos. (200 mm long)
Brass handle with screws	2 Nos (150 mm long)	1 Nos (100 mm long)
Rubber buffer stops with screws Aluminum locking pin	2 Nos	Not Necessary

(Restricting window leaf movement during wind) Not Necessary 1 No. (125 mm long)

All fixtures shall be fixed to the jointing in a secure and efficient manner. Any of the fixtures damaged during fixing shall be removed and new ones fixed in their place and the surface of the joinery made good where affected at the Contractor's expenses. When the type is not mentioned on the drawing it shall be as directed by the Engineer.

If detailed drawing specifies different types of fixtures, the work shall be carried out according to the drawing. Screw shall be suitable length & cover diameter & shall be fixed with screws driven & not by hammers.

1.9.4 Construction Equipment

Equipment and tools for the execution of timber work, carpentry and joinery shall be sufficient in number and capacity, in good working order, and in accordance with the requirements of the applicable safety regulations.

1.9.5 Construction and Workmanship

If not otherwise shown on the drawings, or directed by the Engineer, DIN 18334 shall be binding for the execution of the

Works as well as the other DIN Standards as follow:

1. DIN 1052 Timber Structures
2. DIN 68365 Timber for Carpenters' Work, Quality Specifications
3. DIN 4074 Timber for Wood Building Components
4. DIN 68800 Timber Protection in Building Construction
5. DIN 17440 Stainless Steel; Quality Specification
6. DIN 18202 Dimensional Tolerances in Building Construction,

Timber as specified shall be jointed and erected in accordance with DIN 1052 and the drawings, including the required wind bracing. Posts shall be fixed to the concrete slab by means of bearing plates, straps and angles according to the structural calculations. Only non-rusting steel according to DIN 17440, Material No. 1.4571 shall be used for fixing components.

The Contractor shall supply to the Engineer shop drawings in accordance with the architectural design and Contractor's static analysis, which are subject to approval before any execution starts.

All structural components shall not warp or crack under any circumstances including stresses due to temperature and humidity that will have to be expected.

All timber connections and mitres shall be accurately fitted. The surface exposed to view shall be trimmed, e.g., by planning and grinding. There shall be no plane cutting marks.

Solid timbers shall be joined in such a way that in the event of variations of air humidity, the wood is free to swell and shrink without affecting the joint.

Framing timbers shall not be butted. Dovetailing may be used subject to the Engineer's consent.

All edge surfaces of plywood, plain galvanized sheets and composite shutter exposed to view shall be veneered or provided with banding (insets or strips). On sealed, veneered and coated surfaces joints and irregularities of the base shall not show even after final drying.

All grained veneers and Plain Galvanized sheets shutter shall be protected against tearing. All timbers ultimately in contact with outside air, or permanently in contact with particularly humid air, or connected to masonry or concrete, shall be treated on all sides with suitable wood preservative before being inserted. The manufacturer's instructions shall be observed.

1.9.6 Test and Acceptance

A selection of samples for visual inspection and dimensional checks on material and fittings may be made by the Engineer. Supplier's material and test certificates pertaining to the material to be used shall be supplied to the Engineer by the Contractor. The Engineer shall have access at all reasonable times to all places where the work is being carried out and shall be provided with all the necessary facilities for inspection during all stages of manufacture or construction.

1.9.7 Measurement and Payment

Unless stated otherwise in the BOQ, payment for windows and doors frame shall be in cubic meter including necessary hinges, payment for the door and window shutter shall be in square meter including all necessary fittings & fixtures.

2 ROAD AND RELATED WORKS

2.1 SCARIFICATION AND RECOMPACTION

2.1.1 Scope

This section deals with the scarification and re-compaction of existing bituminous surface for laying of the crushed stone base course. The sequence of operations shall be as follows:

2.1.2 Scarification

Scarification shall be carried out only after completion off all drainage works unless otherwise agreed by the Engineer.

2.1.3 Cleaning the surface

Before scarification, the surface shall be thoroughly cleaned. All foreign material shall be cleaned and removed from the site.

2.1.4 Scarification

The existing pavement surface shall be scarified with suitable grader/ scarifies up to at least 75mm depth. Oversize material shall be removed or broken down so that the maximum size of the particles is not more than 38mm.

2.1.5 Spreading & Mixing

After scarification the material shall be spread to full width of the road uniformly with required slope, if applicable.

2.1.6 Rolling

As soon as possible after laying, compaction shall be carried out. The moisture content shall be adjusted as necessary and, during compaction, care shall be taken to maintain the moisture content evenly at the specified value.

All rolling shall be longitudinal and shall commence at the outer edges of the pavement and progress towards the centre, except that on super-elevated curves, rolling shall progress from the lower to the higher edge. Where laying is carried out in lanes care must be taken to prevent water entrapment.

The minimum dry densities to be achieved as a percentage of the Maximum Dry Density (MDD) determined in accordance with IS 2720 Part 8 shall be 95% of MDD.

On completion of the compaction the surface shall be well closed, mechanically stable, free from visible movement under compaction plant and free from compaction planes, ridges, cracks, lose or segregated material. If the surface fails to meet the requirements, the Contractor shall take the action set out in the appropriate part of Section 1100 of “Standard Specifications for Road and Bridges” published by Department of Roads, GoN or such other action as directed by the Engineer.

2.1.7 Testing

Testing to be carried out during the construction shall include the following:

The MDD (heavy compaction) and OMC shall be determined for each new material encountered and in every 2000m2 or for each stretch of the road. The field dry density shall be determined at least once per 500m2 or part of it of each layer of compacted area. The test of field density shall be conducted in staggered manner i.e., at left, at crown and at right in the carriageway.

The Contractor shall request in writing for the Engineer’s approval for each layer and such request shall be accompanied by the tests results of the above-described testing and all additional relevant information required. If the results are as specified, he will approve for addition of another layer or will ask for further tests or rework to meet the requirements. All the test results shall be attached with each payment certificate.

2.1.8 Finishing

The surface finish after compaction of any treated layer shall be free from ridges, compaction planes, laminations, loose and segregated material and other surface irregularities and shall be to the line and the level within the tolerances.

2.1.9 Measurement

The scarification and recompact ion shall be measured in square meters multiplying length and breadth of the accepted work.

2.1.10 Payment

The scarification and recompact ion shall be paid at their respective contract unit rate. The rates shall include for the cost of scarifying, spreading, mixing, watering, application of screening if necessary, compacting,

rolling, making good defective areas and maintenance of the surface including all required material, labour, equipment and other incidental in accordance with the requirements of these specifications.

2.2 CAPPING LAYERS (SUB-GRADE) AND SUB BASE COURSE

2.2.1 Scope and Definition

This clause covers procuring, furnishing and placing of approved natural river gravel constructing a sub base course layer, as the case may be, in accordance with the requirement of this Specification.

Capping layers are layers of specified materials to be laid and compacted in the subgrade and below as required, (e.g. top of common backfill of pipe trenches) in replacement of in-situ materials to achieve CBR

2.2.2 Sources of Materials

The Contractor shall be responsible for locating and developing suitable of material for capping layers and for sub base course. Such sources shall be termed quarries.

2.2.3 Material Requirements

Capping layer

Where shown on the Drawing or where in-situ material in the subgrade in cutting does not meet the requirements, in-situ materials shall be replaced with selected material from cuttings or borrow pits.

Where materials of differing quality are available for placing in the embankments, the Engineer may also instruct that certain materials should be excluded from the subgrade and that certain materials should be set part, or obtained from borrow pits for use in the upper layers

When materials for subgrade are extracted from borrows to form the capping layers, they shall be natural material complying with the following requirements:

(1) Material classification

Materials used for use in capping layers shall be selected among soils classified as GW, GP, GC, and SW in the General Classification of Soils.

(2) Material Requirements

Material for use in the capping layers shall not contain particles larger than 75 mm and their percentage passing by weight the 0.075 mm sieve shall be less than 15%. The material shall have a CBR of not less than 15% measured after a 4-day soak on a laboratory mix compacted to 95 % MDD (heavy compaction), a swell of less than 1%, a plasticity index of less than 12%.

(3) Laying and Compaction

The material shall be deposited in the layer of 150 mm compacted depth. Each layer shall extend over the full width of the embankments or cutting and shall be compacted in accordance with the requirements specified in Sub-clause 1003 (1) (a) to (d), of Standard Specification for Roads & Bridges, 2001, published by the Department of Roads, Nepal

(4) Tolerances

Tolerances of capping layers shall be in accordance with Sub-clause 1003 (5) of Standard Specification for Roads & Bridges, 2001, published by the Department of Roads, Nepal When each layer is completed the Contractor shall request the Engineer's approval and protecting the layer.

Sub base course

The material for sub base course shall comply with following requirements: The grading of material shall be a smooth curve within and approximately parallel to the envelope given in table 9. The plasticity index shall not exceed 6. The minimum 4 day soaked CBR of the material shall be 30% at the specified in situ density.

Table 10: Grading Envelope Sub-Base Course

Sieve Size (mm)	Percentage by weight passing	
	Type A	Type B
63	100	-
50	-	100
37.5	65 – 95	80 – 100
20	50 – 85	60 – 100
10	40 – 75	-
5	30 – 60	30 – 100
2.36	20 – 45	-
1.18	15 – 37	17 – 7
0.3	-	9 – 50
0.075	4 – 15	5 – 25

Table 11: Physical Requirements of Sub base material

Parameter	
LAA Max. %	40
AIV Max. %	30
FI Max %	25
PI Max.	6

2.2.4 Transporting

The material of capper layers and sub-base shall be transported and dumped in such a way that no segregation occurs.

2.2.5 Compaction Trials

Before commencing construction and from time to time as may be considered necessary by the Engineer, the Contractor shall carry out compaction trials in the presence of Engineer on each main types of materials to be compacted in the Works. He shall carry out all necessary laboratory and field testing and supply the Engineer with the copies of the results of all tests.

Following completion of the compaction trials, the Contractor shall submit to the Engineer, for his approval, proposals for the compaction of each main type of material. The Contractor's Proposals shall include reference to the type of equipment, the operating weights and tyre pressures and the method of adjusting moisture content.

If, in the opinion of the Engineer, the results of the compaction trials indicate that the Contractor's proposed plant and methods shall achieve the densities specified, the Engineer shall approve the same. Otherwise, the Contractor shall submit in writing proposals for modifying the plant and/or methods and shall compact further trials in accordance with these modified proposals until the Engineer approves the Contractor's proposals.

2.2.6 Laying and Compacting

The sub base course material shall be deposited in such quantity and spread in a uniform layer across the full width required, so that the final compacted thickness is nowhere less than shown in the Drawing or instructed by the Engineer. Every reasonable effort shall be made to prevent segregation during the loading, hauling, dumping, spreading, mixing, trimming and compacting operations.

The compacted thickness of any layer laid, processed and compacted at one time shall not exceed 150 mm and where a greater compacted thickness is required, the material shall be laid and processed in two or more equal layers.

The material shall be scarified and the moisture content adjusted by either uniformly mixing with water or drying out the material such that the moisture content during compaction is between 95% and 102% of the Optimum Moisture Content determined as per IS 2720 Part 8. It shall be graded and trimmed to final line and level. Light compaction may be applied before the final trim is carried out but once 25% of the compactify effort has been applied no further trimming or correction of surface irregularities shall be allowed.

The final trim shall be in cut and the Contractor shall ensure that material form the trim is neither deposited in low areas nor spread across the section but graded clear of the works.

Following the final trim, the material shall be compacted to a dry density of at least 95% MDD (Heavy compaction). During the grading, trimming and compaction of the material the Contractor shall ensure that the surface and/or the material does not dry out by applying fog sprays of water or other approved means sufficient to maintain the surface and/or material within the specified limits of moisture content.

Vibratory rollers for the final compaction shall not be allowed.

2.2.7 Setting out and Tolerances

Subbase course shall be set out and constructed to the tolerances given in Section 1100 of "Standard Specifications for Road and Bridges" published by Department of Roads, GoN.

2.2.8 Testing

2.2.8.1 Process Control

The minimum testing frequency for process control shall be as specified in following Table.

Table 12: Sub-base Minimum Test Frequency

Tests	One test in every	Min. no of Tests per section
Materials:		
Gradation	300m3 or part of it and change in source	2
Plasticity Index	300m3 or part of it and change in source	2
Flakiness Index	300m3 or part of it and change in source	2
Maximum Dry Density and Optimum	400m3 or part of it and change in source	2
Moisture Content	300m3 or part of it and change in source	2
Los Angeles Abrasion	300m3 or part of it and change in source	2
Aggregate Impact Value	300m3 or part of it and change in source	2
CBR	200m3 or part of it and change in source	2
Field Density and Moisture Content		
Construction Tolerance:	10 m	-
Surface Levels	25 m	-
Thickness	200 m	-
Width	40 m2	-
Smoothness		

2.2.8.2 Routine Inspection and Testing

Routine inspection and testing shall be carried out by the Engineer to test the quality of materials and workmanship for compliance with the requirements of this section.

Any materials or workmanship that do not comply with the specified requirements shall be replaced by materials and/or workmanship complying with the specified requirements or be repaired so that after being repaired it shall comply with the specified requirements.

2.2.9 Measurement and Payment

Subbase course shall be measured in cubic meter by taking cross Sections at intervals of 10 meters or as directed by the Engineer in the original position before the work starts and after its completion and computing the volumes in cubic meters by average end area method.

The rates for subbase course shall include for the cost of supplying, spreading, mixing, watering, application of screening, watering, compacting, rolling, making good defective areas and maintenance of the surface and all incidental in accordance with the requirements of these specifications.

2.3 GRADED CRUSHED STONE BASE COURSE

2.3.1 Scope and Definition

This clause covers procuring, furnishing, and placing of approved crushed stone material constructing a crushed stone base layer, as the case may be, in accordance with the requirement of this Specification.

"Graded crushed stone" shall mean crushed stone with a smooth grading curve within a specified envelope.

2.3.2 Sources of Materials

The Contractor shall be responsible for locating and developing suitable of material for graded crushed stone. Such sources shall be termed quarries.

2.3.3 Material Requirements

The material shall comply with following requirements:

a. It shall consist of crushed stone, free from clay, organic or other deleterious matter.

b. It shall comply with the physical requirements defined in Table below.

Table 13: Physical Requirements of Graded Crushed Stone

Parameter	
LAA Max. %	30
AIV Max. %	20
SSS Max. %	12
FI Max %	25
CBR Min. %	80
CR Min. %	100
PI Max.	NP

It shall comply with the Following Grading's

After processing, placing and compaction in the pavement the grading of the material shall be smooth curve within and approximately parallel to one of the envelopes defined in Table below.

Table 14: Grading Envelopes for Graded Crushed Stone

Sieve Size (mm)	**Percentage passing by weight**
40.0	100
31.5	85-100
20.0	62-92
10.0	40-70
4.75	26-55
2.36	21-53
0.60	12-28
0.075	2-10

2.3.4 Crushing, Screening and Mixing

Unless otherwise instructed, crushing shall be carried out at least in two stages.

The crushing, screening and proportioning of materials and their subsequent mixing shall be carried out using methods and machines acceptable to the Engineer. To avoid segregation, graded crushed stone shall be moistened when being handled and shall not be stockpiled in heaps higher than 5 m.

If the Contractor wishes to add material from another source in order to achieve the specified grading the following conditions shall apply:

a. The Contractor shall be responsible for all costs associated with the provision and mixing in of the material, including land acquisition.

b. The material shall be non-plastic, hard and durable as specified. Particles shall be free from organic materials, clay and other deleterious substances.

c. Only material passing the 6.3 mm sieve may be added, the percentage to be added shall be agreed with the Engineer and in any case shall not exceed 15% by weight of the mixture.

d. The minimum crushing rations as well as other physical requirements as specified above shall be maintained.

2.3.5 Transporting Graded Crushed Stone

Graded crushed stone shall be transported and dumped in such a way that no segregation occurs.

2.3.6 Compaction Trials

Before commencing construction and from time to time as may be considered necessary by the Engineer, the Contractor shall carry out compaction trials in the presence of Engineer on each main types of materials to be compacted in the Works. He shall carry out all necessary laboratory and field testing and supply the Engineer with the copies of the results of all tests.

Following completion of the compaction trials, the Contractor shall submit to the Engineer, for his approval, proposals for the compaction of each main type of material. The Contractor's Proposals shall include reference to the type of equipment, the operating weights and tyre pressures and the method of adjusting moisture content.

If, in the opinion of the Engineer, the results of the compaction trials indicate that the Contractor's proposed plant and methods shall achieve the densities specified, the Engineer shall approve the same. Otherwise, the Contractor shall submit in writing proposals for modifying the plant and/or methods and shall compact further trials in accordance with these modified proposals until the Engineer approves the Contractor's proposals.

2.3.7 Laying and Compacting

The Contractor shall take appropriate measures to prevent segregation during dumping and spreading operations.

The graded crushed stone shall be laid by plant capable of distributing the graded crushed stone in a layer of uniform thickness and without segregation.

The compacted thickness of any layer laid, processed and compacted at one time shall not exceed 100 mm, and where a greater thickness is required, the graded crushed stone shall be laid in two or more equal layers.

As soon as possible after laying, compaction shall be carried out. The moisture content shall be adjusted as necessary and, during compaction, care shall be taken to maintain the moisture content evenly at the specified value. Unless otherwise instructed by the Engineer, the moisture content at the time of compaction shall be between 95 and 100% of the Optimum Moisture Content determined as per IS 2720 Part 8.

All rolling shall be longitudinal and shall commence at the outer edges of the pavement and progress towards the centre, except that on superelevated curves, rolling shall progress from the lower to the higher edge. Where laying is carried out in lanes care must be taken to prevent water entrapment.

The minimum dry densities to be achieved as a percentage of the Maximum Dry Density (MDD) determined in accordance with IS 2720 Part 8 shall be 98% of MDD.

On completion of the compaction the surface shall be well closed, mechanically stable, free from visible movement under compaction plant and free from compaction planes, ridges, cracks, lose or segregated material. If the surface fails to meet the requirements of these Specifications, the Contractor shall take the action set out in the appropriate part of Section 1100 of "Standard Specifications for Road and Bridges" published by Department of Roads, GoN or such other action as directed by the Engineer.

2.3.8 Setting out and Tolerances

Graded crushed stone subbase and base shall be set out and constructed to the tolerances given in Section 1100 of "Standard Specifications for Road and Bridges" published by Department of Roads, GoN.

2.3.9 Testing

2.3.9.1 Process Control

The minimum testing frequency for process control shall be as specified in Table below:

Table 15: Road Aggregate Minimum Test Frequency

Tests	One test in every	Min. no of tests per section
Materials:		
Gradation	200m3 or part of it and change in source	2
Plasticity Index	200m3 or part of it and change in source	2
Flakiness Index	200m3 or part of it and change in source	2
Maximum Dry Density and Optimum	100m3 or part of it and change in source	2
Moisture Content	200m3 or part of it and change in source	2
Los Angeles Abrasion	200m3 or part of it and change in source	2
Aggregate Impact Value	500m3 or part of it and change in source	2
Sodium Sulphate Soundness	200m3 or part of it and change in source	2
Crushing Ratio	500m3 or part of it and change in source	2
CBR	500 m2 of on every daily stretch	2
Field Density and Moisture Content		
Construction Tolerance:	10 m	-
Surface Levels	25 m	-
Thickness	200 m	-
Width	40 m2	

2.3.9.2 Routine Inspection and Testing

Routine inspection and testing shall be carried out by the Engineer to test the quality of materials and workmanship for compliance with the requirements of this section.

Any materials or workmanship that do not comply with the specified requirements shall be replaced by materials and/or workmanship complying with the specified requirements or be repaired so that after being repaired it shall comply with the specified requirements.

2.3.10 Measurement and Payment

Graded crushed stone base shall be measured in cubic meter by taking cross Sections at intervals of 10 meters or as directed by the Engineer in the original position before the work starts and after its completion and computing the volumes in cubic meters by average end area method.

The graded crushed stone construction shall be paid at their respective contract unit rate. The rates for graded crushed stone base course shall include for the cost of supplying, spreading, mixing, watering, application of screening, watering, compacting, rolling, making good defective areas and maintenance of the surface and all incidental in accordance with the requirements of these specifications.

2.4 GENERAL REQUIREMENTS FOR PRIME COAT

2.4.1 Scope

This Clause comprises general requirements for a bituminous Prime Coat consisting of an application of bituminous material on the prepared base course layer and applied in accordance with this specification, applied at the rate specified below or any modification instructed by the Engineer.

2.4.2 Bituminous Binder

All bituminous binders shall comply with the relevant requirements set out in Section 600 of "Standard Specifications for Road and Bridges" published by Department of Roads, GoN, 2001.

2.4.3 Storage and Handling of Bituminous Binder

When carried in bulk containers, of binder temperature during and at the time of storage shall be kept in a manner acceptable to the Engineer. During storage the temperature of the bituminous binder shall be kept as low as possible, consistent with reasonable pump ability. Any bituminous binder not conforming to the requirements stated below shall be rejected by the Engineer as unsuitable for use.

The bitumen storage area and heating station shall be cleared of vegetation, kept neat and tidy. The drums shall be stacked on their sides in small quantities with gaps between each stack to reduce fire risk.

Bitumen distributors and boilers shall be kept clean at all times. When changing the grade of bitumen and at the end of each day's work, all boilers and distributors shall be thoroughly cleaned out with a solvent. The flushing from boilers and distributors shall not be poured anywhere indiscriminately but shall be led by drainage channels to disposal pits. Care shall be taken that flushing do not find their way into storm water ditches or streams. All boilers, pre-heating pits, tools and plant shall be kept scrupulously clean.

When filling the bitumen distributor from the boilers or bulk containers, the bitumen shall be passed through a filter of fine wire mesh having opening of not more than 0.6 mm.

On completion of the works, the disposal pit and drainage channels shall be filled in and top soiled. The site shall be left clean and tidy.

2.4.4 Heating of Bituminous Binder

The bituminous binder shall be heated in boilers or bulk storage containers, equipped with adequate pumps and accurate thermometers. No bitumen shall be heated in a boiler when the thermometer is broken, inaccurate or not equipped with it.

The minimum pumping temperatures, the range of spraying temperatures and the maximum heating temperatures of cut-backs, penetration grade bitumen and emulsion are given in Table below.

Table 16: Temperatures Ranges for Heating and Spraying Binders

Binder	Temperatures (°C)			
	Minimum Pumping	Spraying *		Maximum Heating
		Slot-jets	Atomizing jets	

Cut-back MC 30	10	35-45	50-60	65
Cut-back MC 70	25	55-65	70-85	85
Cut-back MC 800	60	100-115	120-135	135
Cut-back MC 3000	80	125-135	135-150	150

Notes

* These spraying temperatures are for guidance only, since the optimum spraying temperature depends on the temperature/viscosity relationship of the bitumen.

** The minimum pumping and spraying temperatures for K1-60/A1-60 shall be in accordance with the manufacturer's recommendations.

For slot-jets the viscosity for spraying shall be 70 to 100 centistokes and for atomizing jets 35 to 60 centistokes.

No penetration grade bitumen, cut-back bitumen, or emulsion shall be heated above the maximum temperature given in the Table. Any overheated bitumen or emulsion shall be removed from the site and disposed off by the Contractor.

The rates of application of binder specified or instructed by the Engineer refer to volumes of binder corrected to 15.6oC using Standard Petroleum Measurement Table (ASTM D 1250).

2.4.5 Weather Limitations

The minimum surface temperatures for spraying of the different types and grades of binder shall be:

80/100 penetration grade bitumen: 50° C MC-3000 cutback bitumen: 22° C MC-800 cutback bitumen: 15° C MC-30 cutback bitumen: 10° C Emulsions: 5° C. When a cold wind is blowing the above temperatures shall be increased by 5° C

No bituminous work shall be done during foggy or rainy weather. Strong wind may interfere with the proper execution of the work. Therefore, no surfacing, especially spraying of binder, shall be done when strong wind is blowing.

Bituminous material, except for bitumen emulsions and certain types of prime coat if instructed by the Engineer, shall not be applied on a damp surface.

2.4.6 Cutting Back of Bitumen

The maximum amounts of paraffin as given in Table 16 may be added with the permission of the Engineer to the basic 80/100 penetration grade bitumen upon the road surface temperature at the time of spraying. Lesser amounts than those indicated may be used, if the site conditions allow the development of sufficient adhesion between binder, aggregate and existing surface. Diesel or kerosene shall be used for cutting back of bitumen as per the direction of the Engineer.

Table 17: Maximum Addition of Paraffin

Range of Road Surface Temperature (°C)	Maximum Addition of Paraffin by Volume %	Range (approximate) of Corresponding Ambient Air Temperature °C
22-29	7	10-16
22-36	5	16-21
39-43	3	21-26
43-50	1	26-31
above 50	NIL	above 31

The temperature of bitumen, when paraffin is introduced, shall not be higher than 120°C. The paraffin shall be sucked from 200 liter drums in measured quantities through the bitumen pump and circulated with the bitumen for a minimum of 45 minutes. During this process all burners shall be shut off and no open flames allowed near the distributor.

2.4.7 Adhesion Agent

Where required the adhesion agent shall be of an approved type and shall be used in accordance with the manufacturer's instructions and as instructed by the Engineer.

2.4.8 Safety Precautions

The Contractor shall take every precaution to avoid fire or health hazards. He shall always ensure that:

1. bitumen is heated only to the temperature required for the particular application.
2. hot bitumen never comes in contact with water.
3. suitable protective clothing's, foot wears and gloves are used when handling bitumen; and
4. dust is reduced to the minimum.

Care is required when using rapid-curing cut-back, because of the highly flammable nature of the solvent.

2.4.9 Trial Sections

The Contractor shall carry out trial sections at location instructed by the Engineer to demonstrate to the Engineer that this surfacing operation is capable of executing the works in accordance with the Specification.

Prior to the commencement of trials, the Contractor shall submit in writing to the Engineer his proposals for applying binders and aggregate. On receipt of the Engineer's approval, the Contractor shall proceed with the trials, but in absence of such approvals the Contractor shall submit fresh proposals to the Engineer.

In the course of such trials the Engineer may call upon the Contractor to modify his method of working, to employ other items of equipment and to amend the rates of spread at which various materials are applied.

When the Engineer is satisfied that the Contractor is capable of constructing surfacing that complies with the Specification after trial Section or Section, the Contractor shall receive permission to commence the work. No variation in the approved procedures shall be made without the Engineer's prior consent in writing.

None of the foregoing provisions prevent the Engineer from requiring the Contractor to vary his materials, equipment or methods of working at any time during the execution of Works, if he considers this to be essential for execution of the works in accordance with this Specification.

2.4.10 Measurement and Payment

No separate measurement and payment shall be made for complying with the requirements of Sub-clause from 2.4. The Contractor shall include related costs of complying with the requirements of Clause 2.4 in his rates of the items covered in Clauses 2.5.

2.5 PRIME COAT

2.5.1 Scope and Definitions

This Clause covers the application of a bitumen prime to be applied on a prepared pavement layer.

A prime coat means a thin layer of low viscosity bituminous binder applied to an absorbent non-bituminous surface. If the prime coat is to be trafficked, it shall be covered with binding material.

Materials

The prime coat shall consist of cut back bitumen MC30 complying with Section 600 "Standard Specifications for Road and Bridges" published by Department of Roads, GoN from a source approved by the Engineer. The grade and the rate of application of cutback to be used shall be instructed by the Engineer on site after field trials.

In case of cold mix asphalt reinstatement, the prime coat with emulsion shall comply with the requirements of clause 1302 of the standard specification for road and bridge works.

However, the nominal rate of application of the prime coat shall be 1 lit per sq. m. If the prime coat is to be applied in more than one lane, allowance shall be made for overlapping of lanes by 150 mm. Tentative temperature for cold application shall be around 50°-70 °C for emulsion and 50 °C-80 °C for cutback and for hot bitumen (VG-10): between 150°C and 175°C, measured at the spray bar, to achieve proper atomization and adhesion. *Temperature ranges shall be approved by the Engineer prior to application*

Blinding material shall consist of fine aggregate, or sand, or crusher dust as required and shall contain no more than 15 percent retained on a 6.3 mm sieve.

Density Values

S.N.	Material	Density
1	Bitumen Emulsion	0.98 – 1.05 kg/L
2	Cutback Bitumen	0.90 – 0.95 kg/L
3	VG Bitumen	1.01 – 1.03 kg/L

2.5.2 Preparation of Surface.

The surface to be sprayed shall be thoroughly cleaned by sweeping with mechanical brooms and/or washing or other approved means. All laitance of soil or binder material, loose and foreign material shall be removed.

All loose material shall be swept clear of the layer to expose the full width of the layer upon which prime coat shall be applied. The surface to be sprayed shall be checked for line, camber and level, and the surface corrected, made good as necessary and approved by the Engineer before any bituminous spray is applied. The Engineer's approval, or otherwise, of the surface shall be given immediately prior to the Contractor's intention to start spraying.

Unless otherwise directed by the Engineer, immediately prior to the application of prime coat, the surface of the layer shall be sprayed with water to dampen the surface, but in no case the surface shall be made saturated. If the water is over applied, the surface shall be allowed to dry until dampness is uniform over the entire surface.

In order to bring the surface to be primed to the condition required, water shall be applied in small increments by a distributor. Any water on the surface after spraying shall be allowed to drain away before the prime coat is applied.

No traffic shall be allowed on the prepared surface.

2.5.3 Spraying of Prime Coat

Soon after the surface to be sprayed has been prepared as specified in Sub- clause (3) above and approved by the Engineer, the edges of the area shall be marked out with a line of string or wire pegged down at intervals not exceeding 15 m on straights or 7.5 m on curves. The prime coat shall be sprayed on to it at the specified rate. Spraying shall be carried out not later than 12 hours after the surface has been prepared.

The quantity of binder used shall give complete coverage of the surface with a slight trace of run-off in places. Shall the specified rate of spray appear to be incorrect; the Contractor shall immediately stop spraying, inform the Engineer and amend the spray rate as instructed by the Engineer.

The temperature for storage and spraying shall be as given in the Table below

Table 18: Temperature for Storage Prime Coat

Type of Prime	Maximum storage temperature ^{O}C	
	Up to 24 hrs.	Over 24 hrs.

Cutback bitumen		
MC-30	65	40
MC-70	80	50

Bitumen shall be sprayed from a pressure distributor complying with the requirements of Sub-clause 1303 (6) of "Standard Specifications for Road and Bridges" published by Department of Roads, GoN and no spraying shall be permitted except in small areas, or to make good a defective area caused by a blocked nozzle.

The nozzle shall be arranged to give a uniform spray and shall be tested prior to spraying by discharging on to suitable material (such as building paper, metal sheets, etc.,) or into special troughs made for this purpose. Testing shall not take place on the road, and any bitumen spilt on the ground shall be cleaned off.

If during spraying, a nozzle becomes blocked or develops a defect, the spraying shall be made good with a hand spray, and the machine repaired before further spraying is commenced.

When commencing and stopping spraying, sheets of building paper or metal at least 2 m wide shall be spread across the full width to be spread across the full width to be sprayed to give a clean sharp edge.

The metal sheets used for stopping and starting work shall be cleaned after each run and the troughs used for testing shall be cleaned at the end of each day's work.

During spraying all kerbs, road furniture, culvert headwalls, tree boles, manholes covers and the like which are liable to be disfigured by splashing of bitumen shall be protected, and any such feature which is accidentally marred by bitumen shall be cleaned off with a suitable solvent or made good.

2.5.4 Curing and Blinding of Prime Coat

If after application of the prime coat, the bituminous material fails to penetrate within the time specified or if the road must be used by traffic, blinding material shall be spread in the amount required to absorb any excess bituminous material and to protect the primed surface.

Blinding material shall be spread from trucks in such a manner that no wheel shall travel on uncovered bituminous material.

Unless the Engineer permits otherwise, all loose material on the sprayed surface, including any blinding material shall be removed before any further layer of the pavement is laid.

2.5.5 Tolerances

The actual rate of application of bituminous binder across the width of each spray run shall not vary by more than ± 5% of the rate ordered and the actual of application of binder for each single run of the spray shall not vary from this specified rate by more than 0.03 liter per square meter.

2.5.6 Testing

Tray tests shall be taken at least twice a day during priming operation to check calculations based on dipping of spray trucks. The minimum testing frequency for the purpose of process control shall be as given in the Table below.

Table 19: Minimum Testing Frequencies Prime Coat

Testing	Minimum number of tests
Quality of binder	The Contractor shall produce certificates from concerned suppliers to the effect that all materials supplied by them comply with the relevant Specifications. In addition, one set of tests for each 50,000 liters of supply of binder At regular close intervals Two test per run.

2.5.7 Measurement and Payment

The basic prime coat shall be measured in square meters in the accepted work sprayed at the specified rate as instructed by the Engineer on Site. Cutter and required blinding material shall not be measured separately and shall be deemed included along with other associated costs shall be included in the item rate of prime coat. The measured quantity shall be the area instructed and accepted by the Engineer. The binder application rate shall be corrected to 15.6ºC.

The contract unit rates for prime coat shall be payment in full for carrying out the required operations including full compensation for:

a. Providing all materials for all preparation, delivering and application and

b. Providing all labour, tools, equipment, and incidentals necessary to complete the work. No separate payment will be made for supply and spreading of blinding material.

2.6 TACK COAT

2.6.1 Scope and Definitions

This Clause covers the application of a tack coat on a prepared pavement layer prior to placement of a new asphalt layer.

A tack coat is a thin layer of bituminous material sprayed onto an existing pavement surface before laying a new asphalt layer. It acts as a bonding agent between the existing surface and the new layer, prevents slippage between pavement layers, improves interlayer adhesion, and enhances the durability and service life of the pavement.

Material

The tack coat shall consist of cutback bitumen or bitumen emulsion complying with Clause 1302 of the "Standard Specifications for Road and Bridge Works" published by the Department of Roads (DoR), Government of Nepal. The source of materials shall be approved by the Engineer prior to use in the Works.

For tack coat applications, the binder shall be either:

- Cationic bitumen emulsion (RS-1) conforming to IS: 8887; or
- Suitable low-viscosity paving bitumen of VG-10 grade conforming to IS: 73.

The type, grade, and rate of application of the tack coat material shall be as directed by the Engineer based on site conditions and field trials.

The commonly used materials for tack coat are bituminous emulsions or cutback bitumen or hot bitumen materials includes:

1. **Bitumen Emulsion;** Cationic Rapid Setting (CRS) emulsions such as: CRS-1 and CRS-2 Used cold application.
2. **Cutback Bitumen** such as: MC-30 & MC-70 Used cold application.
3. **Hot Bitumen**; VG-10 / VG-30 as per 1302 "Standard Specifications for Road and Bridges"

However, the nominal rate of application of the tack coat shall be 0.5 kg per sq. m. If the tack coat is to be applied in more than one lane, allowance shall be made for overlapping of lanes by 150 mm. Tentative temperature for cold application shall be around 50^{o}-70 ^{o}C for emulsion and 50 ^{o}C-80 ^{o}C for cutback and for hot bitumen (VG-10): between 150°C and 175°C, measured at the spray bar, to achieve proper atomization and adhesion. *Temperature ranges shall be approved by the Engineer prior to application*

2.6.2 Construction requirements

(1) Equipment.

Furnish an asphalt distributor with the following:

(a) Heater for uniformly heating the asphalt;

(b) Full circulation spray bar adjustable to 15-foot (4.5-meter) width;

(c) Positive controls including tachometer, pressure gauge, volume measuring device, or calibrated tank to uniformly deposit asphalt over the full width within 0.02 gallons per square yard (0.09 liters per square meter) of the required rate; and

(d) Thermometer for measuring asphalt temperature in the tank.

(2) Surface Preparation. Clean the existing surface of loose material, dirt, or other deleterious material by approved methods. When the surface is concrete, remove excess joint and crack filler.

(3) Weather Limitations. Apply asphalt tack only when the following apply:

(a) Surface is dry and unfrozen;

(b) Ambient air temperature is above 35 °F (2 °C) and rising; and

(c) Weather is not foggy or rainy.

(4) Asphalt Application. When using slow-setting emulsified asphalt, dilute by adding an equal quantity of water to the emulsified asphalt.

Apply the asphalt tack coat at a rate of 0.03 to 0.15 gallons per square yard (0.15 to 0.70 liters per square meter).

Calibrate asphalt distributors before the start of project and when directed by the Engineer. Calibrate the spray bar height, check nozzle angle, and verify longitudinal and transverse application rates according to ASTM D2995.

At the end of each day's production, provide the Engineer with documentation of calibrations and application rates.

Apply the asphalt tack coat uniformly and completely by fogging with a hand spray attachment or by another approved method when application with a distributor spray bar is not practical.

Squeegee the excess asphalt from the surface. Allow the tacked surfaces to completely cure before placing the covering course. Place the covering course within 4 hours of placing the asphalt tack coat.

2.6.3 Measurement and Payment

The basic tack coat shall be measured in square meters in the accepted work sprayed at the specified rate as instructed by the Engineer on Site. Cutter and required blinding material shall not be measured separately and shall be deemed included along with other associated costs shall be included in the item rate of tack coat. The measured quantity shall be the area instructed and accepted by the Engineer.

The contract unit rates for tack coat shall be payment in full for carrying out the required operations including full compensation for:

a. Providing all materials for all preparation, delivering and application and
b. Providing all labour, tools, equipment, and incidentals necessary to complete the work. No separate payment will be made for supply and spreading of blinding material.

2.7 GENERAL REQUIREMENTS FOR ASPHALT CONCRETE

2.7.1 Scope

This Clause comprises all the general requirements for bituminous mixes which shall apply to Clause 2.7.

2.7.2 Construction Plant

2.7.2.1 General

The Contractor shall submit to the Engineer full details of the construction plant he proposes to use and the procedures he proposes to adopt for carrying out the permanent works.

The Engineer shall have access at all times to construction plant for the purpose of inspection. The Contractor shall carry out regular calibration checks in the presence of the Engineer and shall correct forthwith any faults found.

All construction plant used in the mixing, laying and compacting of bituminous mixes shall be of adequate capacity, in good working condition and shall be acceptable to the Engineer.

2.7.2.2 Mixing Plant

Bituminous materials shall be mixed in a plant complying with ASTM Designation D995. It shall be equipped with at least three bins for the storage of heated aggregates and a separate bin for filler. All bins shall be covered to prevent the ingress of moisture.

The plant may be either batch-mix type or the continuous-mix type and shall be capable or regulating the composition of the mixture to within the tolerances specified in Sub-clause 2.6.13.

The bitumen tank shall be capable of maintaining its contents at the specified temperature within a tolerance of plus or minus 5o C and shall be equipped with a thermostat to prevent the temperature rising above 180o C and a fixed thermometer easily read from outside the tank. Any bitumen which has been heated above

180o C or has suffered carbonization from prolonged heating shall be removed from the plant and disposed off.

2.7.2.3 Laying Plant

Bituminous materials shall be laid by a self-propelled spreader finisher equipped with a hopper, delivery augers and a heated adjustable vibrating screed. It shall be capable of laying bituminous materials with no segregation, dragging, burning or other defects and within the specified level and surface regularity tolerances. Delivery augers shall terminate not more than 200 mm from the edge plates.

2.7.2.4 Compaction Plant

The Contractor shall provide sufficient rollers of adequate size and weight to achieve the specified compaction. Prior to commencing the laying of bituminous mixes in the permanent works the Contractor shall carry out site trials in accordance with Section 500 “Standard Specifications for Road and Bridges” published by Department of Roads, GoN to demonstrate the adequacy of his plant and to determine the optimum method of use and sequence of operation of the rollers.

2.7.3 Preparation of Surface

Immediately before placing the bituminous mix in the pavement, the existing surface shall be cleaned of all loose materials and foreign matter with mechanical brooms or by other approved methods. The debris shall be deposited well clear of the surface to be covered.

Any defect of the surface shall be made good, and no bituminous mix shall be laid until the surface has been approved by the Engineer.

2.7.4 Design and Working Mixes

The Contractor shall demonstrate that he can produce aggregate meeting the grading requirements of the Specification.

At least two months prior to commencing work using a bituminous mix, the Contractor shall be having demonstrated that he can produce aggregates meeting the grading requirements of the Specification, submit samples of each constituent of the mix to the Engineer.

The Contractor shall then carry out laboratory tests in order to propose the proportions of each consistent of the initial mix or mixes to be used for site trials to be carried out in accordance with Sub-clause 2.6.5.

Shall the Engineer conclude form the site trials that the mix proportions or aggregate grading are to be changed, the Contractor shall submit further samples of the constituents, carry out further laboratory and site trials as directed by the Engineer.

The Engineer may instruct the alteration of the composition of the aggregate passing through 0.075 mm by the addition or substitution of mineral filler.

Following laboratory and site trials the determined proportions of the mix agreed by the Engineer shall become the basis of the working mix and the Contractor shall maintain this composition within the tolerances given in Sub-clause 2.6.13.

Any changes in the nature or source of the materials, the Contractor shall inform the Engineer accordingly. The procedure set out above shall be followed in establishing the new mix design also.

2.7.5 Site Trials

Full scale laying and compacting site trials shall be carried out by the Contractor on all asphalt pavement materials proposed for the works using the construction plant and methods proposed by the Contractor for construction the works. The trials shall be carried out at a location approved by the Engineer in his presence.

The trials shall be carried out to enable the Contractor to demonstrate the suitability of his mixing and compaction equipment to provide and compact the materials to the specified voids content and confirm that the other specified requirements of he completed asphalt pavement layer can be achieved.

The trials area shall be at least 100 meters long to the full construction width and depth for the material. It may form part of the Works provided it complies with this Specification. Any areas which do not comply with this Specification shall be removed.

The Contractor shall allow in his programme for conducting site trials and for carrying out the appropriate tests on them. The trial on any pavement layer shall be undertaken at least 28 days ahead of the Contractor proposing to commence the full-scale work on that layer.

The Contractor shall compact each section of trial over the range of comp active effort the Contractor is proposing. The following data shall be recorded for each level of comp active effort at each site trial.

a. The composition and grading of the material including the bitumen content and type and grade of bitumen used.
b. The moisture content of aggregate in the asphalt plant hot bins.
c. The temperature of bitumen and aggregate immediately prior to entering the mixer, the temperatures of the mix on discharge from the mixer and the temperature of the mix on commencement of laying, on commencement of compaction and on completion of compaction. The temperatures of the mixture are too measured in accordance with BS 598, Part 109.
d. The type, size, mass, width of roll, number of wheels, wheel load, tyre pressures, frequency of vibration and the number of passes of the compaction equipment, as appropriate for the type of roller.
e. The target voids and other target properties of the mix together with the results of the laboratory tests on the mix.
f. The density and voids achieved.
g. The compacted thickness of the layer.
h. Any other relevant information as directed by the Engineer.

The above data recorded in the trial shall become the agreed basis on which the particular material shall be provided and processed to achieve the specified requirements.

During the execution of the works, if the Construction control/process control tests indicate that the requirements for a material are not consistently achieved then work on that layer shall be stopped until the cause is investigated by the Contractor. Such investigation may include further laboratory and/or site trials on the material to determine a revised set of data as described above which when agreed, shall be the basis on which all subsequent material shall be provided and processed to achieve the specified requirements.

Agreement of the Engineer to a set of data recorded in a site trial shall not relieve the Contractor of any responsibility to comply with the requirements of this Specification.

2.7.6 Mixing of Aggregate and Bitumen

The bitumen shall be heated so that it can be distributed uniformly. Care shall be taken not to overheat it. The temperature shall never exceed 170^{o}C for 80/100 or 60/70 bitumen.

The aggregate shall be dried and heated so that they are mixed at the following temperatures unless otherwise specified in relevant clauses.

125- 165^{o}C when 80/100 bitumen is used,

The dried aggregates shall be combined in the mixer in the amount of each fraction of the agreed mix and the bitumen shall then be introduced into the mixer in the amount specified. The materials shall then be mixed until a complete and uniform coating of the aggregate is obtained.

The mixing time shall be the shortest required to obtain a uniform mix and thorough coating. The wet mixing time shall be determined by the Contractor and agreed by the Engineer for each plant and for each type of aggregate used. It shall normally not exceed 60 seconds.

2.7.7 Transportation of the Mixture

The bituminous mix shall be kept free of contamination and segregation during transportation. Each load shall be covered with canvas or similar covering to protect it from dust and adverse effect of the weather.

2.7.8 Laying of the Mixture

Immediately after the surface has been prepared and approved, the mixture shall be spread to line and level by the laying plant without segregation and dragging.

The mixture shall be place in widths of one traffic lane at a time, unless otherwise agreed by the Engineer. Only on area where irregularities or unavoidable obstacles make the use of mechanical laying impracticable, the mixture may be spread and compacted by hand.

2.7.9 Compaction

Immediately after the bituminous mixture has been spread, it shall be thoroughly and uniformly compacted by rolling.

The layer shall be rolled when the mixture is in such a condition that rolling does not cause undue displacement or shoving.

The number, weight and type of rollers furnished shall be sufficient to obtain required compaction while the mixture is in a workable condition. The sequence of rolling operations shall be as agreed with the Engineer.

Rolling shall normally commence from the outer edge and proceed longitudinally parallel to the centerline, each trip overlapping one half of the roller width. On superelevated curves, rolling shall begin at the low side and progress to the high side. Where laying is carried out in lanes care must be taken to prevent water entrapment.

Rolling with a pneumatic tyre or vibratory roller shall follow immediately. Final rolling with a steel wheeled roller shall be used to eliminate marks from previous rolling.

To prevent adhesion of the mixture to the rollers, the wheels shall be kept lightly moistened with water.

In areas too small for the roller, a vibrating rate plate compactor or a hand tamper shall be used to achieve the specified compaction.

2.7.10 Finishing, Joint and Edges

Any mixture that becomes loose and broken, mixed with dirt or foreign matter or is in any way defective, shall be replaced with fresh hot mixture, which shall be compacted to conform to the surrounding area.

Spreading of the mixture shall be as continuous as possible. Transverse joints shall be formed by cutting neatly in a straight line across the previous run to expose the full depth of the course. The vertical face so formed shall be painted lightly with hot 80/100 penetration grade bitumen just before the additional mixture is placed against it.

Longitudinal joints shall be rolled directly behind the paving operation. The first lane shall be placed true to line and level an approximately vertical face. The mixture placed in the abutting lane shall than be tightly crowded against the face of the previously placed lane. The paver shall be positioned to spread material overlapping the joint face by 20 – 30 mm. Before rolling, the excess mixture shall be raked off and discarded.

When the abutting lane is not placed in the same day, or the joint is destroyed by traffic, the edge of the lane shall be cut back as necessary, trimmed to line and painted lightly with hot 80/100 penetration grade bitumen just before the abutting lane is placed.

Any fresh mixture spread accidentally on the existing work at a joint shall be carefully removed by brooming it back on to uncompacted work, so as to avoid formation of irregularities at the joint. The finish at joints shall comply with the surface requirements and shall present the same uniformity of finish, texture and density as other sections of the work.

The edges of the course shall be rolled concurrently with or immediately after the longitudinal joint. In rolling the edges, roller wheels shall extend 50 to 100 mm beyond the edge.

2.7.11 Sampling of Bituminous Mixtures

The sampling of bituminous mixture shall be carried out in accordance with ASTM Designation D979.

2.7.12 Quality of Testing

During mixing and laying of bituminous mixtures, control tests on the constituents and on the mixed material shall be carried out in accordance with Section 600 “Standard Specifications for Road and Bridges” published by Department of Roads, GoN and relevant Clauses.

If the results of any tests show that any of the constituent materials fail to comply with this Specification, the Contractor shall carry out whatever changes may be necessary to the materials and/or to the source of supply to ensure compliance.

If the results of more than one test in ten on the mixed material show that the material fails to comply with this Specification, laying shall forthwith cease until the reason for the failure has been found and corrected. The Contractor shall replace any faulty material laid with material complying with this Specification all at his expense.

2.7.13 Tolerance

The tolerance shall be as per relevant international codes and standards.

2.7.14 Measurement and Payment

No separate measurement and payment shall be made for complying with the requirements of the Clause 2.6. The Contractor shall allow compensation for compliance of the Clause 4.6 in the rates of items covered by Clauses 2.7.

2.8 ASPHALT CONCRETE

2.8.1 Scope

This Clause covers the materials, method of construction and requirements for the construction of Asphalt Concrete.

2.8.2 Definition

Asphalt Concrete means a thoroughly controlled, hot-mixed, hot-laid, plant mixture of well graded dried aggregate and penetration grade bitumen, which compacted, forms a dense material.

2.8.3 Materials

2.8.3.1 Penetration Grade Bitumen

Bitumen shall be 80/100 penetration grade as specified in Section 600"Standard Specifications for Road and Bridges" published by Department of Roads, GoN.

2.8.3.2 Aggregate

Coarse aggregate (retained on a 4.75 mm sieve) shall consist of crushed stone free form clay, silt, organic matter and other deleterious substances. The coarse aggregate shall comply with the requirements given in the Table below.

Table 20: Requirement of Coarse Aggregate

Coarse Aggregate (retained on 4.75 mm Sieve)	
LAA	Max. 35
ACV	Max. 25
SSS	Max. 12
FI	Max. 25

The coarse aggregate shall be entirely crushed. The aggregates shall be clean, free from weathered or decomposed stone, organic matter, shale, clay and other substances which, in the opinion of the Engineer may be deleterious to the mixture.

Fine aggregate (passing a 4.75 mm sieve) shall be free from clay, silt organic and other deleterious matter and shall be non-plastic. It shall consist of entirely crushed rock produced from stone having a Los Angeles Abrasion of not more than 30. The Sand Equivalent of the fine aggregate shall be not less than 60, and the SSS not more than 12.

2.8.3.3 Mineral Filler

Mineral filler shall consist of finely ground particles of limestone, hydrated lime, ordinary Portland cement or other non-plastic mineral mater. It shall be thoroughly dry and free from lumps. At least 75% (by weight) shall pass a 0.075 mm sieve and 100% shall pass a 0.425 mm sieve. It shall have a bulk density between 0.5 and 0.9 g/ml measured in accordance with BS 812-2.

2.8.4 Grading Requirements

The grading of the mixture of coarse and fine aggregate shall be within and approximately parallel to one of the grading envelopes given in Table below or as specified in the Special Specification or in the Bill of Quantities.

Table 21: Grading Requirements of the Mixture of Coarse and Fine Aggregate

Sieve Size (mm)	Percentage passing by weight		
	Wearing course		Binder course
	Type I ((0/16)	Type II (0/10)	0/20
20.000	-	-	100
16.000	100	-	96-100
10.000	76-82	100	75-100
4.750	54-59	64-70	48-90
2.360	33-37	39-47	24-62
0.600	16-21	21-28	12-24
0.075	6-9	6-9	3-8

2.8.5 Requirement for Asphalt Concrete

Asphalt concrete i.e. the mixture of binder, coarse and fine aggregate and mineral filler, if any, shall comply with the requirements given in the Table below.

Table 22: Requirements of Asphalt Concrete

Description	value
Marshall Stability 50 blows (N)	Min 8000
Flow Value (mm)	2-3
Voids in Total Mix (%) Compression/Immersion Ratio	2-5 >0.75

The Contractor shall carry out such tests of mix composition and submit to the Engineer for the approval.

2.8.6 Mixing and Laying of Asphalt Concrete

The Temperature of the bitumen when mixed with the aggregate shall be between 120^{o}C and 140^{o}C.

The minimum temperature of the mixture at the commencement of compaction shall be 125^{o}C. The minimum temperature at completion of compaction shall be 80^{o}C.

2.8.7 Compaction

Rolling shall be continued until the voids measured in the completed layer are within the appropriate ranges tabulated in the Table 22. Rolling shall be carried out by a sequence of roller in such a manner that it shall ensure the full specified compaction and at the same time it will provide a finished surface within the tolerance laid down in this Specification.

The average density after compaction shall not be less than 98% of the average density obtained from Marshall Specimens (50 blows) made during laboratory trials on the mixture used for site trials. No individual density shall be below 95% of the average of the laboratory specimens.

2.8.8 Testing

2.8.8.1 Sampling

Prior to use the Contractor shall supply the Engineer with samples of all materials proposed to be used. The Contractor shall carry out all the specified tests as the Engineer may require to satisfy himself that the material and proportions satisfy this Specification. No material shall be used, nor job mix adopted until they are approved in writing by the Engineer.

Sampling of mixes shall normally be carried out at the mixing plant or from tipper/truck conveying the material from the mixing plant to the paver, but the Engineer may direct for sampling to be carried out form the paver, if there is any danger of segregation of the mix during transporting and spreading process.

2.8.8.2 Process Control

The minimum testing frequency required for the process control shall be as provided in the Table below.

Table 23: Minimum Testing Frequency Asphalt Concrete

Test	Minimum number of tests
AGGREGATE:	
Grading	One test every 100 m3 or part of it and in every change of source
Los Angeles	One test every 500 m3 or part of it and in every change of source
Aggregate Impact Value	One test every 500 m3 or part of it and in every change of source
Flakiness Index	One test every 100 m3 or part of it and in every change of source
SSS	One test every 500 m3 or part of it and in every change of source
Sand Equivalent	One test every 500 m3 or part of it and in every change of source ““50 MT
Quality of Filler	
BITUMEN:	The Contractor shall produce certificates from the concerned all suppliers to the effect that all material supplied by them comply with the relevant Specifications.
Quality of Binder	In addition, one set of tests for each 50,000 liters or part of it of supply of binder
Penetration Test	Daily One test for each 100 MT of mix or part of it. One test for each 100 MT of mix or part of it.
MIXTURE:	
Grading and bitumen content Marshall stability, flow and voids	As required
Control of Temperature	One test per 500 m2 or part of it Every 10 m or at close intervals Every 50 m2 or at close intervals.

2.8.9 Measurement and Payment

Asphalt concrete shall be measured in cubic meter calculated as the product of the length and the compacted cross-sectional area of the asphalt concrete laid as per Drawing or as instructed by the Engineer.

The asphalt concrete shall be paid as per contract unit rate which shall be the full and the final compensation for the cost of compliance of all requirements specified in Clause 2.6 and 2.7.

2.9 SURFACE DRESSING

2.9.1 Scope and Definitions

This clause covers the application of one or more coats of surface dressing, each coat consisting of a layer of bituminous binder sprayed on a based prepared previously, followed by a cover of stone chipping properly rolled to form a wearing course to the requirements of these Specifications.

A single surface dressing means an application of bituminous binder to the road surface followed immediately by a single layer of uniform sized chippings.

A multiple surface dressing means two or more surface dressing placed one on the other.

2.9.2 Materials

2.9.2.1 Binder

The binder shall be a penetration grade 80/100 bitumen.

2.9.2.2 Chippings

(i) Hardness, Soundness, Shape and Cleanliness

The chippings shall consist of crushed stone or natural screened gravel, apparently cubical in shape and free from visible stone dust and harmful material such as clay, salt, organic matter or other deleterious substances. The percentage passing the 0.075 sieve shall not exceed 0.5% by weight.

The chipping shall comply with the requirements specified in Table 24, for the appropriate class as specified in the Special Specification or in the Bill of Quantities.

Table 24: Physical Requirements of Chippings

Chipping	*HP	A	B	C1	C2
LAA max.	20	25	30	35	35
AIV max.	20	20	20	20	20
SSS max.	12	12	12	12	12
CR max.	100	100	100	80	-
FI max.	20	20	20	25	-
Degradability	<5	<5	<5	<5	<5

Notes

* Means high performance aggregate.

The minimum size of the stone to be crushed to produce the chipping shall be at least 4 times the maximum size of the chippings.

(ii) Grading

The grading requirements of chipping shall be as specified in the Table below.

Table 25: Grading Requirements of Chippings

Sieve Size (mm)	Percentage passing by weight			
	Nominal Sizes			
	14/20	10/14	6/10	4/6
25.00	-	-	-	-
20.00	85-100	100	-	-
14.00	0-20	80-100	100	-
10.00	0-3	0-15	80-100	100
6.30	-	0-3	0-15	85-100
4.75	-	-	0-10	-
2.80	-	-	0-2	0-10
1.18	0-2	0-2	-	-
0.60	-	-	-	0-2
0.075	0-0.5	0-0.5	0-0.5	0-0.5

The Engineer shall reject the chipping not conforming to be the above requirements.

2.9.2.3 Rate of Application of Binder

The rate of spray of binder and the size and rate of spread of chippings shall be as specified in the Special Specification, BOQ or as instructed by the Engineer.

Ray tests shall be carried out at least twice per run during surface dressing operations to check spray and spread rates calculated from spray truck chippings and chip-spreader coverage, and more frequently when a number of short lengths are being surface dressed. Spray truck dipping and chip- spreader coverage shall be checked for each length sprayed.

2.9.2.4 Crushing, Screening, Washing and Stockpiling Chippings.

The construction plant provides and the methods of operating it, shall be such as to produce chippings which shall meet the specified requirements of Sub- clause 1303 (2) (b) of Standard Specification for Roads & Bridges, 2001, published by the Department of Roads, Nepal. This may require washing the chippings to meet the cleanliness requirements.

The Contractor shall comply with Section 800 when chipping are stockpiled. If required, the stockpiles area shall be surfaced with 100 mm thickness of gravel or other material, acceptable to the Engineer. Any contaminated chippings shall not be used in the Works. After use the stockpile area shall be cleared, top soiled and left neat and tidy.

2.9.3 Construction Plant for Pavement Works

2.9.3.1 Bitumen Distributors

Bitumen distributors shall be truck mounted and shall have sufficient power to maintain uniform speeds for the proper application of the binder. The truck shall be equipped with an accurate tachometer showing the driver the speed in meters per minute. The truck shall be fitted with a gauge bar and chain or any other acceptable device clearly visible to the driver to enable him to follow the required edge. The distributor tank shall have a capacity of at least 4,000 liters and shall be fitted with a device for indicating the quantity in the tank at any time. It shall be equipped with heaters capable of maintaining temperatures up to 200o C and be fitted with an accurate thermometer.

The circulation system shall permit pumping around the tank and around the spray bar without actually spraying. Spray bars shall be available for spraying in widths varying from 0.5 m to 4 m and shall be adjustable transversely so that the operator can follow the required edge independently. The spray nozzles shall be arranged to give a uniform spray and the shut-off shall be quick-acting with an anti-drip device. The pressure in the spray bar shall be sufficient to give a good distribution and spraying of the binder.

Distributors shall be capable of applying bituminous binder within the limits of ± 5% of the specified rate of application over any portion of the surface.

Distributors shall be checked and calibrated before starting any work or when required by the Engineer. This shall include the calibration of all the metering devices and checking the uniformity of the transverse distribution of spray. All distributors shall be furnished with a “rate of spray/machine speed” chard.

2.9.3.2 Chip-spreaders

Mechanical chip-spreaders shall be capable of spreading the chippings uniformly over variable widths, from 0.5 to 3.5 m, at the rates specified.

The number and output of chip-spreaders shall be sufficient to ensure that chipping are spread immediately after the bituminous binder has been applied.

Chip-spreaders shall be checked and calibrated before starting any work or when required by the Engineer.

2.9.3.3 Rollers

The main rolling shall be carried out with self-propelled pneumatic tyred rollers, having a wheel-load of more than 2 tones. The tyres shall be smooth, and their pressure shall be more than 0.4 N/mm^2.

Where approved by the Engineer steel-wheeled rollers shall be used in tandem with pneumatic tyred rollers after all excess chippings have been removed and insufficiently chipped areas have been chipped over. Only steel-wheeled rollers weighing less than 8 tones (total weight) shall be accepted.

The number and output of rollers shall be sufficient to ensure that rolling does not lag behind spreading. To the extent possible, two pneumatic tyred rollers shall be used for each chip-spreader.

2.9.3.4 Miscellaneous Equipment

Sufficient trucks and loading machinery shall be employed to ensure an adequate, prompt and continuous supply of chippings.

Rubber tyre mechanical rotary brooms towed by or mounted on rubber tyre vehicles shall be provided. Tractor toed air compressor with sufficient length of hose pipes and air jet nozzle shall be provided to ensure sufficient cleaning of surface to be sprayed with bituminous layers.

2.9.4 Preparation of Surface

Immediately before spraying, all loose material and foreign matter shall be removed by thorough brushing with mechanical brooms and/or washing or by use of compressors or by other methods acceptable to the Engineer. All hardened mud or other foreign matter shall be loosened by scraping before sweeping. The debris shall be deposited well clear of the surface to be sprayed. Road furniture (manholes covers etc.) shall be covered with adhesive paper or similar materials. Kerb stones, roadside, and any other objects what shall not benefit from binder spray shall be protected in a manner approved by the Engineer.

Any defect of the surface shall be made good as instructed by the Engineer and no binder shall be sprayed until the surface has been approved by the Engineer. The Engineer's approval or otherwise of the surface shall be given immediately prior to the Contractor's intention to start spraying.

2.9.5 Application of Surface Dressing

Soon after the surface has been prepared and approved, the quantity of binder, chippings, requirement of equipment and other resources shall be worked out so that any operation is not delayed due to lack of required material or resources.

The binder shall be uniformly sprayed at the specified rate. Spraying of the binder shall be in accordance with the requirements specified in Sub-Clause 2.4.4 of his specifications. Spraying shall not be carried out later than 12 hours after the surface has been prepared.

Building paper of sufficient width (not less than 600 mm) or other approved protective material shall be used at the start and finish of each spray run to enable the distributor to reach its calibrated road speed. Each spray jet shall be kept open before discharging binder onto the pavement under treatment.

Ends of previous surface treatment run shall be trimmed back to make the traverse edge straight and to clean it. This shall form the start point of the subsequent spray run. The spray run shall be limited to 300 m of length unless the Contractor demonstrates his ability to plan and execute longer length without impairing quantity of work. Spray width shall be calculated allowing for 150 mm longitudinal overlap with adjoining spray passes and for the width that the following chipping spreader is able to cover. Longitudinal sprayed butt joint shall not be permitted. The Contractor shall submit his spray width and length proposals to the Engineer for approval.

The spraying width shall normally be of one lane width so that construction traffic may run over the other lane.

Immediately after the binder has been sprayed, clean and dry chippings shall be uniformly applied at the specified rate by the use of mechanical chip- spreaders. The elapsed time between the spraying of binder spreading of chippings shall in no case exceed one minute.

Shall it become apparent that the supply of chipping is about to fail, the binder spraying shall be immediately stopped and shall not resume until an adequate supply of chipping is assured.

The correct rate of spread is generally assessed visually, as providing complete coverage, with the film of binder still visible between the chippings. Shall the coverage appear to be incorrect, the Contractor shall immediately inform the Engineer, who shall amend the rate of spread accordingly. Any excess of chipping shall be removed by hand and any insufficiently chipped area shall be chipped over by hand, so that adequate coverage is obtained. Brooming of the material to effect redistribution of chippings shall not be permitted.

Rolling shall begin immediately after the chippings have spread and, in no case, later than two minutes after the application of binder.

Rolling shall continue until all chippings are firmly embedded into the binder and until all excess chipping have been removed or insufficiently chipped areas have been chipped over. The number of passes shall be agreed with the Engineer. Usually, each point shall receive at least 6 passes of the pneumatic tyre roller.

Excessive rolling, resulting in the crushing of chipping, shall be avoided. The roller speed shall not exceed

8 km/h, unless otherwise directed by the Engineer. Additional rolling on a previously completed section shall be given later in the heat of the day by pneumatic tyre rollers in tandem with steel three wheeled rollers unless otherwise instructed by the Engineer.

2.9.6 Aftercare and Control of Traffic

The road shall not be opened to traffic until the binder has attained sufficient viscosity to prevent the stones being whipped off.

The Contractor shall erect temporary traffic restriction signs, barriers and removable bumps or any other device, as instructed by the Engineer, to prevent vehicles traveling too fast over the newly laid surface dressing. Vehicle speed shall be restricted to a maximum of 30 km/h, until there is sufficient adhesion to ensure that the chippings shall not be dislodged by faster vehicles.

Where possible, the traffic shall be distributed across the road so as to obtain uniform polishing of the road surface.

After traffic has been permitted to run on the surface dressing for a period of at least two weeks and when instructed by the Engineer, all loose chippings shall be swept and taken away. Windrows of loose chipping shall not be allowed to accumulate at the sides of the road.

2.9.7 Rectification of Defects

If any defect in surface dressing work is found, the reasons of the defect shall be established and keeping them in view the defect shall be rectified as per direction of the Engineer. It required; the Engineer shall ask the contractor for redoing the defective portion.

The Contractor shall rectify or redo the defective work at his own expense.

2.9.8 Tolerance

The final average overall width of the surface dressing measured at six equidistant points over a length of 100 m shall be at least equal to the width specified or instructed. Al no point shall the distance between the center line of the road and the edge of the surface dressing be narrower than that instructed by more than 13 mm.

The actual rate of application of binder across the lane width shall not by more than ± 5% of the rate ordered and for each single run of the spray it shall not vary from the specified rate by more than 0.03 lit per square meter.

The actual rate of application of chipping along and across the lane width for each single run of the chip-spreader shall not vary by more than ± 5% of the rate ordered.

2.9.9 Testing

2.9.9.1 Process Control

The minimum testing frequency required for the process control shall be as given in the Table below.

Table 26: Minimum Testing Frequency of Chippings

Test	Minimum number of tests
MATERIALS:	
i. AGGREGATE:	
Grading	One test every 50 m3 or part of it and in every change of source
Flakiness Index (FI)	One test every 50 m3 or part of it and in every change of source
Los Angeles (LAA)	One test every 250 m3 or part of it and in every change of source
Aggregate Impact Value (AIV)	One test every 250 m3 or part of it and in every change of source
Crushing Ratio (CR)	One test every 250 m3 or part of it and in every change of source
Degradability Test	One test every 500 m3 or part of it and in every change of source
Sodium Sulphate Soundness	One test every 500 m3 or part of it and in every change of source
Stripping Value	Initially one set of 3 specimens for each source of supply subsequently when warranted by change in the quality of Aggregates
Rate of Application	Two tests per run
ii. BITUMINOUS BINDERS:	
Quality of Binder	The Contractor shall produce certificates from the concerned all suppliers to the effect that all material supplied by them comply with the relevant Specifications. In addition, one set of tests for each 50,000 liters or part of it of supply
Binder Temperature for Application	At close intervals
Rate of Application of Binder	Two tests per run
ii. CONSTRUCTIONTOLERANCES	
Width	One test each and every spray run
Smoothness	All apparently rough areas to be checked.

2.9.9.2 Routine Inspection and Testing

Routine inspection and testing shall be carried out to test the materials and workmanship for compliance with the requirements specified in this Section.

Any materials or workmanship not complying with the requirements specified, shall be replaced or redone with the materials or workmanship complying with the Specifications or, be repaired so as to comply with the requirements specified.

2.9.10 Measurement

Binding material (emulsion/bitumen and cutter) shall be measured separately in liter. For computation of the quantity the following methods shall be adopted.

(a) Design/instructed rate of application times specified area sprayed computed in liters corrected to 15.6o C.

(b) Actual rate of application measured through tray tests times specified area sprayed, computed in liters corrected to 15.6o C.

(c) Actual consumption in specified area sprayed measured in liters corrected to 15.6o C by dip stick feeding of the distribution.

The lowest value of the above three methods shall be adopted for payment. However, if the rate of actual spray of binder is much less or more than the designed/ instructed rate of spray so as to impair quality of surface dressing, the Engineer shall reject the work or shall ask for appropriate rectification which the contractor shall execute at his own cost.

Bitumen and cutter shall be computed on the basis of percentage actually used in the work.

Chipping of each nominal size shall be measured in cubic meter (cum). For computation of quantity the following methods shall be adopted.

(a) Design/instructed rate of application of chippings times specified area applied, computed in cum.

(b) Actual rate of application of chippings times' specified area of application computed in cum.

The lower of these two values shall be adopted for payment. However, rate of application shall not vary with designed/instructed rate of application to impair quality of surface dressing. In such event the Engineer shall reject the work or ask the Contractor to rectify at his own cost.

2.9.11 Payment

The binder and the cutter shall be paid as per their respective contract unit rate. The Contractor shall be the full and the final compensation for the cost of preparation of surface to receive binder, heating, mixing with cutter, spraying, rectification wherever required, compliance of all provisions specified in the respective Clauses of this specifications.

Chipping of each nominal size as specified shall be paid at their respective contract unit rate. The Contract unit rate shall be full and the final compensation for the cost of compliance of all provisions specified in the respective Clauses of this specifications.

2.10 COLD ASPHALT

2.10.1.1 Scope

This Clause covers the materials, method of construction and requirements for construction of Cold Asphalt for Surfacing Base, Leveling and Patching.

Cold Asphalt means a cold-mixed, cold-laid, plant mixture of graded aggregate and bituminous binder

2.10.1.2 Materials

(a) Bituminous Binder

For cold-asphalt to be used immediately, the bituminous binder shall be an anionic emulsion A2 or A3 or a Cationic emulsion K2 or K3.

For cold-asphalt to be stockpiled, the bituminous binder shall be a slow-setting emulsion A3 or K3.

(b) Aggregate

Coarse aggregate (retained on a 4.75 mm sieve) shall consist of crushed stone produced from rock or boulders. The minimum size of rocks or boulders to be crushed shall be at least 4 times the maximum size of the crushed aggregate. The coarse aggregate shall be free form clay, silt, organic matter and other deleterious substances. The aggregate shall comply with the requirements given in the below table:

Table 27: Aggregate Class Requirements

Aggregate Class	A	B
LAA Max. (Los Ángeles Abrasión)	25	30
ACV Max. (Aggregate Crushing Value)	20	20
SSS Max. (Sodium Sulphate Soundness)	12	12

FI Max (Flakiness Index)	20	25

The fine aggregate (passing 4.75 mm sieve) shall be free from clay, silt, organic and other deleterious matter. Unless otherwise specified, it shall consist of at least 90 percent entirely crushed sand produced form stone having a Los Angles Abrasion of not more than 30. The Sand Equivalent of the fine aggregate shall be not less than 60 and the SSS not more than 112

The mixture of aggregate shall be within and approximately parallel to the grading envelope specified below:

Sieve Size (mm)	Percentage passing by weight
14.000	100
10.000	90-100
4.750	54-70
2.360	35-49
1.180	25-38
0.425	16-25
0.075	6-9

(c) Mineral Filler

The mineral filler shall consist of finely ground particles of limestone, hydrated lime, Ordinary Portland cement or other non-plastic mineral matter as specified in the Special Specification. It shall be thoroughly dry and free form lumps. At least 75% (by weight) shall pass a 0.075 mm sieve and 100% shall pass a 0.425 mm sieve. It shall have a bulk density between 0.5 and 0.9 g/ml measured in accordance with BS 812-2.

2.10.2 Requirements for Cold Asphalt

The mixture shall comply with requirements given below:

Description	**Requirements**
Marshall Stability 50 blows (N)	7,000
Flow Value (mm)	<4
Voids in total Mix (%)	2-4
Compression/Immersion Ratio	0.75

The proportion, by weight of total mix, of bitumen shall be stated in the Bill B5. This shall be termed the nominal binder content. The binder content of the working/job mix shall be instructed by the Engineer following laboratory and site trials.

2.10.2.1 Mixing and Laying of Cold Asphalt

Cold asphalt generally shall be laid for surfacing, base, leveling and patching works.

The moisture content of the mixture shall be adjusted in the mixing plant to permit optimum compaction. The aggregate shall have a moisture content in the range 3% - 5% at the time the emulsion is added.

Cold asphalt shall be placed at ambient temperature and may be laid by grader, provided the Contractor can demonstrate in the site trials that the he can achieve the specified geometric tolerances with this method.

2.10.3 Compaction

Rolling shall be carried out by a sequence of roller in such a manner that it will ensure the full specified compaction and at the same time it will provide a finished surface within the tolerance laid down in this Specification.

The average density of the cold asphalt after compaction shall not be less than 98% of the average density obtained from Marshall Specimens (50 blows) made during laboratory trials on the mixture used for site trials. No individual density shall be below 95% of the average of the laboratory specimens.

2.10.4 Testing

(a) Sampling

Prior to use the Contractor shall supply the Engineer with samples of all materials proposed to be used. The Contractor shall carry out all the specified tests as the Engineer may require to satisfy himself that the material and proportions satisfy this Specification. No material shall be used, nor job mix adopted until they are approved in writing by the Engineer.

(b) Process Control

The minimum frequency of testing for process control shall be as given in the Table 4.8.9.1: Minimum Testing Frequency

(**c) Routine Inspection and Testing**

Routine inspection and testing shall be carried out by the Engineer to test the completed work for compliance with the dimensional tolerances, quality of material, density of compaction and any other requirements stated in this Specification. Any material and workmanship that do not comply with the requirements specified, shall be replaced by material and workmanship complying with their respective Specification.

2.10.5 Measurement and payment

The cold asphalt shall be paid as per contract unit rate which shall be the full and the final compensation for the cost of compliance of all requirements specified above.

2.11 OPEN-GRADED PREMIX SURFACING

2.11.1 Scope

This work shall consist of preparation, laying and compaction of an open-graded premix surfacing material of 20 mm thickness composed of small-sized aggregate premixed with bituminous binder on a previously prepared base, in accordance with the requirements of these Specifications to serve as a wearing course.

2.11.2 Materials

(a) Binder

The binder shall be. _ viscosity grade bitumen of a suitable grade as specified in the Contract, or as directed by the Engineer, and satisfying the requirements of IS: 73.

(b) Aggregates

The aggregates shall conform to specification with the water absorption shall be limited to a maximum of 1 percent. The Polished Stone Value, shall not be less than 55, when tested as per BS: 812-114.

(c) Proportioning of Material

The materials shall be proportioned in accordance with Table 29.

Table 28: Quantities of Materials Required for 10 m2 of Road Surface for 20 mm Thick Open-graded Premix Surfacing

Material		Quantity
Aggregates		
a	Nominal Stone size 13.2 mm (passing 22.4 mm sieve and retained on 11.2 mm sieve)	0.18 m^3

b	Nominal Stone size 11.2 mm (passing 13.2 mm sieve and retained on 5.6 mm sieve)	0.09 m^3
	Total	0.27 cum

Binder

a	For 0.18 m3 of 13.2 mm nominal size stone of 52 kg bitumen per m^3	9.5 kg
b	For 0.09 m3 of 11.2 mm nominal size stone of 56 kg bitumen per m^3	5.1 kg
	Total	14.6 kg

2.11.3 Construction Operations

(a) Weather and Seasonal Limitations

Clause 3.2 climatic condition shall apply.

(b) Preparation of Surface

The underlying surface on which the bituminous surfacing is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross-section to approval of Engineer. A prime coat where needed shall be applied as directed by the Engineer.

(c) Tack Coat

A tack coat complying with Clause 2.6, shall be applied over the base preparatory to laying of the surfacing or as directed by the Engineer.

(d) Preparation of Premix

Hot mix plant of appropriate capacity and type shall be used for the preparation of the mix material. The hot mix plant shall have separate dryer arrangement for heating aggregate.

The temperature of the binder and aggregate at the time of mixing, laying and compaction shall be in conformity with the temperature. The difference in temperature between the binder and aggregate shall at no time exceed14°C. Mixing shall be thorough to ensure that a homogeneous mix is obtained in which all particles of the aggregates are coated uniformly. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or hand barrows. The vehicles employed for transport shall be clean and the mix being transported covered in transit if so directed by the Engineer

(e) Spreading and Rolling

The pre mixed material shall be spread on a previously prepared base by a paver or as directed by the Engineer to the desired thickness, grades and cross fall (camber). The cross-fall shall be check by means of camber boards and irregularities levelled out. Excessive use of blades or rakes shall be avoiding. As soon as sufficient length of bituminous material has been laid, rolling shall commence with 8-10 ton rollers, smooth wheel tandem type or other approved equipment. Rolling shall begin at the edge and progress towards the centre longitudinally, except that on super elevated and uni-directional cambered portions, it shall progress from the lower to upper edge parallel to the centre line of the pavement. When the roller has passed over the whole area once, any high spots or depressions, which become apparent, shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled and c: ill the roller marks eliminated. In each pass of the roller the preceding track shall be overlapped uniformly by at least one third width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels. In no case shall fuel/lubricating oil be used for this purpose. Excess use of water for this purpose shall also be avoided. Rollers shall not stand on newly laid material. Rolling operations shall be completed in every respect before the temperature of the mix falls below the rolling temperature indicated in Table 29.

(f) Seal Coat

A seal coat conforming to specification of the type specified in the Contract shall be applied to the surface immediately after laying the surfacing.

2.11.4 Opening to Traffic

No traffic shall be allowed on the road until the seal coat has been laid. In the case of Type B seal coat, traffic may be allowed soon after final rolling when the premixed material has cooled down to the surrounding temperature. In the case of Type, a sealcoat, traffic shall not be permitted to run on any newly sealed area until the following day. In special circumstances, however, the Engineer may open the road to traffic immediately after rolling, but in such cases traffic shall be rigorously limited to 20km per hour until the following day.

2.11.5 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements or as approval of Engineer. For control of the quality of materials and the works carried out, the relevant provisions of quality control shall apply.

2.11.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made.

2.11.7 Measurement

Open graded premix surfacing shall be measured as finished work, for the area instructed to be covered, in square meters.

2.11.8 Payment

Open-graded premix surfacing shall be paid as per contract unit rate which shall be the full and final compensation for the cost of compliance of all requirements of Clauses 2.11 in addition to approval of Engineer.

2.12 ROADSIDE PCC DRAIN

2.12.1 Scope

This Clause covers the materials, method of construction and requirements for the construction of composite roadside PCC drain which includes necessary earthwork excavation, brick soling work, form work, M20 PCC work, cleaning, etc.

2.12.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

2.12.3 Components

Earthwork Excavation

The earthwork excavation shall be performed as stipulated in clause no. 3.2 Earthworks of this specifications.

Brick Soling work

Flat brick soling work shall be performed as specified in the clause no. 3.4 Brickworks of this specification.

Formwork

Formwork shall be constructed of plain steel sheet or waterproof plywood. Such plywood shuttering shall be of minimum 18 mm thickness. Formwork shall be so designed and constructed that concrete can be properly placed and thoroughly compacted.

Formwork shall be firmly supported and adequately strutted, braced, or tied. It shall be capable of adjustment to the lines and dimensions of the finished concrete, and it shall be sufficiently strong to resist, without distortion, the pressure of concrete during its placing and compaction, and other loads to which it may be subjected. It shall not be liable to suffer distortion under the influence of the weather.

When concrete is to be vibrated, special care shall be taken to ensure that the formwork will remain stable and the joints tight.

All joints in the formwork shall be close-fitting to prevent leakage of grout from the concrete. At construction joints formwork shall be tightly secured against previously cast or hardened concrete to prevent the formation of stepping or ridges in the concrete.

Formwork shall be constructed to provide straight and true angle, arises or edges. Where chamfers are shown on the Drawings, the billets shall be accurately cut to size to provide a smooth and continuous chamfer. Formwork panels shall have true edges to permit accurate alignment at sides and provide a clean line at construction joints in the concrete.

Concrete Work

Plain Cement Concrete (PCC) work and its associated works such as curing, etc shall be as specified in the clause no. 3.3 Cement Concrete of this specifications.

2.12.4 Measurement and Payment

The composite item Road Side PCC Drain shall be measured in linear meter as laid and accepted by the Engineer.

The composite item Road Side PCC Drain shall be paid as per contract unit rate which shall be the full and the final compensation for the cost of required earthwork excavation, flat brick soling, form work, PCC work, backfilling for the size and dimensions shown in the drawing including safe disposal of suitable and unsuitable material as instructed by the Engineer.

2.13 CATCH PIT

2.13.1 Scope

This Clause covers the materials, method of construction and requirements for the construction of composite item catch pit or roadside drain which includes necessary earthwork excavation, PCC/RCC, brick masonry work, form work, concrete work, cleaning, etc.

2.13.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

1. General
2. Site Clearance
3. PCC
4. Formwork
5. Brick Work
6. Plastering work

2.13.3 Components

2.13.3.1 Earthwork Excavation

The earthwork excavation shall be performed as per clause no. 1.2 Earthworks of this specification.

2.13.3.2 Brick work

Brick masonry work and flat brick soling work shall be performed as specified in the clause no. 1.4 Brickworks of this specifications.

2.13.3.3 Formwork

Formwork shall be constructed of plain steel sheet or waterproof plywood. Such plywood shuttering shall be of minimum 18 mm thickness. Formwork shall be so designed and constructed that concrete can be properly placed and thoroughly compacted.

Formwork shall be firmly supported and adequately strutted, braced, or tied. It shall be capable of adjustment to the lines and dimensions of the finished concrete, and it shall be sufficiently strong to resist, without distortion, the pressure of concrete during its placing and compaction, and other loads to which it may be subjected. It shall not be liable to suffer distortion under the influence of the weather.

When concrete is to be vibrated, special care shall be taken to ensure that the formwork will remain stable and the joints tight.

All joints in the formwork shall be close-fitting to prevent leakage of grout from the concrete. At construction joints formwork shall be tightly secured against previously cast or hardened concrete to prevent the formation of stepping or ridges in the concrete.

Formwork shall be constructed to provide straight and true angle, arises or edges. Where chamfers are shown on the Drawings, the billets shall be accurately cut to size to provide a smooth and continuous chamfer. Formwork panels shall have true edges to permit accurate alignment at sides and provide a clean line at construction joints in the concrete.

2.13.3.4 Concrete Work

Plain Cement Concrete (PCC) work shall be as specified in the clause no. 1.3 Cement Concrete of this specifications.

2.13.3.5 Plaster work

Cement sand mortar plaster work shall be as specified in the clause no. 1.6 Cement Plaster Works of this specifications.

2.13.3.6 MS Grating Cover

MS grating cover shall be fabricated from material as shown in the drawing and shall be anchored in the PCC top of the manhole/catch pit.

The MS angle and other associated items used in structural steelwork and in the fabrication of sundry items shall be in accordance with the requirements of the relevant applicable standards (e.g. BS 4, BS 4548, IS 808). Regardless of the standards used, the yield stress shall not exceed 450 MPa, the ratio of the tensile strength to the guaranteed yield strength shall be at least 1.2:1, and the elongation shall be at least 15%.

The reinforcement shall be as per clause no. 1.3.5.1. Reinforcement of this specifications.

All welding procedures shall be qualified to BS EN288, and the Contractor shall submit full details of the welding procedures and electrodes.

All metalwork shall, before and after fabrication, be within the tolerances and unless required to be formed to a particular shape, be flat, straight, and free from twist. Any necessary straightening or forming shall be

carried out by methods that neither weaken nor deface the material. Cutting may be done by sawing, shearing, cropping or machine flame cutting. Manual flame-cutting is permissible only when authorized.

Any punching through material thicker than 12 mm shall be done only with the prior approval. The diameter of the holes for bolts other than fitted bolts and friction-grip fasteners shall not exceed the diameter of the bolt by more than 2 mm in the case of fasteners of diameter up to 24 mm and 3 mm for larger diameters. For friction-grip fasteners, the holes shall generally be not more than 2 mm larger than the bolts, and for holes for fitted bolts, the allowable tolerance shall be +0.15 mm.

Slotted holes shall be formed by drilling, punching a pair of holes and flame-cutting between the holes, or slot punching in the case of material of thickness not exceeding 12 mm. All burrs shall be removed form holes before assembly.

For joints in compression, the abutting surfaces of a joint dependent on contact for the transmission of load shall so butt that the areas necessary to transmit the load are in full contact. A bearing face that is to be grouted direct to a foundation need not be machined but such a face shall be true and parallel to the upper face of the foundation.

Before erecting at the site the grating shall be painted with two coats of metal primer and after installation, the grating/mesh shall be painted with two coats of anticorrosive paint or enamel paint as approved by the Engineer.

2.13.3.7 Pipe connecting to the existing sewer line

The Contractor shall lay 160mm dia HDPE pipe (10 kg/cm2) from catch pit to the existing sewer/storm pipe line. The work shall include necessary earth work excavation, supply and laying & jointing of pipe including necessary fittings & bedding material, backfilling and compaction to the satisfaction of the Engineer.

2.13.4 Measurement and Payment

The composite item catch pit shall be measured in number as constructed and accepted by the Engineer. The composite item catch pit shall be paid as per contract unit rate which shall be the full and the final compensation for the cost of required earthwork excavation, flat brick soling, form work, PCC work, brick masonry work, plastering work, metal work with necessary paint, connecting HDPE pipe to the existing sewer/storm pipe line, backfilling for the size and dimensions shown in the drawing including safe disposal of suitable and unsuitable material as instructed by the Engineer.

2.14 REINSTATEMENT OF FLAGSTONE PAVED ROADS

2.14.1 Scope

The scope involves manual removal of flagstone in flagstone paved roads, for laying of pipes, pipe-fittings and other appurtenances, including repair and restoration of the road to original condition, to the satisfaction of the Engineer.

The existing flagstone (recovered) shall be re-used only with prior approval of the Engineer.

The restoration of the road to its pre-existing condition is anticipated to involve the reuse of 85% recovered flagstones, with the remaining 15% supplied as new replacements for damaged or broken materials. The Contractor is responsible for ensuring the works meets all specified requirements for quality and thickness.

2.14.2 Technical Requirements of Flagstone

When, new flagstones are used, these should be of specified thickness and of uniform colour free from cracks and other defects. Each of the four edges shall be trimmed to four straight lines with right angle to other edge unless otherwise stated. The size of the flagstone shall be of uniform in width of 45cm and the variable length not less than 30cm. Thickness of the Flagstone shall not be less than 50mm.

Sample of flagstone shall be produced before Engineer and the contractor shall procure only those stone slabs that clearly and definitely confirm with the approved sample. At any case, the procured slabs shall be

exhibited before being used. Thickness of the flagstone to be used shall be of the same thickness and of quality equal and or better then than one, which is being removed.

2.14.3 Laying

Laying of flag-stone shall be carried out by skilled personnel only, duly approved by the Authority.

Stone slab of specified thickness shall be laid on sand bed (75 mm) or 1:4 cement sand mortar as per the instruction by the Engineer depending upon the site conditions after preparation of bedding of brick soiling or 300 mm granular base bedding layer. The joints between the flag stones shall be kept as thin as possible and shall not exceed 6mm and all the joints are pointed with 1:1 Cement sand mortar after raking with the 1:4 cement sand mortar to the required depth unless specified otherwise by the Engineer.

Laying shall start from one side in the slope as indicated in drawing or instruction.

Under no circumstances shall the contractor insert small stone chips underneath the slab to raise its level to desired level. After the slabs of stone are laid, the mortar in the joints shall be raked to a depth of 12.5mm to 20mm and the joints flush pointed with 1:1 cement sand mortar. Special care shall be taken to protect the floor from walking over it before it is completely dry or in any event not earlier than 3 days.

2.14.4 Measurement and Rate

It shall be measured in square meters for the specified thickness and quality.

Payment shall be made at the unit rate established in the Bill of Quantities.

The unit rate shall be deemed to include all costs associated with the recovery, handling, and installation of stones, the supply of all new flagstones, and all other works necessary to complete the work in accordance with the Technical Specifications and to the satisfaction of the Engineer. The payment of bedding shall be paid from respective other relevant items.

No separate payment shall be made for the supply of new flagstones exceeding 15% of the total measured quantity; all such additional supply is deemed included in the quoted unit rate.

2.15 REINSTATEMENT OF CONCRETE BLOCK PAVEMENT

2.15.1 Scope

The scope involves manual removal of interlocking concrete blocks in pavement for laying of pipes, pipe-fittings and other appurtenances, including repair and restoration of the pavement to original condition, to the satisfaction of the Engineer and Employer.

The existing Concrete Block (recovered) shall be re-used only with prior approval of the Engineer.

The cement concrete interlocking tiles of approved shape size and color shall be provided in cement sand mortar. These shall be pre-cast concrete blocks of minimum grade M30. Cement sand mortar used for bedding and joint shall be in 1:4 ratios.

The restoration of the road to its pre-existing condition is anticipated to involve the reuse of 85% recovered Concrete Block, with the remaining 15% supplied as new replacements for damaged or broken materials. The Contractor is responsible for ensuring the works meets all specified requirements for quality and thickness.

2.15.2 Test and Standards of Acceptance

Concrete shall be tested in accordance with specification for concrete and shall meet the specified criteria. All tiles shall be laid true to the lines and levels shown on the Drawing or as instructed by the Engineer

2.15.3 Laying Requirements

The tiles shall be laid on either concrete or compacted sand-gravel as indicated in the Drawing.

Sand-gravel bedding, shall be of thickness 75mm.

In the case of cement sand base, it shall be 1-part cement; 4 parts sand and mixing shall be done as per specification for mortar mixing of brick masonry work laid to the dimensions, lines and levels shown in the Drawing and well compacted by ramming or other means.

Before laying the foundation of lean concrete, the base shall be leveled and slightly watered to make it damp. In the case of sand gravel, it shall consist of a material approved by the Engineer. The tiles shall then be laid out and bedded on 12 mm thick cement sand mortar of 1:4 ratios. The gaps between the block/slabs shall not be more than 12 mm and shall be filled with 1:4 cement sand mortar.

2.15.4 Measurement and Rate

It shall be measured in square meters for the specified thickness and quality.

Payment shall be made at the unit rate established in the Bill of Quantities.

The unit rate shall be deemed to include all costs associated with the recovery, handling, and installation of Concrete Block, the supply of all new Concrete Block, and all other works necessary to complete the work in accordance with the Technical Specifications and to the satisfaction of the Engineer.

No separate payment shall be made for the supply of new Concrete Block exceeding 15% of the total measured quantity; all such additional supply is deemed included in the quoted unit rate.

2.16 KERBS AND FOOTHPATH WORKS

Construction of kerbs and footpath should be as per section 1400 of standard specification of road and bridge published on 2073, second amendment 2078, Department of Roads, Nepal.

The existing Kerbs (recovered) shall be re-used only with prior approval of the Engineer.

The restoration of the Kerb and Footpath to its pre-existing condition is anticipated to involve the reuse of 85% recovered Kerb Stone, with the remaining 15% supplied as new replacements for damaged or broken materials. The Contractor is responsible for ensuring the works meets all specified requirements for quality and thickness.

2.16.1 Measurement and Rate

It shall be measured in running meters for the specified thickness and quality.

Payment shall be made at the unit rate established in the Bill of Quantities.

The unit rate shall be deemed to include all costs associated with the recovery, handling, and installation of Kerb Stone, the supply of all new Kerb Stone Block, and all other works necessary to complete the work in accordance with the Technical Specifications and to the satisfaction of the Engineer.

No separate payment shall be made for the supply of new Kerb Stone Block exceeding 15% of the total measured quantity; all such additional supply is deemed included in the quoted unit rate.

2.17 CUTTING AND REINSTATEMENT OF CONCRETE ROADS

2.17.1 Scope

The scope involves cutting of Concrete roads, for laying of pipe, pipeline appurtenances, construction of chambers etc including restoration, complete to the satisfaction of the Engineer.

2.17.2 Road Cutting

Dismantling of cement concrete pavement for laying of pipe, pipeline appurtenances shall be by mechanical means, cutting the peripheral edge by CC cutter, breaking to pieces not exceeding 0.02 cum in volume and stock piling at designated locations and disposal of the dismantled materials.

2.17.3 Concrete Laying

The Contractor shall submit to the Engineer full details of all materials which he purposes to use for making concrete. No concrete shall be placed in the works until the Engineer has approved the materials.

Concrete mixes shall be proportioned according to the Design mix or prescribed mix as specified. All mixing operations shall be supervising by experienced supervisor. Cement and aggregate shall be batched by weight or by volume as specified in the contract. Water may be measured by weight or volume. The quantity of cement, each size of aggregate and water as indicated by the mechanism employed shall be with in a tolerance of plus or minus three percent of the respective weight/ volume per batch agreed by the Engineer. The water to be added to the mix shall be reduced by the amount of free water contained in the coarse and fine aggregates. This amount shall be determined by the Contractor by a method agreed by the Engineer.

Concrete for the work s shall be batched and mixed in one or more plants or concrete mixer unless the Engineer agrees to some other arrangement. If concrete mixers are used, there shall be sufficient number of mixtures including stand by mixers.

The Concrete shall be deposited as nearly as possible in its final position. It shall be placed so as to avoid segregation of the concrete and displacement of the reinforcement.

Concrete shall be fully compacted throughout the full extent of the placed layer. It shall thoroughly work against the formwork and around any reinforcement and other embedded item, without displacing them.

A sufficient number of vibrators shall be operated to enable the entire quantity of concrete being placed to be vibrated for the necessary period and, in addition, stand-by vibrators.

Concrete shall be protected during the first stage of hardening from loss of moisture and from the development of temperatures differentials within the concrete sufficient to cause cracking. Concrete shall be cured with wet cotton mat, sheet material or other compound for curing approved by the Engineer. The methods used for curing shall not cause damage of any kind to the concrete.

Freshly placed concrete shall be protected from rainfall and from water running over the surface until it is sufficiently hard to resist damage from these causes. Concrete placed in the works shall not be subjected to any loading including traffic until it has attained at least its characteristic strength.

Records of the details of every pour of concrete placed in the works shall be kept by the Contractor in a form agreed by the Engineer. These records shall include class of concrete, location of pour, date and duration of pour, ambient temperature and concrete temperature at time of placing and all relevant meteorological information such as rain, wind etc., moisture contents of the aggregates, details of mixes batch numbers, cement batch number, results of all tests undertaken, part of the structure and place where test cube samples are taken from.

2.17.4 Reinforcement

Reinforcement as plain bars and deformed bars and steel fabric shall comply with the following Standards:

- NS: 191/ IS: 1786 for high strength deformed steel bars and wires.
- IS: 1566 for steel mesh fabric.
- NS: 84/ IS: 432 mild steel and medium tensile steel bars.

All reinforcement shall be from an approved manufacturer and, if required by the Engineer, the Contractor shall submit the ISI certification mark or other test certificate from the manufacturer acceptable to the Engineer. The sampling and frequency of testing shall be as set out in the NS: 84 and NS: 191.

Reinforcement shall be of Grade Fe-500D, as directed by the Engineer.

All reinforcement not complying with the Specification shall be removed from site.

2.17.5 Measurement and rate

Concrete quantity shall be measured in cubic meters. The thickness of the concrete shall be as per original concrete dismantled or as directed by the Engineer.

Quoted rate to include cost of all materials, labour, incidentals for dismantling, disposal of the spoils, arranging for concreting to complete the work to the satisfaction of the Engineer.

Reinforcement where laid, shall be paid as per the weight, as measured separately. The reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in works or as directed by the Engineer, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in ton on the basis of IS: 1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other method for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

2.18 REINSTATEMENT OF BRICK ON EDGE PAVEMENT

2.18.1 Scope

The scope involves manual removal of bricks in brick paved roads, for laying of pipes, pipe-fittings and other appurtenances, including repair and restoration of the road to original condition, to the satisfaction of the Engineer and Employer.

The existing Brick (recovered) shall be re-used only with prior approval of the Engineer.

The restoration of the Brick Pavement to its pre-existing condition is anticipated to involve the reuse of 30% recovered Brick, with the remaining 70% supplied as new replacements for damaged or broken materials. The Contractor is responsible for ensuring the works meets all specified requirements for quality and thickness.

2.18.2 Technical Requirements of Brick

The Brick must be machine made bricks.

The bricks to be used for the brick paving works shall meet the requirements of the Sub-Clause Section VI-C Technical Specification 1.4.3 Materials, the existing and the new bricks both shall meet the requirements mentioned above.

Sample of brick shall be produced and presented to the Engineer before procurement. The contractor shall procure only those bricks that clearly and definitely confirm with the approved sample.

2.18.3 Laying

All the dismantled and excavated materials shall be cleaned out properly and the base shall be compacted properly with the compactor before proceeding with the brick paving work is. Foundation shall be checked so that it is in exact line and dimensions.

Laying of brick shall be carried out by skilled personnel only and duly approved by the Engineer. Prior to laying of the bricks, bed shall be prepared, compacted thoroughly with necessary cushioning over the bed. Brick shall be laid thereafter, all joints in between

Bricks on vertical edge shall be laid on sand bedding of thickness 75 mm or 1:4 cement sand bed of 25/50 mm thickness or as directed by the Engineer. Joints shall be kept as thin as possible. After the bricks in vertical edge are laid, all the joints shall be filled up with sand including ramming and watering and pointed with 1:1 Cement sand mortar unless specified otherwise by the Engineer. Laying shall start from one side in the slope as indicated in drawing or as per the Engineer's instruction.

Under no circumstances shall the contractor insert small brick pieces underneath the bricks to raise its level to desired level. Special care shall be taken to protect the floor from walking over it before it is completely

set or in any event not earlier than 2 days.

2.18.4 Measurement and Rate

It shall be measured in square meter for specified thickness and quality.

The rate to include cost of excavating, manual removal of brick paving, re-use of approved bricks on top of sand bed or 1:4 sand cement mortar, if instructed, pointing, all labor, materials, incidentals to complete the work except bedding preparation as per technical requirements of this Specification and to the satisfaction of the Engineer.
No separate payment shall be made for the supply of new Machine-made Brick exceeding 70% of the total measured quantity; all such additional supply is deemed included in the quoted unit rate.

3 PIPELINES AND RELATED ACTIVITIES

3.1 PIPE TRENCHES

3.1.1 Scope

This specification covers earthworks for trenches for all types and sizes of pipes. It covers excavation, the preparation of a trench bottom, backfilling and the reinstatement of surfaces.

3.1.2 Interpretations

3.1.2.1 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

3.1.2.2 Application

This specification contains clauses that are applicable to earthworks for pipe trenches associated with the water distribution mains, sewerage and drainage systems.

3.1.2.3 Definitions

For the purpose of this specification the following definitions shall apply:

Backfill (Main fill) - The approved filling material placed in a pipe trench after the pipe has been laid, bedded and surrounded by the blanket that has been compacted at the sides and over the top of the pipe.

Bedding - The material, and the operation of placing it, of the bedding cradle and blanket, up to the underside of the backfill.

Primary Pipelines: the pipelines upstream the Outlet Management Units or the Bulk DMA Flow Meters, mains laid from the reservoirs up to the inlet point of the DMA.

Distribution Pipelines: the pipelines downstream the OMUs or the Bulk DMA Flow Meters, pipelines laid inside the DMAs downstream the inlet point of the DMA.

3.1.3 Materials

The material encountered in excavation will be classified as Normal or Rock in the manner described in the Section Earthworks.

Bedding material shall be of ordinary and natural sand as per clause no. 1.3.3 of this specification.

Backfill material shall be material excavated from trenches, provided only that it contains no organic material, that it excludes stones of average dimension exceeding 150 mm, and that its moisture content will allow it

to be compacted to 95% of the Modified Proctor Density to avoid significant settlement, and shall have a PI not exceeding 12. Backfill material in road or traffic areas shall in addition have a minimum CBR of 15% at specified density if placed in the upper 200 mm of the subgrade, and a minimum CBR of 7% if the backfill is to be placed lower in the subgrade. Material containing more than 10% of rock or hard fragments that are retained at a sieve of nominal aperture size 50 mm, and material containing large clay lumps that do not break up under the action of the compaction equipment being used, will be regarded as unsuitable for use in backfilling.

If the Contractor allows material which, when excavated was suitable for re-use, to become unsuitable when required for backfilling, he shall make good by running it to spoil and replacing with suitable material. The borrowed or imported material will be paid independently as per appropriate BoQ item.

Where trenches cross or run along surfaced roads and paved areas of which the surfaces are ordered by the Engineer to be reinstated, the Contractor shall obtain prior approval for subbase and base materials that may be required to supplement such materials lost during excavation. Materials for bituminous or asphalt construction shall comply with the applicable standards of the Roads Department of the Ministry of Transport.

The Contractor is not required to use selective methods of excavation but may, if he so wishes, screen, wash or otherwise treat excavated material in order to produce material suitable for the bedding. He shall take positive steps to avoid burying or contaminating materials which otherwise would be suitable for use as different types of fill, topsoil, or road material, as applicable.

3.1.4 Construction Equipment

The Contractor may use mechanical excavation equipment or manual excavation means to their choice, except when the Engineer instructs the use of only manual means when the location is critical due to the existence of other underground utilities and/or the Contractor shows negligent use of mechanical equipment with profuse damage to underground utilities.

Irrespective of the means used, the Contractor is responsible to any damage to any existing underground utility and the remedying of the damage is on his account, as stated in **SECTION VI-B: PARTICULAR REQUIREMENTS, Appendix D: Environmental, Health and Safety EHS Management System Plans**

The Contractor shall use appropriate techniques or provide equipment such as pumps, well points and sheeting or close timbering for keeping the trenches sufficiently free from water to enable him to lay pipes true to line and level and to bed them soundly.

The Contractor shall use manual compaction tools or mechanical compaction equipment, but he shall select such equipment and operate it in such a manner that the pipeline is not stressed or damaged. Machine compaction shall not be used directly above the pipe until sufficient blanket backfill has been placed to ensure that machine compaction loads transmitted to the top of the pipe are not greater than would be imposed by normal road traffic over a pipeline with cover of depth 600 mm. Manual compaction shall be used for the backfill surrounding the pipeline and the first blanket layer.

3.1.5 Construction and Workmanship

3.1.5.1 Precautions

With regard dealing with water, the requirements of Clause no. 1.3.5 of this specifications shall apply in addition to the stipulations below.

In the case of a trench on sloping ground, the Contractor shall take approved measures (such as the construction of cross-embankments) to minimize erosion in the trench and adjacent ground.

With regard to accommodation of traffic and access to properties, the Contractor shall, in addition to the requirements of Clause related to Traffic Management, construct or put in order such bypass(es) as may be required to deviate traffic from portions of the road that are to be affected by the construction; or where half-width construction is ordered or approved, so arrange his work that the traffic will at all times have free

one-lane access to at least half the width of the roadway; or ensure, wherever possible, that the whole road is open at night and left in a trafficable condition, complete with traffic signs and protection facilities as specified.

He shall also ensure, wherever possible, that the usable width of the road is at least 3.5 m and he shall provide and allow reasonable access to persons occupying properties that fall within or adjoin the area over which he is working. If, for any reason, such access has to be closed during the construction period, the persons affected shall be given reasonable notice for each such period of closing.

With regard to existing services that intersect or adjoin trenches, the requirements of Section VI-B, Appendix D, Clause A.1.2(a) and Section VI-C, Clause 3.1.4, relating to Existing Services, shall apply.

Special precautions may be necessary when buildings are close to the edge of the trench. Throughout the duration of such activities the Contractor will be fully responsible for the safety of all adjacent property. Wherever the minimum clearances cannot be complied with, e.g. in certain urban areas, the Contractor shall provide adequate temporary protective support by struts, bracing, sheet piles, etc. for adjacent structures and such support must be capable of safeguarding the buildings from structural damages resulting from the execution of the Works. Prior to installation the Contractor shall submit to the Engineer his proposed system of support for approval. Irrespective of the Engineer's approval sufficiency and suitability of the support will remain the sole responsibility of the Contractor. The support shall remain in place until such time as the Contractor is sufficiently convinced that there is no more imminent risk of damage of any kind to the adjacent buildings resulting from the activities. Upon removal of the support any damages caused by the attachment of the support itself shall be repaired to the satisfaction of the Engineer.

3.1.5.2 Minimum base width

Unless otherwise shown on the drawings, or as directed, the clear width of a trench shall be not less than as shown in the drawings.

3.1.5.3 Site clearance

The Contractor shall clear the working strip, in accordance with Clause no. 1.1 Site Clearance. The working strip shall be an area of sufficient width along the route of the pipeline to ensure that his construction operations are not hampered and damage to buildings and the environment is minimized.

3.1.5.4 Excavation

The length of pipe trench excavated by a gang shall not extend more than 200m beyond the start of excavation or the completed backfill unless approved by the Engineer. The width of the trench specified in the trench drawings is the clear trench width. The excavation width shall provide at least the appropriate side allowance (within trench supports, if any), and such that half of the base width is on either side of the designated centre-line of the pipe. The width considered for measurement of trench payment (excavation, bedding and backfilling) will be the clear width with vertical sides, irrespective of the extra width needed for excavation and/or shoring.

Immediately at the start of each section of excavation the Contractor will request the Engineer to attend the site to determine and instruct which levels or layers of existing soil is suitable and to be used for backfilling. The Contractor shall separate and store suitable soil during excavation for reuse as backfill. Unsuitable soil shall be immediately removed from site and disposed of by the Contractor.

The sides of each trench from the bottom up shall be as nearly vertical as possible for at least the height of the bedding. If the excavated slope needs to protect due to site condition, the contractor shall properly protect the slope with shoring/struts etc. as approved by the Engineer.

When cutting through bituminous surfaces, the edges of the existing bitumen base and/or wearing courses shall be cut back vertically to straight lines.

During the course of the Works the Contractor shall clean road surfaces and other paved areas used by his vehicles and employees to minimize disturbance to residents and road users, cleaning shall be to the satisfaction of the Engineer.

3.1.5.5 Trench Shoring

Open cuttings and trenches shall be suitably shored, sheeted and braced, if required by the Engineer or by site conditions, for protecting life, property of the work, adjacent buildings/facilities, trees, poles, etc. All trenches shall be braced and strutted to the satisfaction of the Engineer, if they are:

a. Deeper than 1.5 meters.
b. So close to a building or structure, that a line between the corner of the trench bottom nearest to the building and the underside of the foundation of the building or structure would be steeper than 45 centigrade degrees.
c. If the soil conditions are not providing sufficient stability to the side walls.

The Contractor will be responsible for any damage resulting from trench instability and insufficient bracing and strutting. Particular shoring instructions are given below.

Conventional timber shoring, conventional vertical mild steel (MS) poles and MS plates located behind the poles with all needed welded horizontal U profiles bracing, trench metallic box, interlocked sheet piling or other shoring or trench support systems shall be used, or else by battering the trench sides to a stable slope which can be maintained during the works, but in this case no extra payment in excavation measurement will be considered to the Contractor (battered excavation shall be considered included in proposed rates at tender).

The CONTRACTOR shall well and effectively support the sides of all trench excavations specifically at the loose or collapsible soil terrains. The method of shoring to be pre-planned (before excavation) in accordance with the trial hole soil logs and shall obtain the prior approval from the ENGINEER.

The materials used for shoring should be strong enough to cater lateral earth pressures and vibratory impacts due to dynamic loading. Cross bracings need to be placed where collapsible or boiling soils are encountered to prevent shear failures. Steel sheet piles to be driven where necessary to prevent any fall or run from any portion from the ground outside the excavation to prevent settlement or damage to structure adjacent to the trench excavation. Stability of ground slopes shall also be maintained with proper shoring mechanism while trench excavations are proceeding in the slope terrains.

The CONTRACTOR shall be deemed to have made allowances for shoring up the sides of trenches or any extra provision necessary to provide space for them. If for any reason, full or part of trench excavations or adjoining lands gives away, it is the responsibility of the CONTRACTOR to take immediate steps to rectify the situation at his own expense and compensate other damaged or disturbed property or like.

The shoring shall project at least 150mm above ground level and shall extend to a suitable depth below the bottom of the trench. Wherever necessary, the upright members called 'polling boards or planks' and struts shall be driven by compressed air pile drivers. The polling boards shall be fixed close enough to avoid any running in of sand earth through the joints.

The withdrawal of the shoring shall be done carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded with, systematically to the other end. Pipes, concrete or masonry shall not be damaged during the removal of the shoring.

The detailed arrangement of the shoring, conventional timer, conventional MS steel plates, sizes of the metal trench box and interlocked steel sheet piles or and the spacing shall be subject to the approval of the Engineer.

If timber shoring is allowed, all the major components of shoring (polling boards, struts and walling) shall be of hard wood and shall be approved by the Engineer in writing. Warped or deformed timber shall not be used. Round timber shall not be allowed for the major components of shoring. Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. It shall be the responsibility of

the Contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc. from collapsing.

In the case of open timbering, the entire surface of the side of trench or pit is not required to be covered.

Unless and other wise mentioned in drawing the sizes and spacing of timber shoring component for timber shoring should not be less than values mentioned in the following table:

Table 29: Components of trench timber shoring

SN	Upright		Struts			Wales (Walling)	
	Minimum Dimension (mm)	Max. Spacing (mm)	Minimum Dimension (mm)	Max. Spacing (mm)		Minimum Dimension (mm)	Max. Vertical Spacing (mm)
				Vertical	Horizontal		
For Ordinary Soils (Firm Soils to Soils likely to crack and crumble)							
1	40x200	600	100x100	1200	600	100x150	1200
For loose and Soft Soils							
2	40x200	600	100x100	900	600	150x200	1000

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members. The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal walling, strutted with bellies or as approved by the Engineer. The length of the Ballie struts shall depend on the width of the trench or pit. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical walling, which in turn shall be suitably strutted. The lowest boards supporting the sides shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

In a vertical plane, there shall be at least three struts or more as directed by the Engineer. They shall rest on walling pieces. The spacing of the struts shall be as per above table. At the bottom, extra struts shall have to be provided if ordered by the Engineer.

The rates for excavation do not include the cost of shoring, which shall be paid for separately as per relevant item of the Bill of Quantities. The Contractors shall be held responsible for providing secure shoring, and for adopting every other precaution, which may be necessary for protecting nearby structures, which are likely to be damaged as a result of excavation. The Contractors shall design the shoring required for actual site conditions and shall provide shoring accordingly. The design shall be submitted to the Engineer on demand. The shoring shall be so designed that lowering of pipe of normal length or any other pipe laying operation does not necessitate the removal of any strut or any other member of shoring. If the Engineer requires the adoption of any special measures or precautions, the Contractor will comply with the same immediately. If any part of a nearby structure is cut out or removed for facility of work, the same shall be made good on completion of the work by the Contractors at their cost.

In the event of the Contractors not complying with the provisions of this contract in respect of shoring the Engineer may, with or without notice to the Contractors, put up shoring or improve shoring already put up or adopt such other measures as he may deem necessary, the cost of which shall be recovered from the Contractors. Such action on the part of the Engineer, shall not, however absolve the Contractors of their responsibilities under this contract.

No part of the shoring shall, at any time, be removed by the Contractors without obtaining permission from the Engineer. While taking out shoring planks, the hollows formed shall be simultaneously filled in with soft earth and shall be well compacted as directed.

No payment will be made if the Contractors leave shoring material in the trench on his own or merely to suit their own convenience. The work of providing shoring shall be measured and paid for one the basis of areas

of planks provided from the bottom of the trench up to ground level and no separate payment will be made for providing and fixing of walling pieces, struts, dog spikes etc. the cost of which shall be deemed to have been covered by the rate for shoring.

The planks shall project at least 150mm above the ground level. For the purpose of payment, however, measurements shall be taken up to ground level only and no payment will be made for planking above ground level.

3.1.5.6 Dewatering

The Contractor shall ensure that the trench excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rainwater so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programme. The Contractor shall provide sump pits at suitable lower depth. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Engineer, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. Alternatively, or complementary to pumping, well points arrangement may be instructed by the Engineer to lower the static level of water table during pipe excavation and laying works.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Engineer to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Engineer. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a buildup of water in the opinion of the Engineer obstructs the progress of the work, leads to insanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

When there is a continuous inflow of water and the quantum of water to be handled is considered in the opinion of Engineer, to be large, a well point system- single stage or multistage, shall be adopted. The Contractor shall submit to the Engineer, details of his well point system including the stages, the spacing, number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval.

The dewatering activity will not be paid independently, but shall be included in excavation BoQ Items.

3.1.5.7 Rainwater Drainage

Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Engineer.

3.1.5.8 Trench bottom

Material that the Engineer considers to be unsuitable at the bottom of the trench shall be excavated to the depths directed and disposed of in the manner described. The resulting space shall be refilled, as ordered, with approved material and compacted as directed.

Where the bottom of the trench has been loosened during excavation, it shall be compacted at OMC to 90 % of modified AASHTO maximum density prior to bedding and pipe laying.

Bottoms of the excavated trenches shall be trimmed flat and levelled to provide an even base for the pipeline or pipe bedding; rocks, debris or other extraneous matter that may damage the pipes shall be removed.

Where pipes are to be laid on formation made in undisturbed ground (i.e. without bedding), the Contractor shall ensure that excavation in the first instance is stopped 75 mm above formation level and the trimming the formation shall be done by hand immediately prior to starting the laying of the pipes.

Where granular or concrete beddings are required, bottoms of trenches shall be excavated to a depth below the proposed level of the pipe over the full width of the trench as shown in the Drawings.

The depth of the trench shall be such that the depth of the cradle can be placed under the pipeline, and the trimming and grading of the bottom of the trench shall be such that the barrel of each length of pipe can be uniformly supported over its full length, free at the joints, and at the correct grades and levels.

The bottom of pipe trenches shall be sufficiently straight to enable the pipe to be laid without reduction of the trench width given in Clause 3.1.5.2 above and in conformity with the applicable tolerances specified.

3.1.5.9 Cradle Bedding and Embedment Backfill

This clause applies to all the sand bedding and backfilling in the DI pipe trench: the sand layer located bellow the pipeline (cradle bedding) and the Embedment Backfill (side backfill around the DI pipeline and blanket cover above the pipeline).

3.1.5.9.1 Materials

Bedding and Embedment Backfill for all pipelines shall be as shown on the Drawings. The bedding and Embedment Backfill (Pipe zone) shall be of natural sand SW or SP (according to Unified Soil Classification System USCS).

3.1.5.9.2 Construction Equipment

Adequate equipment shall be provided by the Contractor for the placing and compacting of bedding and embedment backfill as specified in Sub-Clause below.

The Contractor shall also provide the necessary test equipment for performing on Site the tests referred to in Sub-Clause below.

3.1.5.9.3 Construction and Workmanship

Bedding type shall be decided in accordance with the findings of the investigation of soil logs of the pipe traces. Standard beddings with granular sand could widely be used for average soil conditions of the trenches, except for waterlogged areas with bearing and settlement problems, when specific bedding should be designed.

Prior to pipe laying it should be ensured that the pipe bedding is in conformity to the invert levels of the pipe traces as specified in the drawings. No bedding shall be laid until the Engineer has approved the trench, measured the depth if necessary, and authorized pipe laying to proceed.

The bedding layer thickness requirements for ductile iron pipes shall be as shown in the drawings, but also complying with the following: the thickness of the lower bedding layer "a" (stated in EN 1610 Norm) must be minimum 100 mm. In order to reduce the danger of damage and settling, the thickness "a", dependent on the diameter of the pipe should be increased to 100 mm + 1/10 DN in mm.

With very firm layered subsoil (e.g. rock, clay stone, marl, glacial gravel, etc.) the lower bedding layer under the pipe shank should be carried out with a thickness a = 100 mm + 1/5 DN, and it must be at least 150 mm thick, in order to avoid load concentrations.

The preparation of the trench bottom or surface of the bed shall be completed for at least one full pipe length in advance of the pipe laying, except where in exceptional circumstances another arrangement is approved. No bedding material shall be placed in trenches containing water.

Stones, bricks or similar materials shall not be used below or against the pipes to locate them in position in the trench or to level the pipes.

Except in the case of concrete surround, the joint holes shall be refilled with fine granular material and lightly compacted to prevent the migration of adjacent pipe bedding material into the holes and to obviate the forming of hard spots under joints.

The granular material shall be spread over the full width of the formation and lightly hand compacted to a level slightly higher than the level corresponding to the underside of the pipe barrel to allow for settlement of the pipe to the correct level.

Further granular material shall be placed in the trench, special care being taken to fill under the sides of the pipe to ensure full contact with the barrel of the pipe, but leaving the joint exposed for a length of approximately 200 mm on each side of the joint collar, sleeve or socket. The granular material shall then be compacted evenly on both sides of the pipe.

Clay, or other approved impermeable material barriers shall be constructed to limit the uninterrupted length of granular bedding and backfill to a maximum of 500 m. The cost of this provision shall be deemed to be included in the bedding price.

Bedding shall be carried out as pipe laying proceeds and shall be completed before the acceptance test is carried out.

Embedment backfill (side backfill and blanket cover) shall be deposited in 15 cm (6 inch) layers and thoroughly manually rammed, working alternately on either side of the pipe (particular care being taken to avoid damage to the pipe or sheathing) until the filling has been carried out at least 15 cm (12 inch) above the top of the pipe.

The degree of compaction attained for bedding (other than concrete) shall be 90% modified AASHTO maximum density.

3.1.5.9.4 Compacting of Bedding and Embedment Backfill

Pipes shall be supported on a cradle as indicated in the drawings. Initially continuous bed of natural sand of compacted depth indicated shall be placed in 100 mm layers and covering the full width of the excavated trench. After laying of the pipeline, additional bedding material shall then be placed carefully and evenly between the sides of the trench and the pipeline, in layers of uncompacted thickness approximately 100 mm and in accordance with the construction detail sand covering the full width of the excavated trench. Each layer shall be compacted individually to the density specified in Sub-Clause above.

When placing and compacting the bedding and embedment backfill particular care shall be exercised to prevent damage, deflection, or displacement of the pipeline and the polyethylene sleeving, if any.

Preferably compacting method is:

a. Cradle bedding under the pipe: Mechanical Hand Compactors: Vibratory Plate or Rammer Type
b. Embedment backfill (also called initial or side backfill around the pipe and blanket cover above the pipe): Manual soil tamper tool (hammer or similar weight tool)

3.1.5.9.5 Concrete surround

In special cases, and where ordered by the Engineer, pipes shall be surrounded in concrete of the specified grade, generally of at least M 20 grade. The lower part of the encasement shall be constructed in the manner specified for Class A bedding. Once the pipeline has been tested and approved, the pipes shall be covered with concrete to the specified depth and expansion joints shall be cut or constructed in the upper part to coincide with those in the lower part. No earth filling over the concrete shall be commenced until at least 5 d after the concrete has been placed or until the concrete has attained a strength of at least 15 MPa.

3.1.5.9.6 Testing and Acceptance

The Engineer may order density tests to be carried out to determine the density and grading of the bedding. Tests will be carried out for every 200 linear meter of trench or part thereof by the Contractor in the presence of the Engineer, or by an independent laboratory approved by the Engineer. The cost of all testing will be included in the Contractor's rates. If the density is found to be below the specified value, the Engineer may order removal and re-compaction at the Contractor's expense, and the cost of retesting shall be borne by the Contractor.

The tests may be carried out by the sand replacement method or, where the grading of the bedding is such that the particle size is not less than 0.075 and not more than 2 mm, by use of a dynamic cone penetrometer.

3.1.5.9.7 Measurement and Payment

The Measurement of the sand bedding and embedment backfill work shall be the net volume of filling, computed from the net dimensions shown on the drawings.

The Contractor must install bedding to the full width of the excavated trench but will only be paid based on the net trench width. The Contractor must allow in his rates for all additional materials and works required if the actual trench width is greater than the net trench width.

Rates for sand bedding work shall cover the cost of supplying, cleaning, screening, laying, compacting to the required density, dealing with storm and ground water dewatering, protection of slopes and disposal of any surplus material at a safe location or as instructed and approved by the Engineer.

3.1.5.10 Main Backfilling

Backfilling of pipe trenches shall commence as soon as possible after the pipe has been laid and sand cradle bedding and embedment backfill has been placed around and over the top of the pipe to the height of blanket cover specified.

In general, the trenches shall be refilled using suitable material selected from the excavation, provided the specified compaction as per cent of maximum soil density is attained.

Main backfill (the remainder of the refilling on top of the embedment backfill and up to the underside of the surface reinstatement layers) may consist of native backfill materials from excavation (except when they are clay, silt and muck) that are substantially free from wood, trash, grass, roots, bush or other vegetation, boulders, stones and clods of earth larger than 15 cm in size, provided that the final compacted backfill is, in the opinion of the ENGINEER, sufficiently dense to prevent material from the superimposed layers being washed into the soils in such backfill. It should not contain broken concrete, masonry, rubble, asphalt pavement or other similar materials.

Any deficiency of backfill material from trench excavations because of removal of organic or other unsuitable material shall be made up from suitable surplus material from other excavations on the Site. If insufficient suitable material is available for this purpose from such excavations, the Contractor shall import sufficient suitable material. The Contractor shall so arrange his work that the importation of backfill material is kept to a minimum.

The imported material shall only be installed after prior approval of the Engineer.

Any earth material (except clay, silt and muck) satisfying the specification for suitable native backfill above may be used to replace unsuitable native materials as imported backfill.

Unless prior approval has been obtained, no filling shall be placed in water.

Excavated material from the trench, which is unsuitable or has become surplus because of bulking, displacement by the pipe and importation, shall be disposed of as approved by the Engineer, to the cost of the Contractor.

The Contractor shall complete backfilling of trenches expeditiously and in reasonable lengths, as stated in **SECTION VI-B: PARTICULAR REQUIREMENTS, Appendix D.**

3.1.5.11 Temporary Steel Plate Bridge

When backfilling operations of an excavation in the traveled way, whether transverse or longitudinal, cannot be properly completed within a workday, the contractor shall provide steel plate bridging with a nonskid surface and shoring to preserve unobstructed traffic flow. In such cases, the following conditions shall apply:

1. Shore the trench to support the bridging and traffic loads.
2. Steel plates used for bridging shall extend a minimum of 600mm beyond the edges of the trench.
3. The pavement shall be cold planed to a depth equal to the thickness of the plate and to a width and length equal to the dimensions of the plate.

4. Install steel plate bridging to operate with minimum noise.
5. Maintain the steel plates and its shoring for repetitive uses.

The following table shows the required minimal dimensions and spacing of steel members for steel plate bridging. This table of supporting arrangements has been for illustration purpose only; the contractor shall be responsible for the design and adequacy of the temporary support system to trenches. The Contractor shall design these temporary arrangements as per BS 5950 with deflection at centre not exceeding 1/360 of trench width. Loading shall be designed to HA loading according to BS 5400.

Table 30: Schedule of Steel Plate trench covers

TYPE	Trench Width (m)	Min. Thickness of Steel Plate (mm)	Main Stiffener (mm)	Intermediate Stiffener	
				Size (mm)	Max. Spacing (m)
I	<0.9	25	NOT REQUIRED	NOT REQUIRED	
II	0.9 to <1.3	25	ISMB 125x75 (@11.9 Kg/.m)	ISLB 100x50 (@8.0 Kg/m)	0.4
III	1.3 to ≤ 1.6	25	ISMB 150x80 (@14.9 Kg/.m)	ISLB 100x50 (@8.0 Kg/m)	0.5
	1.6 to <1.9	25	ISMB 150x80 (@14.9 Kg/.m)	ISLB 100x50 (@8.0 Kg/m)	0.6
IV	1.9 to < 2.2	30	ISMB 150x80 (@14.9 Kg/.m)	ISLB 100x50 (@8.0 Kg/m)	0.7
	2.2 to < 2.5	30	ISMB 150x80 (@14.9 Kg/.m)	ISLB 100x50 (@8.0 Kg/m)	0.8
V	2.5 to <2.8	40	ISMB 150x80 (@14.9 Kg/.m)	ISLB 100x50 (@8.0 Kg/m)	0.9
	2.8 to <3.0	40	ISMB 150x80 (@14.9 Kg/.m)	ISLB 100x50 (@8.0 Kg/m)	1.0

The whole arrangement shall be of modular type for repetitive uses along trench excavation. In the event of the Contractors not complying with the provisions of this contract in respect of temporary steel bridge decking, the Engineer may, with or without notice to the Contractors, put up temporary decking arrangement or improve the arrangement already put up or adopt such other measures as he may deem necessary, the cost of which shall be recovered from the Contractors. Such action on the part of the Engineer, shall not, however absolve the Contractors of their responsibilities under this contract.

No part of the temporary steel bridge decking arrangements shall, at any time, be removed by the Contractors without obtaining permission from the Engineer.

3.1.5.12 Temporary Transportation of Excavated Material to be Backfilled

If the excavated materials are allowed to be used for backfilling of trenches, it is the responsibility of the CONTRACTOR to make his own arrangements for temporary storage of such material in his yards at his own cost.

Stacking or placing excavated material along the sides of the trenches may not be allowed when working along the carriageways, streets and other congested areas unless written approval is obtained from the relevant authorities. Continuous and efficient transport arrangements shall be organized to dispose excavated materials in such places when the excavation is in progress to avoid disturbances to road traffic. Excavated material shall be transported in covered containers to prevent dust and depositing loose materials on the road during hauling.

If the disposed material is to be deposited in private or local authority lands, prior consent shall be obtained by the Contractor from the legal owners or from the respective local authorities.

All backfill material may either be retained loaded on trucks on-site or removed off-site and either option is to meet all safety and environmental obligations stated in the contract. Upon readiness of the pipeline works,

the off-site stored backfilling material is then to be returned to the work site and used to backfill the contract works, at the cost of the Contractor.

3.1.5.13 Compaction

Trenches shall be backfilled with selected fill material in layers of thickness (after compaction) not exceeding 150 mm and the material shall be compacted to at least 95% of Modified Proctor AASHTO T-180 maximum density up to the top of the subgrade level.

3.1.5.14 Reinstatement of surfaces

The Contractor shall reinstate all the trench width immediately.

The backfill needs to be completed within the same day, immediately followed by reinstatement with subbase material within the same day and base material the following day unless due to unforeseen circumstances.

The subbase and base material road surface shall be rolled daily as required or minimum 4-5 days for removal of undulation after reinstatement.

Stone and brick pavements, particularly in heritage areas and old city areas shall be reinstated properly using required percentage of new stone and bricks within a day of opening the trench. Skilled labour in laying stone and brick pavements shall be kept at standby by the contractor at all times.

In the case of gravel roads or similar surfaced areas, the Contractor shall, immediately after completion of the backfilling to the top of the subgrade level, reinstate the trench width with a well-graded and approved hard-wearing gravel surface and of quality equal to that of the existing road surface compacted to at least 95% Modified Proctor AASHTO T-180. The gravel layer shall be finished with a slight camber in order to allow for initial settlement but shall not be shaped such as to cause excessive jolting of any vehicle proceeding with normal speed.

Sealing of the pipe laid trench area of the existing bituminous roads shall be reinstated following the successful completion of the pressure test

Within 1-2 weeks of the pipe installation works of a particular stretch, the contractor shall complete sectional pressure test and then within one week after successful completion of pressure test, surface sealing and reinstatement of the pipe trench, which shall be undertaken as follows:

- Major blacktop bituminous roads of 7.3m width or greater and DOR Roads:

  Reinstatement to a full carriageway width either by temporary reinstatement with cold emulsion followed by permanent asphalt concrete; or immediate permanent reinstatement with asphalt concrete.

- Major concrete roads of 7.3m width or greater and DOR Roads:

  Reinstatement to a full carriageway width either by temporary reinstatement with cold emulsion followed by permanent concrete; or immediate permanent reinstatement with concrete.

- Minor blacktop bituminous roads:

  Reinstatement of the pipe trench width, plus any overbreak caused by the Contractor's work, shall be undertaken with either Cold Asphalt or Asphalt Concrete as instructed by engineer

- Minor PCC or RCC Roads/Footpaths

  Reinstatement of the pipe trench width, plus any overbreak caused by the Contractor's work, by temporary reinstatement with cold emulsion followed by permanent concrete; or immediate permanent reinstatement with concrete, as instructed by the Engineer.

- Interlocking Concrete Block Paving Roads/Footpaths

Reinstatement of the pipe trench width, plus any overbreak caused by the Contractor's work, by interlocking concrete block paving, using new or existing undamaged materials to match the existing surface.

The Contractor shall get prior approval from the Employer/Engineer before reinstating road surfaces beyond the pipe laid trench area, especially full width of at least one carriage way lane. However, reinstatement of any overbreak caused by the Contractor's work, must be carried out at no additional cost, as stipulated in Clause 3.1.7 below.

3.1.6 Testing and Acceptance

The Contractor shall prove: the optimum moisture content, the maximum dry density, the CBR, Marshall and the specified properties of reinstatement and backfill materials before use at a rate of one test per 200 m3 of material. In-situ density test of non-bituminous materials, and Marshall compaction/in-situ coring of bituminous materials will be carried out on each layer for every 200 linear meter of trench or part thereof by the Contractor in the presence of the Engineer, or by an independent laboratory approved by the Engineer. The cost of all testing will be included in the Contractor's rates. In the event of failure results, the Engineer will order any necessary re-testing and remedial works at the Contractor's expense.

3.1.7 Measurement and Payment

3.1.7.1 Measurement of Pipe Trench Excavation

Measurement of the pipe trench excavation shall be the net volume of excavation computed as follows:

- For Primary pipelines: measurement width is the net width of the trench as per the drawings; measurement depth is the actual trench depth executed at site.
- For Distribution Pipelines: measurement width is the net width of the trench as per the drawings; measurement depth is the fixed depth as per the drawings.

The Contractor is responsible for any additional excavation outside of the above net dimensions and must allow in his rates for the costs of all works involved.

Payment for trench excavation includes:

- site clearance, cutting and removal of existing pavement or land, storing of all reusable pavement material for further reinstatement,
- excavation of pipe trenches in all soils/rock with vertical sides as per drawings, including any extra excavation: for soft soil or rocks, fittings, bends, flanges and sockets, for battered sides, for shoring, for preparation of trench bottom, etc.,
- temporary storage, transport, lead and lift of excavated material,
- final safe disposal of surplus material including transport and lead and lift,
- dewatering.

3.1.7.2 Measurement of Pipe Trench Bedding and Embedment Backfill

Measurement of Pipe Trench Bedding and Embedment Backfill is as prescribed in Clause 3.1.5.9.7 of Section VI-C above.

3.1.7.3 Measurement of Pipe Trench Backfill

Measurement of the pipe trench backfill shall be the net volume of backfill computed from the net width of the trench and the net depth of backfill from the top of the Embedment Backfill to the underside of the Trench Reinstatement layers, as per the drawings.

The Contractor must install backfill to the full width of the excavated trench but will only be paid based on the net trench width. The Contractor is responsible for any additional backfilling outside of the above net dimensions and must allow in his rates for the costs of all materials and works involved.

Payment for Pipe Trench Bedding and Embedment Backfill includes:

- supply, temporary storage, transport, lead and lift of materials,
- testing and compaction
- final safe disposal of surplus material including transport and lead and lift,
- dewatering

3.1.7.4 Measurement of Pipe Trench Reinstatement

The following rules for measurement and payment apply to reinstatement of all types of surfaces, such as: bituminous /blacktop /asphalt/ asphalt concrete; cold asphalt; open-graded premix surfacing material; surface dressing; PCC and RCC concrete; brick; flagstones; gravel, etc., and their capping, subbase and base layers; and prime and tack coats.

For minor roads, pipe trench reinstatement will be measured based on the net widths of reinstatement and the total net depths of the reinstatement layers as per the drawings. The Contractor must reinstate to the full width of the original surface removed by or caused by his works, including any undermining or collapses, but will only be paid based on the above net dimensions. The Contractor must allow in his rates for the costs of all materials and works involved.

For major roads and DOR roads, where reinstatement to a full carriageway width is required, measurement will be based on the width of the carriage way and the total net depths of the reinstatement layers as per the drawings.

Payment for pipe trench reinstatement includes:

- supply, temporary storage, transport, lead and lift of materials,
- testing and compaction
- final safe disposal of surplus material including transport and lead and lift,
- dewatering

3.2 INSTALLATION OF WATER PIPELINES AND APPURTENANCES

3.2.1 Scope

This specification covers the transportation to Site, installation and testing of ductile iron (DI) and HDPE pipe, valves, fittings and appurtenances.

It also covers the construction of valve chamber, thrust blocks and other structures required for the operation of the distribution pipelines.

3.2.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

1. Site Clearance
2. Earthworks
3. Concrete
4. Pipe Trenches
5. Pipe Bedding and Fill

6. Brickwork

3.2.3 Materials

Ductile iron and HDPE pipes, specials, fittings, polyethylene sleeving and valves, shall be capable of withstanding the applicable test pressure specified in Clause. 3.3.7 below. All pipes and fittings shall be supplied complete with couplings and jointing material.

Satisfactory temporary end covers shall be provided by the contractor for the protection of threads, flanges, and prepared ends of plain-ended pipes and fittings, and to prevent damage to internal lining during transportation and during handling on Site.

Pipeline materials shall be so transported, stored, and handled that pipe are not overstressed at any time and fittings are not damaged in any way. Pipes damaged or cracked in any way shall be removed from the Site and replaced at the Contractor's expense.

Materials for manhole covers and surface boxes shall be as specified in Clause 3.2.5.8.

3.2.4 Construction Equipment

Any vehicle on which pipes are transported shall have a body of such length that the pipes do not overhang. Large pipes shall be placed on cradles and the loads properly secured during transit. The pipes shall be handled in accordance with the manufacturer's recommendations.

The equipment and rigging equipment used by the Contractor for the handling and placing of pipes shall be in accordance with the manufacturer's recommendations and shall be such that no pipe is overstressed during any operation covered by the specification.

The Contractor shall:

- Provide all tools and equipment used for the cutting, jointing and laying of pipes, fittings and valves.
- Use any acceptable device, including one incorporating a laser beam, to control the alignment and laying of the pipeline subject to the approval of the Engineer.
- Provide all equipment and tools required for installation of polyethylene sheeting, mastic putty and all types of wrapping tape.
- Provide all equipment, materials, tools and fittings required for the cleaning and swabbing of the pipeline.
- Provide all the equipment, materials, tools, and fittings required for the performance of the tests given in Sub-section 3.3.7 below. Test gauges shall be of approved manufacturer having dials at least 200 mm diameter, graduated such that the test pressure is at least 75% of the gauge reading. If necessary different gauges shall be supplied for different pipeline sections. Two gauges of each type shall be provided for the sole use of the Engineer and shall remain in the Engineer's possession for the duration of the Contract.

All equipment and methods shall be subject to the approval by the Engineer

3.2.5 Construction and Workmanship

The below specifications are applicable to all pipelines.

3.2.5.1 Handling of Pipes and Fittings

Coated pipes shall be transported on trucks or trailers fitted with approved padded timber cradles shaped to fit the curvature of the pipes and of adequate dimensions so as to prevent any damage to the pipe coating. Successive tiers of coated pipes shall be separated by similar suitable shaped timber cradles when more than one tier of pipes is being transported. Pillows shall be provided between securing chains or lashings when loads are being transported. Particular care shall be taken during unloading, loading, handling and transportation to avoid distortion, flattening, denting, scoring or any other damage to the pipes, fittings and

any damage to the external or internal coating or lining of the pipes, fittings etc. Under no circumstances shall pipes be dropped, be allowed to strike on another, be rolled freely or dragged along the ground.

Loading, unloading and handling shall be carried out using special hooks, well padded, with a curved plate to fit the curvature of the pipes or webbing slings not less than 30 cm wide or other means approved by the Engineer. Steadying ropes shall be employed. The positions of lifting slings shall ensure that stresses and tendency towards deformation in the pipes are kept at a minimum. Pipe handling equipment shall be maintained in good repair and any equipment which in the opinion of the Engineer may cause damage to the pipes shall be discarded.

End covers and protection shall not be removed until incorporation of the pipes and fittings into the Works. Care shall be taken during loading, transporting, and unloading to prevent damage to the pipes, fittings or coatings. When loading pipes in the stockyard the Contractor will be responsible for any damage to pipes and fittings which shall be noted and reported to the Engineer. After unloading all pipes or fittings will be examined and any defects or damage shall be noted and reported to the Engineer. Any damage shall be repaired in a manner recommended by the Manufacturer with the approval of the Engineer. Any pipe not considered by the Engineer to be of an acceptable quality after repair will not be accepted and the Contractor will not be paid for the supply of the item.

When materials are temporarily stored at the edge of the wayleave, they shall be stored clear of the ground and positioned to avoid damage by passing traffic in a manner approved by the Engineer.

3.2.5.2 Laying

To ensure that his supervisors and operators are familiar with the manufacturer's instructions/pipeline construction manuals for the laying and jointing of pipes and that these instructions are strictly adhered to, the Contractor shall employ the manufacturer to demonstrate laying and jointing. The demonstration shall also include the cutting of pipes and the repair of damaged pipes.

Pipe laying shall not commence until the bottom of the trench and the pipe bed have been approved by the Engineer. The trench bottom shall be prepared as specified above. Trenches shall be kept dry to allow proper and safe bedding, laying, jointing of pipes and construction of the selected fill blanket over the pipes.

The DI pipeline shall be sheathed in polythene sleeve for protection, installed in accordance with AWWA C105. The use of the type of protection shall be based on ground conditions as directed by the Engineer. The Contractor shall measure soil resistivity and pH at 100 m intervals.

The protected pipeline shall be laid and bedded to even grades and to levels and alignments shown on the drawings or as directed. It shall be laid centrally in the trench and with the manufacturer's class and quality identification marks visible from the top of the trench, if possible.

Pipes shall be brought to the correct alignment and inclination, concentric with the pipes already laid. Adjustments to line and grade should be made by scraping away or adding adequately compacted foundation material under the pipe and not using wedges and blocks or beating on the pipe.

Pipes shall be handled in manner which eliminates any possibility of high impact or point loading, taking care to protect the joint elements.

Every reasonable precaution shall be taken to prevent the entry of foreign matter and water into the pipeline.

Plugging of Pipeline: When a water supply pipeline construction/installation is to be paused and/or the trench needs to be buried for whatsoever reasons, the contractor at its own cost, shall plug/seal the ends of pipe segment properly to prevent contamination, debris intrusion, or damages. Sealing Plugs or inflatable pipe plugs made of PE as per IS 4984:2016 and SDR value equal to the pipe segment shall be used to seal the HDPE pipes. Mechanical end caps or inflatable pipe plugs made of DI with pressure rating equal to the pipe segment shall be used to seal the DI pipes. Plugging details (type of plug, location) shall be properly recorded in project logs. Should the Engineer deem it necessary, he may require the Contractor, at the Contractor's own cost, to conduct a pressure test upon each resumption of work to ensure pipeline integrity and no choking occurred during the interim period.

Where so required, the cover or the alignment of a pipeline may change gradually by deflection at pipe joints, but this deflection shall not be greater than half the deflection permitted by the manufacturer of the pipe.

The minimum clearance between the outside of a pipeline being laid and the outside of any other pipe that it crosses shall be 150 mm. Where this requirement conflicts with the requirements for cover over the pipeline the Contractor shall ask the Engineer for written instructions and shall carry out the work in accordance with those instructions.

3.2.5.3 Jointing

All pipelines shall be jointed in accordance with the manufacturer's instructions and to the approval of the Engineer.

Until required for incorporation in a joint, each rubber ring or gasket shall be stored in the dark, free from the deleterious effects of heat or cold, and kept flat so as to prevent any part of the rubber being in tension.

Spigots and sockets of pipes being jointed shall be thoroughly cleaned by brushing and wiping immediately before being jointed. All rubber rings and seals shall be carefully inspected after being placed in position and before the joint is closed, to ensure that they have not suffered any cuts, tears, or other damage, and are not in any way defective. All pipes with flexible joints shall be accurately marked prior to laying to ensure that the correct gap is left in the joint.

For push-fit and bolted gland joints only lubricants recommended by the manufacturer shall be used in connection with rubber rings and these lubricants shall not contain any constituent soluble in water conveyed in the pipe. They shall be suitable for the climatic conditions at the Site and shall contain an approved bactericide.

For bolted gland joints the joints ring shall be pushed into place by the gland ring using only hand pressure, fixing nuts and bolts should then be fitted and first tightened to finger pressure. Thereafter tightening shall be in the sequence proposed by the manufacturer and to the torque recommended.

In the jointing of pipes with flanges, special care shall be taken to align, grade, and level the pipes, specials, and valves to avoid straining of the flanges. All bitumen and paint shall be removed from the mating face of each flange immediately before jointing. Bolts shall be tightened up evenly in opposite pairs to ensure uniform bearing, the final tightening shall be to the torque specified by the manufacturer.

For flanged joints the gasket shall be fitted smoothly to the flange and the joint made by tightening the nuts to finger pressure first. Thereafter the final tightening of the nuts shall be made by gradually and evenly tightening bolts in diametrically opposite positions using only standard spanners of a type approved by the Engineer.

Graphite grease shall be applied to the threads of bolts before joints are made. All joints containing nuts and bolts which are buried shall be protected with anticorrosive mastic and wrapping tape, applied in accordance with the manufacturer’s recommendations.

For electrofusion couplings, ensure that the pipe ends are round and cut square. The fusion area must be clean from dirt and contaminants, prior to scraping to remove expose clean virgin material. The pipe shall be marked with respect to the stab depth of couplings to ensure proper fusion. Align and restrain the electrofusion fitting as pre the manufacturer’s recommendations.

Care shall be taken to avoid damage to the internal surface of the pipes during assembly of the pipeline. Once joints are made they shall be protected to a level appropriate for the pipe by: polyethylene sleeving, muffs, or with molding putty and tape wrapping.

3.2.5.4 Setting of Valves, Specials, and Fittings

Unless otherwise shown on the drawings, or directed by the Engineer, gate valves shall be set upright and butterfly valves shall be set with the main shafts horizontal. All valves, specials, and fittings shall be located in the exact positions shown on the drawings or otherwise directed. All bolts and flanges which are to be

buried shall be covered with a corrosion inhibiting mastic putty or molding compound to produce smooth contours, the prepared fitting shall then be wrapped in protective tape.

3.2.5.5 Cutting of Pipes

Pipes shall be cut by a method which provides a clean square cut of the pipe and of the lining, without damage to pipe or lining. All cut or trimmed ends and the parts of any pipe on which the coating may have suffered damage shall be re-coated as specified before the pipes are laid.

The external area at cut spigot ends of ductile iron pipes shall be ground smooth for a distance of at least 125 mm, and then chamfered or otherwise made suitable for jointing as recommended by the pipe manufacturer.

The cutting of pipe for inserting valves, fittings or specials shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe cutting machine shall be used. No extra payment will be given to the Contractor for cutting of pipe activity, as this task shall have been considered in the pipeline laying rates.

3.2.5.6 Anchor/Thrust Blocks and Pedestals

At tees, bends, terminal valves, end caps of DI pipes, and where otherwise directed, anchor/thrust blocks shall be constructed to dimensions ordered or shown on the drawings. Whereas for the HDPE pipes only at each end caps are to have anchor/thrust blocks shall be constructed to dimensions ordered as shown on the drawings. Similarly, at each joint of HDPE and DI pipes also are to have anchor/thrust blocks shall be constructed to dimensions ordered as shown on the drawings. Unless otherwise indicated on the drawings, anchor/thrust blocks and pedestals shall be constructed of M20 concrete. The concrete shall be well punned around the pipe, if in trenches, against the undisturbed faces and bottom of the trench. Backfilling behind or under thrust faces will not be permitted. Excess excavation shall be replaced with the prescribed mix concrete given above and its associated works at the Contractor's own expense.

Care shall be taken to leave all joints accessible. No anchor/thrust block and pedestals shall be concreted before the approval of the Engineer has been obtained.

3.2.5.7 Valve Chambers

All washout valves, pressure reducing valves, bulk flow meters, underground hydrants, air valves and gate/butterfly valves above 300mm shall be housed in a chamber as shown on the drawings or directed by the Engineer.

3.2.5.8 Covers for Chambers

All covers and frames shall be manufactured from Cast Iron or ductile iron or polymer composite (ASTM D 3039), and be coated to the approval of the Engineer. Covers to be used in surfaces which are subject to heavy vehicular traffic(roads) and parking areas, shall be Class D400, according to EN 124. Other covers and frames not in heavy vehicular traffic (roads) or parking areas, shall be heavy duty HD-20 and conform to or IS 1726.

All covers shall be fitted to the frames and tested at the manufacturer's works, and covers and frames shall be similarly numbered in a legible and permanent manner in a position which will not be visible when fitted in place, and shall be of such construction as to minimize the ingress of sand.

The Contractor shall ensure that the covers are fitted to the appropriately numbered frames after the frames have been fitted.

The name of the Employer, year of manufacture, and any additional markings shown on the drawings shall be embossed in all covers.

All covers shall be lockable when instructed by the Engineer. Two pairs of keys for use with each type of cover shall be handed over by the Contractor after completion of Works.

3.2.5.9 Manhole steps or rungs

Individual rungs or steps used for access or egress, embedded in the walls of risers or conical top sections of manholes, shall be safe, well-constructed and installed in accordance with good engineering practices. Manhole steps to be installed to access to the bottom of the chambers shall be made of a steel reinforced rod grade 60 minimum diameter 12mm injection molded of tough copolymer polypropylene or similar cover.

The manhole steps shall conform to ASTM C-478, and AASHTO M-199. The copolymer polypropylene used in manhole steps shall conform to ASTM D-4101. The steel used in our manhole steps shall conform to ASTM A-615.

Polypropylene has shown superior resistance to all types of corrosive environments found in manholes. Tests show polypropylene resists even 50% hydrogen sulfide or sulfuric acid up to 120°F. Accelerated aging tests on polypropylene indicate a life expectancy as long as the manhole you install in it.

Manhole steps must withstand a vertical load test of 800 lbs. This test measures the deflection of the step after a load of 800 lbs. is applied. There can be no more than 1/2" deflection.

Manhole steps must have a minimum of 400 lbs. pullout strength. This test is performed regularly outing the field by our sales force. Steps will withstand Impact Testing of up to 300 ft. lbs. with only minor deflection and no cracking or breaking.

3.2.5.10 Interface Points

i. General

Where the interface is a pipe flange, the Contractor may be instructed by the Engineer either to install a blank flange, backfill and mark the interface, or to expose and connect to a flange installed by another contractor and backfill on completion.

ii. Installation of Flanged Connection Point

The connection point shall be provided at the location specified. The flange shall be installed so that it is vertically plumb and its face is perpendicular to the axis of the pipeline. The flange shall be covered by a PN 16 blank flange; the flange shall be installed in the specified manner. The flange shall be backfilled and the location marked with a marker post.

iii. Connection to Flanged Connection Point

The connection point shall be at the location specified and indicated on Site by a temporary marker post. The Contractor shall excavate to expose the flange, remove and dispose of the blank flange and water contained in the pipe and make the flange joint in accordance with the Specification, including the provision of all jointing materials.

3.2.5.11 Underground Protective/ Warning Tapes and Marker Posts

Protective (warning) tapes

Protective tapes shall be laid 300 mm above pipe crest to mark location of primary and distribution pipelines in the ground. Tape shall satisfy the requirements of EN 12613. Thickness shall be not less than 0,25 mm and width shall be at least 100 mm, colour shall be blue and made of PVC or polyethylene (non-detectable) or aluminum (detectable). The tape shall be supplied in coils of at least 250 m.

For DI and other metallic pipelines, non-detectable warning tapes shall be installed. For all other pipelines, detectable tapes shall be installed.

Protective tapes shall be printed with the words “WATER LINE BELOW”, or similar, at intervals not exceeding 500mm. The tape shall have a minimum tensile strength of 1750 psi.

Underground warning tape cost shall be included in the pipeline supply rate.

Marker posts

Marker posts shall serve to mark DN and locations of valves, air venting and underground hydrants of mains. Locations shall be indicated by x, y offset originating from the location of the plate. Each unit shall consist of a plate and the letters and figures that shall be fixed to it. Letters and figures shall be 50mm high and be of English and Nepali character, respectively.

Plate, letters and figures shall be of weather-proof plastic or galvanized steel. The plate shall be fixed at a galvanized steel or aluminum-alloy pipe of at least 40 mm. The pipe shall be fixed in the underground by concrete foundation.

The plate for sluice valves and air valves/ venting set shall be dark blue and the characters of white colour.

The plate for underground hydrants shall be white with red border strip and the characters of black colour.

3.2.5.12 Internal Pipe Cleaning

Pipelines of 750 mm diameter (primary mains) and larger shall be manually cleaned internally of all debris, stones and sand prior to testing.

All pipelines less than DN 750 (secondary and tertiary mains) shall be cleaned by the passing through of a foam swab before the hydraulic test on completion. Swabbing shall be carried out successively between adjacent temporary swabbing points installed by the contractor.

The foam swab shall comply with the following: Size:

Main up to DN 300: swab diameter = pipe diameter + 25%

Main over to DN 300: swab diameter = pipe diameter + 75 mm

Quality:

Hard: Where restrictions in the main do not reduce the diameter of the pipeline to less than two thirds of the swab diameter.

Soft: Where restrictions in the main are in excess of the above but do not reduce the diameter of the pipeline to less than one half of the swab diameter.

3.2.5.13 Disinfection of Potable Water Pipelines

The internal surfaces of all pipelines and pipework including all equipment incorporated in a pipeline or pipework (primary mains) through which water will pass shall be disinfected after they have been cleaned to the satisfaction of the Engineer.

Disinfection of mains shall be carried out in accordance with EN 805.

EN 805 recommends several disinfectants. The disinfectant may be selected by the Contractor and submitted to the Engineer for approval together with the method of application. It is recommended to use a hypochlorite solution; the process for the hypochlorite solution is given hereinafter

Disinfection shall be effected by filling the pipeline with water heavily dosed with chlorine, and shall be carried out when filling the pipeline with water for carrying out the hydraulic test on completion. Alternative methods may be adopted with the approval of the Engineer.

The mains section shall be disinfected with a chlorine solution at a rate as to obtain 50 mg/l of active chlorine at the point of introduction. The line shall be blown-off until a residual of 10 mg/l chlorine is obtained at the point of blow-off.

The water, heavily dosed with chlorine, shall stand in the pipeline for a period of 24 hours or for such longer period as the Engineer shall require and all valves in the system shall be operated at least once during this period. If a residual of 10 mg/l chlorine is obtained, the blow-off will be closed and the water allowed to remain in the pipe for a minimum of 24 hours (static method). After this period the water shall be tested for residual chlorine at the point of blow-off. If no residual chlorine remains, the process shall be repeated until satisfactory results are obtained

At the termination of the required period, chlorine residual tests shall be taken at the end of the pipeline farthest from the point of injection and the test shall be repeated if necessary, until the residual is not less than 10 mg/l.

After completion of the disinfection process the main shall be flushed with portable water until effluent concentration at the point of blow-off is less than 0.25- 0.5 mg/l.

The Contractor shall obtain the Engineer's approval to the method to be adopted for disposing of the chlorinated water and the time when such disposal shall take place on completion of disinfection. The Contractor shall neutralize the chlorine by the use of sodium thiosulphate prior to disposal.

3.2.6 Tolerances

The below specifications 5.3.6.1 to 5.3.6.5 are applicable to all pipelines.

3.2.6.1 General

No deviation will be permitted from the minimum cover specified or as shown on the drawings. The criteria for the level and gradient to which pressure pipelines shall be laid are as follows:

(i) the cover above the crown of the pipe to ground level shall be as shown on the Drawings.

The upward gradient shall be steeper than 1 in 500 with flow, or steeper than 1 in 250 against the flow except where expressly shown in the Drawings.

3.2.6.2 Control Points

For the purpose of this specification valves set on the centre line of the pipeline, designated changes in gradient and designated changes in horizontal alignment, shall be regarded as control points and shall be located with a permissible deviation of + 100 mm on the centre line. The same deviation will be permissible laterally except where the Contractor is required to lay the pipeline to a curve or at a designated distance from a boundary, kerb line, or fence line, in which case the permissible deviation shall be + 30 mm.

Unless otherwise directed and subject to a permissible deviation (measured along the centre line) of + 5 m, scour valves shall be located at the lowest points in pipelines and air valves at the highest points.

3.2.6.3 Alignment (plan and level)

Unless otherwise directed, the permissible deviation in alignment between control points from a straight line joining the control points, when measured on the top centre of the pipeline, shall be +100 mm or + 20% of the nominal diameter, whichever is the larger, and the permissible deviation per pipe length shall be +

30 mm. The permissible deviation from the designated level at any point on the invert of the pipeline shall be + 50 mm or + 10% of the nominal diameter of the pipe, whichever is the larger.

Each pipe shall be laid to the required gradient such that the end of the pipe is + 5mm of the required level relative to the other and of the pipe.

3.2.6.4 Valve chambers, Manholes, etc.

Valve chambers, manholes, and the like shall be constructed centrally on the control points and, with the exception of tolerances that affect access to bolts, nuts, etc., with a permissible deviation of + 50 mm on all clearance dimensions. The clearance dimension between the outside of each nut and bolt-head and the inside face of the wall of a structure or any other fitting shall generally be not less than 150 mm.

Materials for manholes shall be as stated in 5.12.

3.2.6.5 Pipe Protective Coatings, etc.

No air must be trapped underneath the wrapping tape. Unsatisfactory pipes shall be cleaned, prepared and rewrapped.

All damage to protective coatings must be repaired. In the following manner.

a) Bitumen Coating

Damage to bitumen coating will be repaired by preparing and repainting the damaged area in accordance with the pipe manufacturers' instructions.

b) Polyethylene Sleeving

Minor damage, small holes etc, to polyethylene sleeving may be repaired by sticking adhesive tape over the damaged point. Larger damage shall be repaired by replacing the sleeve or by sticking a large patch of the sleeving material over the damaged area.

c) Tape Wrapping

Minor damage, small holes etc, to wrapping may be repaired by sticking adhesive tape over the damage after cleaning and preparing the damaged point. Larger damage shall be repaired by cleaning and rewrapping the damaged area.

3.2.7 Horizontal Directional Drilling Trenchless Pipe Installation

3.2.7.1 Scope of Work

The Contractor shall furnish all labor, materials, tools, and equipment required to install a new water main using the directional drilling method to the sizes and limits as shown on the tender drawings and as specified by these technical specifications herein. Work includes, but not limited to, proper installation, testing, restoration of underground utilities and environmental protection and restoration.

The directional drilling method involves first drilling a pilot hole as shown on the Contractor`s proposed pilot Boring Plan/Profile, and then enlarging the pilot hole no larger than 1.5 times the outer diameter of the pull-in pipe, pipe joint or coupling and pull back the pipe through the enlarged hole.

3.2.7.2 General

The Contractor shall design work using the Horizontal Directional Drilling (HDD) method to satisfy the Employer's Requirements. The design and method statement shall be submitted with full detail calculations to the Engineer for approval before construction commences.

The drilled pipes shall be designed to withstand in conjunction with the jacking load applied, the external loads derived from the overburden load from the site.

Excavation material shall be removed from the conduit as the work progresses. No accumulation of excavated material within the conduit will be permitted. Should appreciable loss of ground occur, the voids shall be backpacked to the extent practicable with cement grout. After the completion of the drilling operation, the Contractor shall fill up the voids, if there is any, at the interface between the external surface of the pipe and the surrounding earth.

3.2.7.3 Detailed Design of HDD Pipelines Submittal

Specific Surveys - Identification of additional utility lines – Ground Penetrating Radar (GPR)

In addition to the provisions which relates to establishing the location of utilities, the Contractor shall carry out a ground survey for locating the different utilities present on the road and underground survey / subsurface survey to locate other infrastructures presence at close proximity of the line of proposed alignment of the HDD drilling axis. This will help to protect the said infrastructures during execution. The entire length of proposed pipe line under execution as HDD has to be surveyed in detail.

Survey should indicate the area to be taken up for execution and help in determining the inlet and outlet point where execution shall be made for placing the machinery for using trenchless technology. The survey should also determine the condition of existing pipes (sewers, water supply, others), material of the existing pipe and its diameter, alignment of the existing pipe and its depth of installation from G.L.

The GPR survey should include service connection (water, sewers, etc.), their exact location and the existing branch connection if any. All the above information is to be plotted in a drawing following scale as decided by the Engineer. Prior to starting GPR operation the Contractor shall submit a detailed operation plan and procedure to the Engineer for approval.

Detailed Design (Working Drawings)

Prior to starting the Contractor shall submit hard and soft copies of all drawings and calculations to the Engineer when seeking his approval and the Engineer will return one copy of the drawings and calculations to the Contractor with his comments.

The Contractor shall prepare and submit all Working Drawings and calculations including details for the construction and completion of the Works. These drawings and calculations shall be produced and submitted to the Engineer for his approval, and shall comprise the following:

- Hydraulic calculations, including determination of test pressures;
- Site plan and general arrangement drawings:
- Pipeline profiles and boring profiles (each section of HDD);
- Drawings and schedules showing all pipe works, fittings, bridge and culvert crossing details, chamber and trench details and thrust block arrangements;
- Updated implementation method and quantities (HDD);
- Reinforcement drawings and calculations for thrust blocks to pipe works and Plant;
- Drawings, calculations and method statements for all road, rail and river/road crossings and inter connections and connections to existing pipe works;
- Landscaping, land drainage, top-soiling and all ancillary works relating to reinstatement works; and
- Site records and as-built drawings for each executed HDD line along with the DMA final design (incl. interconnections and node sketches) shall be submitted in ring binders with dividers for each subject.

Alterations and/or remarks made by the Engineer on the drawings or calculation shall be incorporated immediately and the drawings and/or calculations re-submitted until final approval from the Engineer is obtained.

The original, hard copies and soft copy on CD of each set of the approved drawings and calculations shall be submitted to the Engineer. The drawings shall be clearly marked as “WORKING DRAWING APPROVED BY THE ENGINEER” in English.

Commencement of work on any part of the works will only be permitted after the approval of the Contractor’s designs and calculations by the Engineer. All modifications requested by the Engineer shall be carried out without any additional charge. In the event of the Contractor disagrees with the alterations requested by the Engineer, the Contractor shall send written notice to the Engineer within seven days of receiving the requested alteration(s).

3.2.7.4 Other Submittals

The Contractor shall submit shop drawings, product data as well as design calculations prepared to be checked and approved by the Engineer. The following information shall be supplied: Directional drilling experience meeting the requirements of works: Contractor shall furnish document(s) supporting the directional drilling Contractor's qualifications and experience.

Detailed construction scheduling plan complying with overall work progress prior to the pre-construction meeting. The schedule shall detail the procedure and schedule to be used to execute the project. The Work plan is to include a description of all equipment to be used, down-hole tools, a list of personnel and their qualification and experience (including backup personnel in the event that an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including MSDS (Material Safety Data Sheet) of any potentially hazardous substances to be used), an environmental management plan, and contingency plans for possible problems. The schedule should be comprehensive, realistic and based on actual working conditions for this particular project. The plan should document the thoughtful planning required to successfully complete the project.

The type and capacity of the drilling rig to be used on the project, include manufacturer, pullback and push torque. Contractor to verify that allowable pipe stresses of the pipe will not be exceeded by the drilling rig.

Type of locating and tracking system.

Type and capacity of mud mixing system. Include proposed composition of drilling fluid, viscosity, and density.

Drawing showing proposed crossing configuration, including entry and exit angles, radius of curvature, and entry and exit points. Drawings to include location and dimensions of the starting area at both entrance and exit pits.

Diameter of the pilot hole and size and number of pre-reamers used for development of the borehole.

Method to address and mitigate obstruction problems during drilling, reaming, and potential problems of product pipe becoming stuck during pipe pull back, emergency procedures when drilling through existing underground utilities, or other events that lead to work stoppage. Procedures must comply with all regulations.

Method of slurry containment, method of recycling drilling fluids and spoils (if applicable), or method of containing drilling fluids or spoils and transporting drilling fluids and spoils off-site (including anticipated volume), and identify method and disposal site for drilling fluids and spoils. All material must be disposed in accordance with local, state, and federal regulations.

Plan for cleanup and disposal of spills and fan outs (drilling fluids, hydraulic fluids) including measures to contain and clean the affected area. Include details for cleanup of surface seepage of drilling fluids and spoils. All material must be disposed in accordance with local regulations.

Method to address and mitigate collapse or subsidence of surface roadways, adjacent utilities during drilling, reaming and installation of the pipe.

3.2.7.5 Record Keeping

The Contractor shall maintain a logbook that includes driller notes and records for bores using steering and tracking system. Data will include pipe number, depth, pitch, steering commands, and notes. Log must also include rig performance parameters (thrust, pullback, torque, drilling fluid circulation, drilling fluid composition), ground conditions, obstructions encountered, time shift started and ended, footage during the shift). Logbook will include information on drilling fluid (composition, viscosity, density). This logbook must be available for review throughout the project and must be submitted to the Engineer and the Employer at completion of project.

At the completion of the horizontal directional drilling, the pipe log indicating the horizontal and vertical position at 5 or 10 meter intervals along the pipe to confirm conformance with the depth and line shown on the Drawings. This submittal shall include the type and manufacturer of tracking equipment used, date of most recent shop calibration record, and the method to ensure the data was captured. No payment for any length of pipe will be made until its corresponding log is submitted to the Engineer.

3.2.7.6 Quality Assurance

The horizontal directional drilling shall be performed by a Contractor who is experienced in the installation of water pipelines utilizing the horizontal directional drilling method. The method and equipment used shall be proven technology supported by manufacturers' certificates, training and details of successful exploitation.

The Contractor shall provide an installation list including the following information:

City or District, project name and location, contact person and phone number, contract amount, project environment (river crossing, urban area), date of installation, pipe diameter, pipe material, maximum length of each bore, and total length of directional drilling.

3.2.7.7 Pipe

All pipe installed by the horizontal directional boring method shall be PN10 High Density Polyethylene (HDPE) pipe, type PE 100.

The butt-fusion or electro-fusion method for pipe and electro fusion fitting joining shall be carried out in the field by qualified fusion technicians following the pipe and fitting manufacturer's specifications. The joints shall be smooth, uniform, and de-beaded while supplying the proper melt, pressure, and alignment. It shall be the sole responsibility of the Contractor to provide an acceptable butt-fusion or electro-fusion joint.

All joints shall be made available for inspection by the Engineer before insertion and shall be marked with record of butt-fusion/electro-fusion welding data in the logbook.

For jointing of pipes within launching or receiving pits (incl. intermediary pits as necessary), the following requirements are mandatory:

Only electro-fusion fittings shall be used for connection of pipelines in launching and receiving pits. The fittings shall be injection moulded fittings made of PE but incorporating integral heating element(s) to enable fusion with PE pipes. Installation shall be carried out in accordance with ISO 11414.

Mechanical Joints and Fittings can be used upon approval by the Engineer: The materials and constituent elements used in making the fitting (including elastomers, greases and any metal parts) shall be as resistant to the external and internal environments as the other elements of the piping system and shall have a life expectancy under the following conditions as least equal to that of the PE pipe conforming to ISO Standard.

No service connections shall be installed at any of the HDD pipelines nor pit.

All joints shall be protected with specific plastic or PE sleeves after inspection and approval by the Engineer.

All pipe works inside the pits shall be executed as per the provision of Clause 3.1 PIPE TRENCHES 3.2 PIPE BEDDING AND FILL and 3.4. SECTIONAL PRESSURE AND/OR LEAKAGE TEST OF INSTALLED PIPELINES.

3.2.7.8 Directional Boring System / Equipment Requirement

Contractor to provide a pneumatically or hydraulically operated, fluid assisted remote guided boring system capable of installing the pipe by trenchless methods per the Drawings without damage. The equipment shall be designed to provide accurate control of both the line and the grade of the boring head.

Contractor to provide pumps, compressors, tools and all equipment certified as suitable by the system manufacturer to install the new pipe without stressing or damaging the pipe. Contractor shall provide a circulatory and recovery system that will recover the bentonite or other drilling fluids. Contractor shall supply water for mixing drilling fluid.

The Contractor shall ensure that appropriate HDD equipment is provided to facilitate the installation as follows:

S N	System Description	Pipe Diameter	Max. Bore Length	Thrust and Pull Back
1	HDD	Up to 315 mm	200m	30 Tons
2	HDD	Up to 160 mm	300m	15 Tons

The Contractor shall match equipment to the size of pipe being installed. Obtain the Engineer's approval for installations differing from the above chart. The Contractor shall ensure that the drill rod can meet the bend radius required for the proposed installation.

3.2.7.9 Protection

The Contractor shall field verify the location and depth of all existing utilities, including service connections, to be paralleled or crossed prior to the start of directional drilling operations. The Contractor shall modify alignment, depth or grade as necessary to avoid utilities and minimize the number of peaks and valleys along the alignment.

The Contractor shall submit all survey information including GPR logs to the Engineer together with the proposed work plan.

The Contractor shall consider all site conditions, namely:

a) Carry out excavation for entry, exit, recovery pits, slurry sump pits, or any other excavation as specified by the Engineer. Sump pits are required to contain drilling fluids if vacuum devices are not operated throughout the drilling operation, unless approved by the Engineer.

b) Within 48 hours of completing installation of the pipeline, clean the work site of all excess slurry or spoils. Take responsibility for the removal and final disposition of excess slurry or spoils. Ensure that the work site is restored to pre-construction conditions or as identified in the Boring Plan.

To minimize potential damage from soil displacement/settlement, the Contractor shall be limiting the ratio of the bore hole to the product size. The size of the back reamer bit or pilot bit, if no back reaming is proposed or required, will be limited relative to the pipeline diameter to be installed as follows:

Maximum Pilot or Back-Reamer Bit Diameter:

S N	Outside Pipe Diameter	Maximum Bit Diameter
1	Less than 200 mm	Diameter +100mm
2	200mm to 315 mm	1.5 x Diameter

3.2.7.10 General Pipe Installation

Unless otherwise specified in the plans and/or specifications, the following pipes shall be considered for horizontal directional drilling contingent upon approval by the Engineer:

HDPE pipe PE 100 PN 10

Each pipe to be used must be certified for use as a pressure-rated water delivery system and fire protection piping applications conforming to all standards and procedures, and meeting all testing and material properties as described in applicable pipe specifications (refer. to Part 6B - Section 6.5. HDPE pipes and fittings).

Pipes shall be installed by the directional drilling method where required and specified in the Drawing Sets. Should survey information indicate that the method is not feasible the Contractor shall inform the Engineer and gain prior approval for an alternative method or for open trench construction.

Pipes shall be installed by continuously pulling the pipe into place from insertion point to exit point without causing damage to the pipe being inserted. Provide lubricants as required by the pipe manufacturer to avoid stressing the pipe past its elastic limit. Contractor shall provide rollers or alternative apparatus to prevent damage to the pipe.

The Contractor shall excavate installation (launching) and receiving pits as necessary for complete installation of the pipe. The excavation of the installation (launching) and receiving pits shall be incidental to the work.

The Contractor shall not start the pullback unless it can be completed without interruptions. Contractor shall coordinate scheduling with the Engineer.

The Contractor shall provide sediment and erosion control measures to prevent drilling fluid or borehole cuttings from entering water courses or other land adjacent to the site in accordance with local environmental legislation.

The pilot hole shall establish the horizontal plane of the pipeline. A plot of length versus elevation versus left / right variance will dictate the actual as-built plan and profile of the pipeline. Data feedback and electronic guidance systems shall be used to provide confirmation of position.

Reaming shall consist of using an appropriate tool to open the pilot hole to a slightly larger diameter than the carrier pipeline. The percentage oversize shall depend on soil types, soil stability, depth, drilling fluid hydrostatic pressures, etc. Normal over sizing shall be from Diameter +100mm (for pipes of diameter less or

equal to OD 200mm) to 1.5 x Diameter (for pipes of diameter above 200 mm and up to OD 315mm) of the pipe diameter. Drilling fluid shall be forced down the hole to stabilize the hole and to remove soil cuttings. The Contractor shall carefully monitor the reaming operations to prevent damage to adjacent utilities.

The Contractor shall maintain accurate alignment and grade control and shall determine the pipe elevation (above mean sea level) at intervals not exceeding 100 meter.

The pipe shall be installed by continuously pulling and/or pushing the pipe into place through the drilling fluid along the reamed hole pathway from insertion point to exit point without causing damage to the pipe and pipe joints being inserted. The pullback speed shall be within the pipe manufacturer's recommendations. Drilling fluid/lubricants shall be provided as required by the pipe manufacturer's recommendations and specifications to avoid stressing the pipe and joints past the materials elastic limits. Proper pipe handling, cradling, bending minimization, and consistent insertion velocity shall be recorded.

Any bits, drills, reamers, or other tools lost or stuck in the hole shall be removed at the Contractor's expense. If tools cannot readily be removed, Contractor may at Contractor's discretion abandon the hole. The Contractor will seal the borehole and re-drill the crossing. No payment shall be made for any lost equipment, material, or work on abandoned holes.

Drilling fluid to be used to facilitate the installation of the pipe shall be adjusted within acceptable limits such that ground heaving and subsurface cavity formation through erosion are prevented.

A variation greater than ± 300 mm from the horizontal and ± 0.5 percentage points from the designated grade may be sufficient reason for the rejection of the pipe, and the pipe shall be re-bored to proper grade if so directed by the Engineer at no cost to the Employer.

The alignment shown on the Drawings shall be adhered to unless existing physical obstructions prevent otherwise. The number of setups and the length of pipe installation per set up as shown on the Drawings is merely a suggested layout to achieve the alignment shown on the Drawings. The Contractor shall be ultimately responsible for determining the number of set ups required to install the pipe to the alignment shown on the Drawings. The number of setups shall be incidental to the work.

The Contractor shall supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction. Spent drilling fluids and cuttings shall be confined to the entrance and exit pits. The Contractor shall take all necessary precautions to minimize the damage to the adjacent properties. Any drilling fluid that enters the pipe shall be removed by flushing or other suitable methods. Upon completion of the bore, Contractor will dispose of any drill cuttings and excess drill fluids in a manner consistent with the local and state regulations. If working in an area of contaminated soil, the slurry shall be tested for contamination and disposed in accordance with local and state regulations. The disposal of the drilling fluids and any necessary flushing of the pipe shall be incidental to the work.

The Contractor shall be responsible for cleanup and restoration, due to hydro-fractures from excessive pressure in the drilling fluid. Contractor shall prevent drilling fluids from entering streams or other water bodies and municipal storm or sanitary sewer lines (unless prior approval is obtained from the Engineer). No additional payment shall be made for cleanup costs required by Engineer due to loss of drilling fluid.

Pits excavated to permit connection of bored pipe shall be backfilled, and disturbed areas shall be restored to their original state or better. Sections of sidewalks, curbs, and gutters or other permanent improvements damaged during horizontal directional drilling operations shall be repaired or replaced at the Contractor's expense. The backfilling of the boring and receiving pits shall be incidental to the work.

3.2.7.11 Boring Path, Profile and Tracking System

The method of locating and tracking the drill head during the pilot bore will be shown by the Contractor in the Plan. The Department recognizes walkover, wire line, and wire line with surface grid verification, or any other system as approved by the Engineer, as the accepted methods of tracking directional bores. Use a locating and tracking system capable of ensuring the proposed installation is installed as intended. If an area of radio signal interference is expected to exceed 5 feet, the Engineer may specify the use of a suitable tracking system. The locating and tracking system from the Contractor must provide information on:

a. Clock and pitch information
b. Depth and profile
c. Transmitter temperature
d. Battery status
e. Position (x, y)
f. Azimuth, where direct overhead readings (walkover) are not possible (i.e. subaqueous or limited access transportation facility)
g. Ensure proper calibration of all equipment before commencing directional drilling operation.
h. Take and record alignment readings or plot points such that elevations on top of and offset dimensions from the center of the product to a permanent fixed feature are provided. Such permanent fixed feature must have prior approval of the Engineer.

The Contractor shall provide in his Boring Plan/Profile elevations and dimensions at all bore alignment corrections (vertical and horizontal) with a minimum distance between points of 25m. The Contractor shall provide a sufficient number of elevations and offset distances to accurately plot the vertical and horizontal alignment of the installed product. A minimum of three elevation and plot points are required.

3.2.7.12 Tracer Wire

The Contractor shall install all facilities such that their location can be readily determined by electronic designation after installation. The Contractor shall attach a continuous conductive tracer wire, either externally or integral with the HDPE pipeline.

The minimal characteristics of the tracer wire shall be:

1. Minimal section of cable shall be 12 AWG, equivalent to:

AWG #	Diameter (inch)	Diameter (mm)	Area (kcmil)	Area (mm^2)
12	0.0915	2.3241	6.5755	4.24

2. Coating: high molecular weight polyethylene (HMWPE), conforms to ASTM D-1248.

   Min. thickness: 45 mil (0.045 inches)

3. Break load: 1000 lb.

3.2.7.13 Removal of soil cuttings & other drilling operations

The Contractor shall ensure adequate removal of soil cuttings and stability of the bore hole by monitoring the drilling fluids such as the pumping rate, pressures, viscosity and density during the pilot bore, back reaming and pipe installation. He shall relief holes can be used as necessary to relieve excess pressure down hole. He shall obtain the Engineer's approval of the location and all conditions necessary to construct relief holes to ensure the proper disposition of drilling fluids is maintained and unnecessary inconvenience is minimized to other facility users.

To minimize heaving during pull back, the pull back rate shall be determined in order to maximize the removal of soil cuttings without building excess down hole pressure. The operation shall contain excess drilling fluids at entry and exit points until they are recycled or removed from the site or vacuumed during drilling operations. The Contractor shall ensure that entry and exit pits are of sufficient size to contain the expected return of drilling fluids and soil cuttings.

The Contractor shall ensure that all drilling fluids are disposed of or recycled in a manner acceptable to the appropriate by the Road Authorities (Department of Road namely). When drilling in suspected contaminated ground, the Contractor shall test the drilling fluid for contamination and appropriately dispose of it. He shall remove any excess material upon completion of the bore. If in the drilling process it becomes evident that

the soil is contaminated, he shall contact the Engineer immediately. He shall not continue drilling without the Engineer's approval.

When conditions warrant, as determined by the Engineer, back reaming for enlarging the bore diameter shall be accomplished by connecting the reamer to trailing drill stems at the exit pit of the pilot bore. The drill pipe shall remain in the bore hole until the final pipe is pulled into place. After the pilot bore is established, the Contractor shall not push anything from the entry pit to the exit pit.

The timing of all boring processes is critical. The Contractor shall install the pipe into a bore hole within the same day that the pre-bore is completed to ensure necessary support exists

3.2.7.14 Boring failure

If an obstruction is encountered during boring which prevents completion of the installation in accordance with the design location and specification, the pipe may be taken out of service and left in place at the discretion of the Engineer. Immediately the Contractor shall fill the pipe left in place with excavatable flow able fill or by grouting the pipe ends. The Contractor shall submit a new installation procedure and revised Boring Plan to the Engineer for approval before resuming work at another location.

Damage restoration and remedial plan

The Contractor shall take responsibility for restoration for any damage caused by heaving, settlement, separation of pavement, escaping drilling fluid, or the directional drilling operation, at no cost to the Employer

When required by the Engineer, the Contractor shall provide detailed plans which show how damage to any roadway facility will be remedied. These details will become part of the As-Built Plans. Remediation plans must follow the same guidelines for development and presentation of the As-Built Plans. When remediation plans are required, they must be approved by the Engineer before any work proceeds.

Failed Bore Path: If conditions warrant removal of any materials installed in a failed bore path, as determined by the Engineer, it will be at no cost to the Employer. The Contractor shall promptly fill all voids with excavatable flow able fill

Pipeline Testing

All sectional pressure and leakage test shall be carried out as per provisions of Clause 3.4. SECTIONAL PRESSURE AND/OR LEAKAGE TEST OF INSTALLED PIPELINES.

3.2.7.15 Documentation Requirements

Boring Plan

The Contractor shall furnish a Bore Plan to the Engineer within seven (7) days of the completion of each bore path. He shall include the following in the report:

a. Location of project number, street number and node numbers
b. Name of person collecting data, including title, position and company name
c. Investigation site location (station number or reference to a permanent structure within the project right of way)
d. Identification of the detection method used
e. Elevations and offset dimensions of the bore

The Plan shall include for each section the drawing of the pilot bore plan for review and approval (Max. Vertical Scale 1" = 2' and Max. Horizontal Scale 1" = 20'). The Contractors shall show finished grade, deflection and radiuses of the pilot bore, all existing utilities with minimum vertical and horizontal clearances. He shall address the location of the drill rig setups and for multiple bores, the lengths of each bore based on soil condition, equipment used, topography, etc. The proposed vertical and horizontal clearances between the bored pipe and any existing/proposed conflicting pipes, conduits or obstructions cannot exceed the guidance system accuracy tolerance by a minimum of 100%.

As-Built Plans

The Contractor shall provide the Engineer a complete set of As-Built Plans/Drawings showing all bores (successful and failed) within 14 calendar days of completing the work. The Contractor shall ensure that the plans are dimensionally correct and in line with the Tender Drawings, and that they include roadway plan and profile, cross-section, boring location and subsurface conditions as directed by the Engineer. The plans must show appropriate elevations and be referenced to a Department of Survey or Department of Road. Plans must be same scale in black ink on white paper, of the same size and weight as the Tender Drawings. Submittal of electronic plans data in lieu of hard copy plans is preferred and may be approved by the Engineer if compatible with the software. Specific plans content requirements include but may not be limited to the following:

a. The Contract plan view shows the center line location of the bore to an accuracy of 1 inch at the ends and other points physically observed in accordance with the bore path report
b. As directed by the Engineer, the Contractor shall provide either a profile plan for each bore path, or a cross-section of the roadway at a station specified by the Engineer, or a roadway centerline profile. He shall show the ground or pavement surface and crown elevation of each pipe/bore to an accuracy within 25mm at the ends and other exposed locations.
c. If, during boring, an obstruction is encountered which prevents completion of the installation in accordance with the design location and specification, the Contractor shall show the failed bore path along with the final bore path in the Plans.
b. d. The Contractor shall show the top elevation, diameter and material type of all utilities encountered and physically observed during the subsoil investigation. For all other obstructions encountered during a subsoil investigation or the installation, he shall show the type of material, horizontal and vertical location, top and lowest elevation observed, and note if the obstruction continues below the lowest point observed.
a. The Contractor shall include bore notes on each plan stating the final bore path diameter, product diameter, drilling fluid composition, composition of any other materials used to fill the annular void between the bore path and the pipe.

3.3 SECTIONAL PRESSURE AND/OR LEAKAGE TEST OF INSTALLED PIPELINES

The below specifications related to Sectional Pressure and/or leakage testing are applicable to all pipelines:

- New primary mains
- New distribution pipelines inside DMAs
- Repaired/replaced pipelines from existing networks used in the new network.

All newly installed pipelines must undergo sectional pressure and leakage testing prior to final acceptance. This memorandum provides recommended standards for pressure and leakage testing ductile iron and HDPE water lines. These recommendations closely follow relevant AWWA Standards and industry specifications. The applicable AWWA Standards are C600 for ductile iron mains, and M55 for HDPE.

The distribution pipelines must be tested with all necessary service connections installed, with end cap or if the customer water meter is already installed, with the inlet ball valve closed.

Simultaneous or separate pressure and leakage tests should be performed. The test duration and pressures for each option are specified in table below. If separate tests are made, the pressure test should be conducted prior to the leakage test.

Pressure and Leakage Test Methods:

Procedure	Duration of Test
Simultaneous Pressure & Leakage Test	2 Hours
Separate Pressure test	1 Hour

Separate Leakage Test	2 Hours

3.3.1 Pressure Test

The **hydrostatic System Test Pressure (STP)** shall be calculated from the Maximum Design Pressure (MDP) as follows:

PRIMARY PIPELINES

Water Hammer surge calculated (primary pipelines only):

STP = MDPc + 100 kPa (1.0 bar) ,

Water Hammer surge not calculated:

STP = MDPa x 1.5 or

STP = MDPa + 500 kPa (5.0 bar),

whichever is the most. MDP can be assimilated to Maximum Static Pressure if there is no trustful hydraulic model.

SECONDARY AND TERTIARY PIPELINES

MDP in the distribution network as per the hydraulic design (usually 5 bar in PID designs), therefore the **STP shall be 10 bar** for pipelines in the distribution network.

The purpose of the pressure test is to locate defects in materials or workmanship. Before testing, the pipeline must be backfilled and braced sufficiently to prevent movement under pressure.

If concrete thrust blocks are used, sufficient time must be allowed before testing to ensure that the concrete has cured sufficiently. The test ends also should be restrained to withstand thrusts potentially developed under the test pressures.

A pressure test should be conducted as indicated in the above table. The design pressure is the working pressure defined as the maximum anticipated sustained operating pressure in the line being tested. Care must be taken not to exceed the pressure rating of pipes, valves, fittings, thrust restraints, or other appurtenances. Pressures in the main may exceed the specified test pressure if the water pressure is read from a gauge located at a high point in the main.

Potable water is introduced into the main through a temporary connection line. While filling the new main, air must be expelled from the pipeline by venting through service connections, hydrants, or air-release valves. It is important to completely expel air from each section of the main to be tested. Compressed entrapped air may amplify surges within the main or cause erroneous pressure test result.

After filling the main with water and expelling air, a pump is utilized to increase the water pressure within the line up to the required test pressure and to maintain that pressure for the required duration (see table above). An accurate method for measuring the amount of water pressure within the line must be provided. A key criterion for the pressure test is that the measured water pressure within the main (after reaching the required test pressure) **should not vary by more than 5 psi during the duration of the test**. While the line is under pressure, the system and all exposed pipe, fittings, valves, hydrants, or joints should be repaired or replaced and the pressure test repeated until satisfactory results are obtained.

3.3.2 Leakage Test

The purpose of the leakage test is to establish that the section of main being tested, including all joints, fittings and other appurtenances, will not leak or that leakage is within acceptable limits. if the leakage test is to be performed simultaneously with the pressure test, the system should be allowed to stabilize at the test pressure before conducting the leakage test.

Equipment necessary for conducting the leakage test includes a pump equipped with a make-up reservoir and pressure gauge for measuring water pressure in the main. In addition, there must be an accurate method

for measuring the quantity of water pumped into the main being tested. Methods used to measure water volume include a calibrated make-up reservoir, a calibrated positive-displacement pump, or a water meter.

The specified test pressure for the leakage test is the same as for the pressure test (see Table) and the test should be conducted for at least 2 hours in duration. Leakage is defined as the quantity of water that must be supplied into the main in order to maintain the water pressure within 5 psi of the specified test pressure after the pipe has been filled with water and air expelled. No pipe installation will be acceptable if the leakage is greater than that determined by the following formulas:

$$L = (SD\sqrt{P})/80344.7$$

Where:

L = allowable leakage, in liters per hour

S = length of pipe tested, in meter

D = nominal diameter of the pipe, in millimeters

P = average test pressure during the leakage test, in kg per square centimeter

The above equation is based on a leakage rate of 9.7234 liters per day per kilometer per centimeter of nominal diameter of pipe at an average pressure of 10.6 kg/cm2.

Leakage less than the quantity specified by the above equation may be considered "allowable leakage" resulting from such factors as trapped air, take-up of restraints, and temperature variations during testing. However, observed leaks should be repaired regardless of leakage measurements through metering equipment.

A swift loss of water pressure in the main could be the result of a break in the line, major valve opening, loose mechanical joint bolts, missing or dislodged gasket, or inadequate thrust block. a slow loss of pressure in excess of allowable limits could be the result of minor problems such as a leaking valve or a corporation stop not completely shut off. In addition, air entrapped in the line can result in an apparent leakage in excess of the allowable limit.

Recommendations for avoiding minor leaks include the following:

- Vent all high points in the line by use of air release valves or corporation stops.
- Check all mechanical joint bolted connections.
- Cure thrust blocks before testing.
- Insure that exposed gasket grooves are properly cleaned before inserting gaskets.
- When inserting pipe into a mechanical joint or gasket joint, insure that the spigot end is squarely cut and beveled properly for the hub.

One approach for determining if the apparent leakage is the result of air trapped in a line is to immediately repeat the leakage test (i.e., continue the test for another two hours) and determine the amount of make-up water required to fill the line a second time. If this amount is significantly less the first filling, the difference in apparent leakage is probably the result of air being present in the line. If no significant difference in make-up water is recorded, a leak is probable.

3.3.3 Measurement and Payment

Hydraulic sectional test for primary pipelines will be measured and paid as the length of the pipeline tested including the length of fittings, chambers, and bridge culvert crossings. For distribution pipelines, sectional hydraulic test will not be paid separately but deem to be included in the appropriate supply items. The rate shall include all labour, material, equipment & other incidental including cleaning the pipe prior to the test, sealing the pipe after the test to prevent contamination of the pipeline, cost of potable water required for the test, etc.

3.4 CLEANING AND FLUSHING OF INSTALLED PIPELINES AFTER TESTING

3.4.1 General

It is a pre-requisite requirement to sterilize all potable water pipe lines prior to make use them for the intended purpose. Hence before being placed into service or before certification of completion by the ENGINEER whichever occur earlier, all new pipelines which will convey potable water shall be disinfected with chlorine, and a satisfactory bacteriological analysis of the water certified in accordance with AWWA C601 shall be submitted to the ENGINEER.

A newly installed main shall be sterilized or disinfected in accordance with ANSI/AWWA C651 or any other equivalent standard. The CONTRACTOR shall supply all necessary equipment for the cleansing and sterilizing operations, including labour, water and chlorine.

3.4.2 Cleaning and Flushing Prior to Disinfection

After the sectional tests, the CONTRACTOR shall flush out and cleanse the pipe line by required means.

Pipelines of 750 mm diameter and larger shall be manually cleaned internally of all debris, stones and sand prior to flushing.

All pipelines shall be flushed out with clean water until there is no evidence of foreign material or colour in the waste flushing water. When the pipelines have been cleaned to the satisfaction of the ENGINEER, it is a responsibility of the CONTRACTOR to make sure preventing any foreign material or dirt entering to the pipe lines.

If in the opinion of the ENGINEER, dirt or other foreign materials enters the pipe lines which will not be removed by flushing, then the CONTRACTOR shall clean and swab the interior of the pipeline (whichever diameter) with a 5% hypochlorite disinfecting solution up to the satisfaction of the ENGINEER.

3.4.3 Measurement and Payment

Cleaning and flushing for all pipelines will be measured and paid as the length of the pipeline tested including the length of fittings, chambers, and bridge culvert crossings. The rate shall include all labour, material, equipment & other incidental including cleaning the pipe prior to the test, cost of potable water required for the test, disposal of water, reporting, etc.

3.5 FUNCTIONAL GUARANTEE TESTS

This functional Guarantee Tests are part of the Tests on Completion needed for the taking-over of the works by the Engineer.

3.5.1 DMA Development

Contract implementation is based on District Metered Areas DMA development, discrete parts of a water distribution network, created by closing boundary valves or by permanently disconnecting pipes to neighboring areas, using a proper network design using computer hydraulic modelling. The differences in the distribution network nodal pressures are kept as low as possible in order to maintain uniform distribution. Each Distribution Network Improvement DNI zone is therefore further divided into smaller DMA hydraulic service- zones, which can be separated and controlled easily to regulate uniform services within the Contract area and follow non-revenue water control reduction.

3.5.2 Step Wise Commissioning Plan for Each DMA

- Procedures for pressure and leakage testing the segments of pipe network, as indicated in Technical Specifications Section 3.4;
- Procedures of full hydraulic pressure testing for 24 hours, disinfection and commissioning of DMA network, as indicated in Section 3.5.3

- Identification of all equipment and necessary tools, such as isolating valves, meters, pressure test points, etc., in order to achieve a successful commissioning;

The Contractor shall submit to the Engineer, DMA wise commissioning plan at least 28 days before the start of full hydraulic pressure and disinfection testing. The Commissioning Plan shall be approved by the Engineer prior to the commencement of the Commissioning Works in each DMA.

The training/resource personnel, workshop program, workshop venue, and training materials shall be submitted by the Contractor for the approval of the Engineer.

3.5.3 DMA Full Hydraulic Leakage and Disinfection Test for 24 Hours

3.5.3.1 Prior Requirements:

a) Installation:

Prior to the start of DMA hydraulic pressure test, the Contractor shall have completed sectional pipeline (including secondary & tertiary pipelines with service connections executed), pressure and leakage testing as per specifications and shall have installed all valves, bulk meters, pressure & data loggers at each pressure test points, and magnetic lockable corporation stop at the consumer connection end. The Contractor shall ensure that:

- ✓ All installed bulk meters, valves, pressure transducers and corporation stops are not leaking and are in working condition, and at the same time that water is at disposal with sufficient pressure at every service connection.
- ✓ Internal Pipe Cleaning: all network pipelines have been cleaned according to Internal Pipe Cleaning Clause in the Technical Specifications, and no debris, stones and sand are removed from the pipelines prior to testing.

The Contractor shall raise request for testing (RFT) to the Engineer at least 14 days before the date of testing.

b) Customer Communication Campaign:

The purpose of this is to inform and educate public on the test location, timing, duration and precautions during the test so that the public do not tap the water during testing as the same is highly chlorinated, harmful and not to be consumed. Prior to the start of start of pressure testing, the Contractor shall undertake customer communication campaign giving information on the date/time of testing and also notify the area TLO/CAPC. The cost towards this campaign shall be included in the quoted price for full hydraulic pressure and disinfection testing.

c) Testing Arrangements:

The Contractor shall arrange all required testing equipment like blank flanges with gaskets/fasteners, flange adaptors, pressure transducers and dataloggers etc.

The service area must be hydraulically isolated with the boundaries clearly identified, the boundary valves closed and watertight, the outlet(s) closed, all service connections closed at the corporation stop valve, and the pressure at all critical points monitored (including at least 4 critical points: the highest, the lowest, the inlet point and at the farthest point to the inlet). Data loggers shall be installed for monitoring all pressure transmitters and the inlet bulk water meters used in the testing.

For filling and implementing the leakage test during the test period of 24 hours, the pipelines of the distribution network must be completely filled with water, either from the network (to be checked with KUKL in first instance) or if this is not possible, then filled with water tanks on contractor's own cost.

Usually the test will be carried out with water from the KUKL reservoirs, with the network pressurized between 10 and 50 water column meters (as per hydraulic design), therefore an inlet bulk water meter (preferably only one inlet for the whole DMA test) will be the point of water control.

If the water is not from the KUKL network, then a sufficient capacity measuring water tank connected to a fire hydrant is needed for adding the makeup water to maintain the minimum test pressure, fitted with a suitable water meter (1 electromagnetic flowmeter or 2 mechanical meters (1 of 25mm and 1 of 40 / 50mm) with an accuracy of +2% as per ISO standard 4064 B class), and one pump, including a diesel generator, needed to sustain a minimum pressure of 10 water column meters at the highest point and at the farthest point.

d) Disinfection Procedure

Disinfection shall be carried out in accordance with EN 805 immediately before the final commissioning and handing over the system for operation.

The CONTRACTOR produces a slow rate of water flow through a chlorinator or other approved means, a solution of sterilizing agent in such quantities and of such strength as will result in a target concentration of chlorine throughout the length of pipelines for disinfection.

A stock disinfecting solution shall be prepared by mixing not less than 5 minutes in a clean container with the concentration of effective chlorine 50 mg per liter. The amount of chlorine substances to make that concentration of chlorine solution applied shall be worked out in considering the length of pipe line as well as the efficiency of the chlorine substances use. The point of application of the chlorination agent is normally at the beginning of the pipeline through a corporation stop insertion on the top of the laid pipe, and the point of withdrawal (normally by blow-off) is at the opposite end of the line. Prior to start disinfection such working shall be directed to the ENGINEER method application for his concurrence.

The main to be disinfected shall be filled with potable water at the same time as the stock solution is added through a convenient measure as will result in a final solution containing 50 mg/l free chlorine near the point of introduction. Care shall be taken to ensure that the stock solution is added at a constant rate commencing when is fed into the main and ending as soon as the main is full. The line shall be blown off till the required volume of chlorine solution is injected in such way the trace of residual chlorine is detected (not less than 10mg/ltr) at the farthest point.

Every main charged with disinfection shall stand for 24 hours. After a contact period of 24 hours, the chlorine residual at the end of pipeline shall not be less than 10 mg per liter, measured at 10 service connections, one of them the farthest from the inlet point. If chlorine residual is less at any of the 10 sample points, disinfection shall be repeated. The system shall then be flushed with clean water until the residual chlorine is not greater than 0.75 mg per liter but not less than 0.25 mg per liter.

After the satisfactory completion of the pipeline disinfection, the ENGINEER shall collect water samples for bacteriological analysis. If any of the results of the analysis are unsatisfactory when compared with those of the control sample of the supply water, the sterilizing process shall be repeated until satisfactory results are obtained. On completion of sterilizing and flushing the pipelines shall be left full of water.

e) Safe Disposal of Water:

The Contractor shall dispose of the water used in the pipeline testing and disinfecting operations, without causing damage to adjacent property. The Contractor shall neutralize the chlorine by the use of sodium thiosulphate prior to disposal. The Contractor shall have identified points for safe disposal of water from the network if necessary after successful testing and arrange all required pumps and other equipment. The Contractor can plan carefully to utilize the testing water with additional make up volume in the next segments of pipe networks subject to geographical feasibility. Shifting of used water in to next segment or safe disposal as necessary shall start immediately after the successful pressure testing of the DMA and no water used for testing/disinfection shall be left in the network.

f) Testing Formats:

The Contractor shall provide to the Engineer, testing formats which shall include all particulars such as location of DMA, pipe diameter, class, length, junction numbers, valve types and their locations, pressure gauges and their locations, flow meter for measuring make up water, bulk meter readings if applicable, pressure gauge log, location and details leaks noticed, details of leak repair carried out etc. for approval. All

costs of stationary and electronic data capture and reports shall be included in the quoted price for DMA full hydraulic and disinfection pressure testing.

3.5.3.2 Methodology

The objective full leakage and disinfection testing of a DMA is to keep all networks including tertiary & secondary pipelines under pressure (at minimum 10m) for 24 hours and disinfection carried on at the same time, with all service connections closed. At the end of the test, the measured make up water or Measured Leakage Volume (MLV), measured with the DMA inlet bulk flow meter, shall be less than the Allowable Leakage Volume (ALV). To achieve this, all small leaks, holes, weak connections and any joints of fittings which cannot resist the sustainable pressure, shall be identified and must be repaired and/or replaced without any extra cost. Air in the system shall be removed during filling of water by operation of corporation stop at the consumer end and corporation stop closed. This is one of the important tasks of the Contractor.

To attain this, complete leakage and disinfection test shall be required for the whole DMA system. However, if the Contractor prefers smaller area for testing purpose alone, then the Contractor at its own cost shall isolate parts of DMA by supply and installing additional valves/ specials for isolation and undertake leakage testing.

The test shall start after completion of all laying and installations of house connections up to corporation stop with relevant segmental pressure and leakage tests. The test shall be done in minimum 10m water column pressure for identification of leaks and simultaneous repair. The works shall be done by the Contractor's experienced Engineer. The Contractor shall prepare complete work program comprising of location map, ALV estimation calculations and time schedule for this test. Prior to start the work, all these shall be approved by the Engineer. The Contractor shall maintain and provide all the records to the Engineer including pressure and flow measurement recorded by the data loggers.

If the cumulative MLV measured at the end of the test (24 hrs.) is within the permissible limits determined as per the functional guarantee provided above (ALV), then the DMA is said to be confirming to the requirements of functional guarantee. The Contractor shall safely dispose of the water in the network.

On the other hand, if the MLV is exceeding the permissible limits ALV, then the Contractor shall investigate and undertake all such measures necessary to detect and identify the leaks, determine the reasons, record details and repair them and repeat pressure and disinfection test at its own cost till the level of leakages is brought down to the permissible limits.

3.5.3.3 Personnel

The quoted price for pressure testing shall be inclusive of all the costs towards Contractor's personnel, operators, labour etc., complete as necessary.

3.5.3.4 Reporting

The Contractor shall provide the Engineer with a detailed DMA wise report enclosing all the pressure test results undertaken, including the leakages reported and repaired during repeat tests, photographs etc. The cost of reporting shall be included in the quoted price for DMA full hydraulic leakage and disinfection testing.

3.5.4 Functional Guarantees

Majority of Service Connection should be connected before the Functional Guarantee test. Subject to compliance with the foregoing preconditions, the Contractor guarantees the physical losses as follows:

- real loss of 15% or less of supplied volume, and
- an average of 100 liters per connection per day when the system is pressurized at 10m (average) should not be exceeded. This parameter shall be adjusted accordingly as a direct proportion of actual average pressure readings during the test period.

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In and during the functional guarantee tests, the physical losses shall be ensured, data communication from the installed instruments shall be tested and recorded including remote monitoring and operation of valve / valve controls / functioning.

3.5.5 Water Flow Assuring Test

The Contractor shall undertake the Functional Guarantees test by ensuring supply to the DMA's which have successfully completed the full DMA hydraulic and dis-infection test. In the Test the supply should be released to ensure the functioning of the DMA (or DMAs) is consistent and pressure and supply is ensured to every service connection. The Contractor shall monitor and record the flows and pressure (at inlet and within the DMAs) for each of the DMA / DMAs including the control valves (setting) during the period of the tests. The supply of potable water to the DMA (/ DMAs) shall be ensured for a period of 7 days to assess the supply conditions and DMA performance.

During this period, the Contractor should record the grievances of the consumers (as received) related to low pressure / inadequate supply. The Contractor in consultation with Employer, Engineer shall identify the possible causes for the grievances and undertake remedial measures (pressure setting / valve control / partial valve closure and others as deemed necessary) to address them.

The Contractor must check and record on appropriate forms all data and information and submit the same to the Employer, Engineer after the Functional Guarantee test, as part of meeting the functional guarantees. Data Requirements

It is the Contractor's responsibility to prove compliance to the contractual requirements for demonstrating the Functional Guarantee and the data to evidence this compliance must be supplied. This may be in any format deemed appropriate by the Contractor and acceptable to the Engineer. A summary report shall be submitted with a full print out (from loggers, spreadsheets, databases etc) which shall include but not be limited to the following:

- Indication of methods used and their approval
- Conformity or otherwise with expected losses during operations
- Analysis of inflows, outflows and consumption within DMA

3.5.6 Allowable Leakage Volume (ALV)

According to the functional guarantee, the total Allowable Leakage Volume in liters per day will be the number of service connection in the DMA area subject to testing multiplied by 100 l/connection/day at P_0 = 10 water column meters (wcm):

$$ALV_0 = N_c \, X \, 100$$

Where: ALV_0 = Allowable Leakage Volume in liters/ day
Nc = Number of service connections in the DMA under testing

As the average pressure test P_1 may be different than P_0, then the Allowable Leakage Volume shall be adjusted by the formula:

$$ALV_1 = ALV_0 \times \frac{P_1}{P_0}$$

Where: ALV_1 = Adjusted Allowable Leakage Volume in liters/day at test average pressure P_1
ALV_0 = Allowable Leakage Volume in liters/ day at P_0 = 10 wcm

3.5.7 Measurement and Payment

The measurement shall be in DMA wise lump sum basis which shall be paid only once after the Contractor successfully meets the Functional Guarantee Requirement ALV, plus the disinfection of the entire DMA and shall be inclusive of all costs of Contractors personnel for planning, supervision and execution, cost of water management, cost of disinfectant, testing equipment, transport, fuel, safe disposal of water after successful testing, reporting etc., all complete.

4 PIPES AND FITTINGS PROCUREMENT

4.1 GENERAL AND STORAGE

4.1.1 Scope

The Contract shall include but not be limited to: provision of guards and storekeeper until completion of the works; supply of items; transport to Site; insurance; unloading and storing at Site in an acceptable manner (in air-conditioned stores if necessary); repair of any damage during transportation; provision of operations and maintenance instructions; provision of spares; making records of storage, stock control program; and provision of special tools, provision of a warranty against manufacturer's defects for the items supplied for a period of one year from the date of Taking Over Certificate (except where otherwise indicated for specific items). During the delivery of items train the Employer's staff in the store keeping system, methods of handling pipes and fittings.

4.1.2 Drawings

The drawings issued to the Contractor show details of the pipes, fitting, and valves assumed during the design of the civil works, the Contractor should take note of these drawings and notify the Engineer if any of the dimensions of the items he supplies are different to those indicated on the drawings.

4.1.3 Transport and Handling of Materials

Any vehicle on which pipes, valves or fittings are transported shall have a body of such length that the items do not overhang.

Coated pipes, valves and fittings, not in crates, shall be transported on trucks or trailers fitted with approved padded timber cradles shaped to fit the curvature of the pipes, valves or fittings and of adequate dimensions so as to prevent any damage to the coating. Successive tiers of coated pipes valve or fittings shall be separated by similar suitable shaped timber cradles. Pillows shall be provided between securing chains or lashings when load are being transported.

Particular care shall be taken during unloading, loading, handling and transportation to avoid distortion, flattening, denting, scaring or any other damage to the pipes, valves or fittings and any damage to the external or internal coating or lining of the items etc. Under no circumstances shall pipes, valves or fittings be dropped, be allowed to strike on another, be rolled freely or dragged along the ground.

Loading, unloading and handling shall be carried out using special hooks, well padded, with a curved plate to fit the curvature of the pipes, valves or fittings or webbing slings not less than 300 mm wide or other means approved by the Engineer. Steadying ropes shall be employed. The positions of lifting slings shall ensure that stresses and tendency towards deformation in the pipes, valves and fittings are kept at a minimum. Handling equipment shall be maintained in good repair and any equipment, which in the opinion of the Engineer may cause damage to the pipes, valves or fittings, shall be discarded.

Additional precautions shall be taken to avoid deformation of the flexible or large items. To maintain their dimensions struts and supports shall be fitted to the items and shall be retained in position until laying and jointing have been completed. Struts shall be adjustable in length having the ends suitably shaped. Where pipes or fittings are cement mortar lined struts shall be fitted after curing. At least two struts shall be used in each full length of pipe.

Details of the proposed strutting and support system shall be submitted to the Engineer for approval and if required by the Engineer, the method of strutting shall be demonstrated and tested on Site.

End covers and protection shall not be removed until incorporation of the pipes and fittings into the Works. Care shall be taken during loading, transporting, and unloading to prevent damage to the pipes, valves and fittings. After unloading all items will be examined, any defects or damage to the pipe, valve, fitting, lining or coating, shall be noted and reported to the Engineer. Any damage shall be repaired in a manner

recommended by the manufacturer with the approval of the Engineer. Any pipe or fitting not considered by the Engineer to be of an acceptable quality after repair will not be accepted.

Any items which, in the opinion of the Engineer are delivered damaged or are damaged by the Contractor in the process of stockpiling at Site shall be promptly removed from the Site. The Contractor shall receive no compensation for the damaged material or its removal until it is either repaired to the satisfaction of the Engineer or replaced.

4.1.4 Storage of Materials

Pipes, valves and fittings shall be unloaded and stocked by the Contractor at the stockyard.

Pipes shall be stored in piles only up to such height as recommended by the manufacturer. The first layer will be placed on beams, large enough to distribute the pipe loads on the ground and to give sufficient clearance from the ground; the pipes will be secured by wedges. Each layer will be separated from the next by an adequate number of beams (at least two).

Valves and fittings, if not in crates, shall be stacked as recommended by the manufacturer and shall be adequately supported clear of the ground on timbers all to the Engineer's approval.

Couplings and joints (and all components thereof) and other similar items shall be stored in dry conditions, raised off the ground in sheds or covered areas.

Crated small items shall be delivered and stored in their original containers. Each crate, box and other packing shall be clearly labeled with weatherproof marking identifying the quantity and exact nature of the contents thereof, such that materials may be readily identified without opening of the crates.

Until required for incorporation in a joint, each rubber ring or gasket shall be stored in the dark, free from the deleterious effects of heat or cold, and kept flat so as to prevent any part of the rubber being in tension.

Where items to be stored have a limited shelf life or require special storage arrangements, the method of storage shall be to the approval of the Engineer and in accordance with the manufacturer's instructions.

Storage areas shall be set out to facilitate unloading, loading and checking of materials. Different consignments shall be stacked or stored separately with identification marks clearly visible. All areas and sub-areas should be clearly sign posted and marked out.

4.1.5 Standard of Storage

The standard of storage to be provided by the Contractor shall be as follows:

All items; pipes, fittings etc. shall be stored by the Contractor in a secure stockyard at a site approved by the Employer and cleared, prepared for storage and fenced by the Contractor at his own expense. Such items shall be protected as appropriate to prevent its deterioration while in store. While the items are in store the Contractor shall make all necessary precautions to maintain the items in a serviceable condition and these precautions shall be to the approval of the Engineer.

All other items which require a stable environment, gaskets, joint materials, lubricants, paints, oils etc. shall be stored by the Contractor in suitable wind and watertight stores to be provided by the Contractor in the stockyard. The stores shall be dust free and shall be adequately ventilated and temperature controlled, to prevent condensation and deterioration of the stored items. The temperature control shall be provided by a thermostatically controlled air conditioning system. The stores shall also be adequately lit. The storage facility shall be to the approval of the Engineer and be provided at the Contractor's expense.

4.1.6 Store Records

The Contractor shall prepare records which will include but not be limited to, lists and drawings giving details of each item delivered to site and its storage location. The lists shall be in the form of a computer program that can be used for stock control during the execution of the civil works.

4.2 MATERIALS AND PACKING

4.2.1 General

Before manufacturing items of any description intended for supply, the Contractor shall submit for the approval of the Engineer the names and locations of the factories proposed. No manufacture shall start before the factory and the proposed items to be manufactured in the factory are approved. All items supplied must be new.

Materials used in the supplied items which are, or can be in contact with the untreated or treated water shall not contain any matter which could impart taste, odor or toxicity or otherwise be harmful to health or adversely affect the water conveyed. Listing by the UK Water Fittings Byelaws Scheme as operated by the UK Water Research Centre will generally be regarded as satisfactory evidence of suitability.

4.2.2 Samples

Unless expressly excused the Contractor shall provide samples of all manufactured items required for the supply, or alternatively the Contractor shall submit trade literature where the provision of samples, in the first instance and as agreed by the Engineer, is impracticable. All samples rejected by the Engineer shall be removed. All approved samples shall be stored, at a location approved by the Engineer, by the Contractor for the duration of the Contract, and any items subsequently supplied shall be of a quality at least equal to the approved sample.

4.2.3 Samples and Tests

Unless expressly stated, the Contractor shall provide samples of all manufactured items required for the supply, or alternatively the Contractor shall submit trade literature where the provision of samples, in the first instance and as agreed by the Employer, is impracticable. All samples rejected by the Employer shall be removed.

All approved samples shall be stored, at a location approved by the Employer, by the Contractor for the duration of the Contract, and any items subsequently supplied shall be of a quality at least equal to the approved sample.

The Contractor shall provide to the Employer three certified copies of the results of any routine analyses or tests carried out by him or his manufacturer on materials used in the manufacture of the Goods when and if asked by the Employer.

In addition, when and if required by the Employer, the Contractor shall provide samples of all or any materials used in the manufacture of the Goods and shall carry out any specified test on the said materials as may be required the Employer at the place of manufacture or at a laboratory approved by the Employer and shall provide to the Employer within seven days of each such test three certified copies of the results of the analysis or test.

Samples shall be submitted, and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Employer. The Contractor or his manufacturer shall prepare the necessary test pieces and supply all labor, appliances, testing apparatus and everything necessary for carrying out all specified tests.

The Contractor shall give the Employer 28 days' notice in writing of the date on which any of the samples will be ready for testing or inspection and unless the Employer shall attend at the appointed place within the said 28 days, the test may proceed in his absence.

Approval by the Employer as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Employer's rights under the Contract.

4.2.4 Test Certificates

Test certificates in triplicate shall be provided by the Contractor for each consignment of pipe supplied, giving the process of manufacture and the results of the specified tests.

Similar certificates in triplicate shall be provided by the Contractor in respect of materials to be used in the manufacture of the pipes giving the process of manufacture, chemical analysis (where relevant) and the results of the specified tests. The material shall be suitably marked to enable it to be identified from references on the certificates.

Any materials subject to test incorporated in the manufacture of the pipes and fittings before the Employer has received a satisfactory Test Certificate shall be at the Contractor's risk.

4.2.5 Independent Tests

The Employer reserves the right to carry out any independent tests he may deem fit on the completed pipes or on any material to be used in the Contract at any stage of manufacture or delivery, in addition to those tests specified to be made by the manufacturer.

Any samples of materials which may be required for such tests shall be provided by the Contractor at no extra cost to the Employer.

The cost of making any such independent tests shall be borne by the Employer, unless it is shown that the workmanship or materials under test are not in accordance with the Specification, and in such case, the cost of the test shall be to the account of the Contractor.

Any materials, workmanship or completed pipes, which are shown by such independent tests not to be in accordance with the Specification shall be rejected, notwithstanding any previous certificate which may have been provided.

4.2.6 Rejected Goods

Any Goods delivered to the Site which have been rejected by the Employer shall immediately remove from the Site by, the Contractor, free of cost. Replacement of rejected Goods shall be made as soon as possible but in no case exceeding, for imported goods, forty-five (45) days from the time of rejection, and for locally-supplied materials, fourteen (14) days from time of rejection.

Any goods which have been rejected shall be marked in a distinctive manner which shall preclude any possibility of their use for the purpose for which they were supplied. Such goods may be submitted for retest following the correction of any defects, where such correction is permitted by the Employer.

4.2.7 Tropicalization

In choosing materials and their finishes, due regard shall be given to the humid tropical conditions to which they will be subjected when installed. The Contractor shall submit details of his practices that have proven satisfactory, and he recommends for application on the parts of the supplied items which may be affected by the tropical conditions

4.2.8 Approved Manufacturer's Instructions

The Contractor shall supply manufacturer's instructions in English for the operation and maintenance, and where necessary the assembly, of the items supplied. If the translation of the instructions, the quality of accompanying illustrations, or any other element of the instructions are unclear or ambiguous they shall be revised and resubmitted, until approved by the Engineer, all revisions will be at the Contractor's expense.

4.2.9 Spare Parts

All spare parts shall be fully inter-changeable and suitable for use in place of the corresponding parts supplied with the Goods and shall be properly packed for shipment and for storage without deterioration over long periods on the Site.

All spare parts ordered shall be clearly marked with their description and purpose to facilitate easy identification.

4.2.10 Identification and Marking

4.2.10.1 Permanent Marking of Items

All supplied items shall have permanent distinguishing marks as per this Specifications or a standard approved by the Engineer. All marks shall be visible and legible and not obscured by any protective coating.

4.2.10.2 Marking for Shipping

Items shall be clearly marked for identification against the list, which shall be placed in every crate or package and protected in a waterproof envelope. The marking may be by means of a bar code or number which allows generic and individual identification of items to facilitate stock control and quality audits.

All crates and packages shall be clearly marked with a weather-proof material to show the weight and where the weight is bearing, and where the sling should be attached. They shall also be marked to identify the packing lists.

Each crate or package shall have a clear indelible and, as far as possible, indestructible unique identification cypher, also quoted on the packing list inside it. Three copies of the packing list shall be posted separately to the Employer at the time of shipment.

4.2.10.3 Marking on the crate shall comprise of:

DISTRIBUTION NETWORK IMPROVEMENT IN KIRTIPUR, CONTRACT No. PID/SKV/DNI2-KIRTIPUR

CONSIGNMENT No.

CONSIGNEE:

PROJECT IMPLEMENTATION DIRECTORATE

KATHMANDU UPATYAKA KHANEPANI LIMITED

ANAMNAGAR

KATHMANDU NEPAL

4.2.11 Packing and Protection

Before any item is dispatched from a manufacturer's factory it shall be adequately protected and packed so as to arrive at the Site intact and undamaged. The method of protection and packing must be suitable to withstand the conditions which may be experienced in shipment and delivery to the Site. It should also be suitable to withstand long periods of storage out of doors. As a minimum requirement: unpainted surfaces, including bolts and nuts, machined surfaces, tapped holes and studs, and all other exposed ferrous surfaces, shall be protected with a heavy coat of suitable grease or other easily removed corrosion- protective material, rubber gaskets and glands, and other components which are subject to deterioration by ultraviolet light shall be packed so as to exclude sunlight.

All flanges and mating surfaces shall be protected by means of a wooden template or similar. This template shall not be secured by the bolts, screws etc, which form part of the final installation.

Unless otherwise specified all pipes and fittings shall receive their complete protective coatings before dispatch from the manufacturer's works and shall be additionally protected by approved means for the period of transit, storage and erection, against corrosion and accidental damage.

For the protection of pipe linings and in particular for protecting cement mortar linings from drying out, protective metal or timber discs shall be attached to all flanges of pipes and fittings by means of bolts specifically provided for the purposes and which shall be discarded when the item is incorporated in the Works. The ends of non-flanged pipes and fittings shall be wrapped with two layers of opaque 0.3 mm thick

plastic sheeting secured with plastic bands, the sheeting and the bands shall not deteriorate during long (4 years) exposure to sunlight. The sleeves and flanges of flexible joints shall be wired together in suitable bundles.

4.2.12 Pre-Shipment Inspection

Before the Goods are ready for packing and dispatch after production, the Employer or its representative shall have the right to inspect and / or to test the Goods to confirm its compliance with the provisions of the specifications. All in-house technical, production and test data related to the Goods that may conducted on the premises by the manufacturer shall be furnished to the Engineer or an inspection (third party) agent appointed by the Employer, at no charge to the Employer.

The Engineer and/or an agent appointed by the Employer will visit the manufacturing premises of the Goods being manufactured and satisfy himself either through the in-house test results provided by the manufacturer; or shall draw samples of the Goods readied for delivery and carry out necessary tests on the manufacturing premises to determine that the Goods fully comply with the requirements of the Contract. Test carried out at the manufacturing premises shall be at no charge to the Employer.

The Goods will be packed and shipped only after it has been cleared for shipment by the Employer or an inspection agent appointed by the Employer.

Should the Goods or any part fail to meet the requirements of the specifications, the Contractor shall replace such Goods or the part within the time specified for delivery or extension granted. However,

Under such circumstances the Contractor shall bear the extra costs incurred in connection with additional inspection, failing which the Employer shall be entitled to recover all such costs from any payments due to the Contractor.

The Engineer's right to inspect, test and, where necessary, reject the Goods after delivery to the Employer's stores, shall in no way be limited or waived by reason of Goods having previously been inspected, tested and passed by the Employer or its representative prior to the shipment from the country of origin.

Providing always that replacement is possible, the Contractor shall refund to the Employer all amounts paid on account or recovery may be made from the security for performance.

Nothing in this clause, in any way, releases the Contractor from any warranty or other obligations under the Contract. Employer's failure to inspect and accept or reject Goods shall not relieve the Contractor from responsibility nor impose liability on Employer, for non-conforming Goods.

4.3 SUPPLY ITEMS

4.3.1 General

All items supplied under this Contract must be new, of first quality, free from defects, and shall be designed to meet the requirements of the specification. They shall be service proved products of specialized manufacturers. For the reference to the Contractor, the list of major reputed international brands is annexed in Annex 4 of this Specifications. The Contractor has to procure/supply the materials either from the vendor listed in the Annex-4 or from equivalent vendors/brands. The equivalent vendor/brand should have monetary turnover. The credentials for the particular/proposed model/make/item that of the said brands indicating the satisfactory performance shall be submitted for the Engineer’s approval. The manufacturer must be registered to ISO9001-2015 and ISO 14001:2004 accredited.

The Contractor shall submit evidence to the Engineer that the items have performed successfully in comparative projects under similar conditions for at least 5 (five years). Alternately if the products have been designed or developed more recently, the Contractor shall prove in a way acceptable to the Engineer that the supplies are suitable in every respect for the work intended and meet the requirements for this contract. In this respect reliability in operation and ease of maintenance will be considered the decisive criteria.

Each item should be dimensioned as indicated in the drawings or the specified standard or code, where there is a difference between the details and the manufacturer's item the Contractor shall inform the Engineer of the differences.

4.3.2 Equivalency of Standards and Codes

Wherever reference is made in the Contract to specific standards and codes to be met by the items to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards which ensure an equal or higher quality than the standards and codes specified will be accepted subject to the Engineer's prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the documents.

4.3.3 Abbreviations

4.3.3.1 Standards and Codes

The following is a list of some internationally accepted associations concerned with the standardization of products and abbreviations below will be used in the following text.

ANSI - American National Standards Institute (Successor of ASA).

AS - Australian Standard

ASTM - American Society for Testing and Materials

AWWA - American Water Works Association

BS - British Standard

BSP - British Standard Pipe

DIN - German Industrial Standard

ISO - International Organization of Standards

JIS - Japanese Industrial Standard JWWA - Japanese Water Works Association

SIS - Swedish Standards

IS - Indian Standards

NS - Nepalese Standards

4.3.3.2 Technical

Wherever the following technical abbreviations are used they shall have the meaning indicated:

DCI or DI - Ductile Cast Iron or Ductile Iron

DN or ND- Nominal Diameter

CI - Cast Iron

GI - Galvanized Iron

GS - Galvanized Steel

HDPE - High Density Polyethylene

PN - Nominal Pressure PVC - Polyvinyl Chloride ST - Steel

UPVC - Unplasticized Polyvinyl Chloride

4.3.4 Application

This chapter shall apply to all ductile iron pipes, valves and fittings unless otherwise required by the Specification.

4.3.5 Definitions

The following words and expressions shall have the meanings hereby assigned to them except where the context otherwise requires:

'Valves' shall mean flow control equipment which are not joints or fittings.

'Fittings' shall mean couplers, bends, junctions, reducers, tapers, tees and similar items which are not joints or flow control equipment.

'Internal' shall mean those parts of pipes or fittings which are to be in contact with the liquid being conveyed.

'External' shall mean those parts of the pipes or fitting which are not to be in contact with the liquid being conveyed and which are likely to be in contact with pipe bedding or native soil.

'Flexible joints' shall mean joints made with factory made jointing materials, loose collars, rubber joint rings and the like which permit angular deflections between adjacent pipes.

'Sleeving' shall mean a polyethylene sheet applied to the outside of pipe to give it additional corrosion protection.

4.3.6 Works Inspection

The Contractor shall provide a program showing the planned manufacture of items and a schedule of works test. The minimum tests shall be those necessary to show compliance with the required standards. The manufacturer shall give the Engineer 28 days' notice of the start of a series of tests and an equivalent amount of notice of the end of the test series. The manufacturer shall give unimpeded access to witness the tests, to the Employer and /or his designated inspection agent.

4.3.7 Shop Testing and Inspection

The inspection and testing of pipes, valves, fittings and accessories will take place on the manufacturer's premises. The manufacturer shall provide, free of charge, the testing equipment, the needed material, checking devices and necessary trained personnel for each test. The Contractor shall provide, free of charge, for transportation of the Employer's personnel or representatives to and from the manufacturer's premises, accommodation for the Employer's personnel or representatives during the testing periods, and incidental expenses of the Employer's personnel and representatives during the periods of testing.

Tests shall be carried out in accordance with relevant standard as approved by the Engineer.

Each successfully tested batch will be identified by a mark. Results of all such tests shall be submitted to the Engineer on a previously approved certificate or form certified by the manufacturer or by a recognized agency.

The pipes, valves, fittings and accessories which show in the opinion of the Engineer minor imperfections unavoidable occurring during manufacturing and not disadvantageous for their use, shall not be rejected and the manufacturer may under his own responsibility decide the method of removing such small visual superficial imperfections. He may also after approval of the Engineer repair certain defaults by any method other than welding.

4.4 DUCTILE IRON PIPES AND FITTINGS

4.4.1 Pipes and Fitting

4.4.1.1 General

Ductile iron pressure pipes and fittings shall comply with ISO 2531(2009).

All pipes are socket and spigot unless otherwise specified and up to a diameter of 300mm shall be Class C40, pipes with diameters from 350 to 600mm shall be Class C30 and pipes greater than 600mm shall be Class C25.

All fittings (spigot, socket and flanged) shall be PN 16. All socketed fittings shall meet the requirements of 4.2.1.3 of ISO 2531(2009).

Considering the geometric design of road of the Kathmandu Valley, the effective length of the pipe shall be 5.5 to 6.0m. However, smaller required length as per site condition, would then be modified at site without damaging the properties of the pipe and with no extra cost and time.

The manufacturer should be equipped with a specific devise in order to control the wall thickness of pipes. All DI fittings have to produce by Sand Mould cast using a sand mould plus a resin-sand core, so as to ensure the designed shape (to ensure accurate dimensions that guarantee joint water tightness) and thickness (to ensure strength) of fittings

4.4.1.2 Materials

The materials used in the manufacture pipes and fittings shall comply with ISO 2531(2009).

4.4.1.3 Tests

Tests on pipes and fittings shall be carried out in accordance with ISO 2531 (2009). The Employer shall be permitted free access to the place to manufacture for the purpose of examining and witnessing the testing of pipes and fittings.

4.4.2 Joints

4.4.2.1 Flexible non restrained (push fit)

These shall be flexible spigot and socket joints with sockets integral with the pipes and incorporating rubber rings recommended by the manufacturer and approved by the Engineer. Elastomeric gasket components shall comply with ISO 4633.

All push on joints shall be designed to be fully flexible; consequently, the angular deflection certified by the manufacturer shall not be less than the allowable angular deflection in article 5.2.2 of ISO 2531(2009), but preferably to provide below angular deflection degree in order to achieve the best protection to the safety of the pipeline in the event of unequal ground settlement due to the earthquake and swampy area.

All joints shall be designed to provide sufficient axial movement; the manufacturer shall declare the allowable withdrawal.

4.4.2.2 Mechanical joints

These shall be flexible spigot and socket joints with the sockets integral with the pipes. The joint shall be sealed by compressions of a rubber ring in the socket by means of bolting. The joint shall be suitable for use on the spigot of normal push fit jointed pipe.

4.4.2.3 Restrained joints

These shall be push fit type joints and shall incorporate some means of preventing the spigot being withdrawn from the socket once the joint is made. The joint shall be able to withstand the forces imposed when testing the pipeline using an end cap fixed with the restrained joint.

The restrained joint designs rely on a weld bead located around the spigot end of the pipe to provide the restraint against the hydraulic thrust force. This weld bead ring is factory-welded at exact position on the pipe so that the joint restraining chamber matches with the said ring, but if in site cuts are required to exactly match the length for a determined position of a bend, the cut end will need a new weld bead field-welded. Welds should be applied using a Direct Current D.C. arc welder employing reversed polarity and operating at amperage ranges recommended by the electrode manufacturer. Weld electrodes used should be nickel-iron type, in conformance with Class designation AWS 5.15 (ENiFe-CI), and/or the electrode and electrode diameter recommended by pipe manufacturers for their retainer ring should be used.

Procedure to follow to execute in filed welding the weld bead retainer ring is:

1. Mark the pipe such that a square cut can be made.
2. Cut the pipe at the marked location. Field cuts for restrained joint welding be smooth, regular, and as square as possible with the axis of the pipe. The outside of the cut end should be beveled smooth as per the manufacturer's recommendations using a grinder or file to prevent damage to the gasket during assembly.
4. Mark the location of the weld bead.
5. Remove the external coating on the pipe in the area the retainer ring is to be welded. After the external coating has been removed, grind the retainer ring location to bright metal.
6. Re-mark the location of the weld bead.
7. Clamp the weld-on retainer ring securely on the pipe in the correct location using the manufacturer's special welding jigs, fixtures, and/or C-clamps.
8. With the retainer ring fitted closely to the pipe surface, weld on the side of the ring next to the cut end of the pipe. Weld according to the pipe manufacturer's recommendations (electrode diameter, weld size, weld passes required, welding technique, etc). Thorough peening of the weld passes before they cool will minimize thermal stresses. The ends of adjoining passes should be slightly overlapped before the arc is broken. If weld cracks occur, they should be ground away and repaired with a weld overlay. After the entire ring has been welded to the pipe, weld the ring ends to the pipe and weld in the space remaining between the ring ends according to the pipe manufacturer's instructions.
9. Thoroughly clean the weld and ring to remove all weld flux and splatter.
10. Coat the weld bead and ground pipe surface with a smooth uniform coating of brush able mastic according to the pipe manufacturer's recommendations.
11. Inspect the pipe lining for possible damage. if cement lining damage occurs, it should be patched in accordance with recommended procedures of manufacturer.

4.4.2.4 Flanged Joints

All flanges shall comply with ISO 7005-2 or EN 1092-2. Joint sets shall be provided with all necessary nuts, bolts, washers and gaskets. The Contractor shall also supply in suitable containers sufficient graphite grease for application to the bolt threads when joints are made.

In case of flanged connections (valves, air valves, dismantling joints, etc.) connecting material such as stainless steel bolts and nuts and washers shall be used.

4.4.2.5 Nuts, Bolts and Washers

Hexagonal Nuts, bolts and plain washers shall be of product grade C suitable for use with ISO 2531(2009) or BS EN 1092-2 flanges and shall be made of steel with hot dipped galvanization.

Bolts shall be of sufficient length that one thread shall show through the nut when in the fully tightened condition.

4.4.2.6 Gaskets and Joint Rings

Joint rings shall be manufactured to conform to ISO 4633 and shall be of chloroprene rubber or other approved synthetic material suitable for temperatures up to 50°C.

Gaskets for flanged joints may be inside the bolt circle type and shall comply with BS EN 1514 or ISO 7483. Alternatively, the gasket shall be to the full diameter of the flange, drilled to suit the appropriate bolt provisions.

Until immediately required for incorporation in a joint, each rubber ring or gasket shall be stored in the dark, free from the deleterious effects of heat or cold, and kept flat so as to prevent any part of the rubber being in tension.

Only lubricants suitable for use with potable water and recommended by the manufacturer shall be used in connection with rubber rings and these lubricants shall not contain any soluble constituent, shall be suitable for the climatic conditions at the Site and shall contain an approved bactericide.

4.4.2.7 Underground Marker Tape:

The underground marker tapes shall be non-detectable, color blue, 15 cm wide,4mm thick made of PVC or Polyethylene, The Tape shall be printed with the words " WATER LINE BELOW" at intervals not exceeding 500mm. The tape shall have a minimum tensile strength of 1750 psi.

4.4.3 Puddle and Thrust Flanges

Puddle and thrust flanges shall comply with Clause 4.4.1 but remain un-drilled.

4.4.4 Internal Linings

4.4.4.1 Pipes

The pipes shall be internally lined in the factory with Portland cement mortar. The thickness and the lining shall be in accordance with ISO 4179. Prior to application of the lining the internal surfaces shall be shot blast cleaned to acceptable standard. The lining shall be applied centrifugally. The cement composition shall conform to BS EN 197-1.

Certain sections are amplified as follows:

No additives shall be used without the written approval of the Engineer and shall be used strictly in accordance with the manufacturer's recommendations.

The thickness of the lining at any one point shall not be less than the specified minimum thickness. All linings shall have a smooth uniform surface finish.

4.4.4.2 Fittings

The fittings shall be internally lined in the factory with fusion bonded epoxy coating of 250microns, in accordance with EN 14901-2006. The epoxy coating shall be suitable for potable water by test certificate from an international health institute, shall be abrasion resistant, and shall be subject to the approval of the Engineer. Prior to application of the lining the internal surfaces shall be shot blast cleaned to acceptable standard. All linings shall have a smooth uniform surface finish.

4.4.5 External Coating

4.4.5.1 General

Unless otherwise specified, ductile iron pipes and fittings shall be zinc coated with a bitumen over coating, all in accordance with the following Specifications. Buried pipes and fittings shall also have a site or factory applied polythene sleeving. Pipe coatings shall be inspected on site and any damage or defective areas made good to the satisfaction of the Engineer.

4.4.5.2 Zinc Coating

Zinc coating shall comply with ISO 8179-1and shall be applied as a spray coating. The mass of sprayed metal shall not be less than 130 g/m2 when measured as described in Clause 4.5 of ISO 8179-2.

4.4.5.3 Bitumen Coating

Bitumen coating shall be of normal thickness 0.07 mm unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416 Type II, suitable for tropical climates, factory applied in accordance with the manufacturer's instructions.

Damaged areas of coating shall be repainted on site as per the manufacturer's instructions after removing any remaining loose coating and wire brushing and rusted areas of pipe.

4.4.5.4 Polyethylene Sleeving

Unless indicated otherwise, polyethylene sleeving shall be provided in addition to bitumen coating. Polyethylene sleeving shall comply with ISO 8180 and be marked in accordance with AWWA C105.

Site applied sleeving shall be stored under cover, out of direct sunlit, and its exposure to sunlight shall be kept to a minimum. Pipes having a factory applied sleeving must be stored in the same conditions.

4.4.6 Pipes and Fittings Marking

In addition to the marking required to comply with ISO 2531, the pipes and fittings shall additionally bear readable and indelible marks as follows:

A unique identification numbers

Employer's Name (Kathmandu Upatyaka Khanepani Limited)

Spigot ends will show control marks for ease in connection.

Pipes which are gauged to allow them to be cut shall be marked by a two diametrically opposed longitudinal lines each at least 20mm wide.

4.4.7 Measurement and Payment of Ductile Iron Pipes and Fittings

Measurement for the DI pipelines supply and installation BoQ items is the total length in linear meters of the pipelines measured after installation, including, but not including the length of bends, valves, meters and other fittings. No additional lengths will be measured for spigots inserted into sockets at flexible joints.

BoQ items for supply and installation of pipelines shall include for finished, jointed pipelines, materials, transportation, laying, placing, jointing with rubber gaskets and appurtenances all complete.

The measurement of bends, valves, meters and other fittings on DI pipelines shall be by number as per the BoQ supply and installation items.

BoQ items for supply and installation of bends, valves, meters and other fittings shall include for finished, jointed assemblies, materials, transportation, laying, placing, jointing with rubber gaskets, actuators, instruments and appurtenances all complete.

Payments for DI pipelines and fittings shall be made in the following stages:

(i) 45% of the Contractor’s quoted item rate for supply and installation of pipes and fittings shall be paid upon delivery of procured pipes and necessary fittings for the said procured length of pipe.
(ii) 35% of the Contractor’s quoted item rate for supply and installation of pipes and fittings shall be paid after laying jointing of the pipes and fittings, its sectional pressure test, and reinstatement of respective road sections.

(iii) 20% of Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid upon completion of testing and disinfection as per Technical Specifications as well as completion of any pending reinstatement works.

4.5 HDPE PIPES AND FITTINGS

4.5.1 Materials

The term "materials" shall mean all materials and articles of every kind whether raw, processed or manufactured which are used in the manufacture of the Goods to be supplied under the Contract.

The intent of these specifications is the provision of high density polyethylene (HDPE) pipes and fittings. The terms PE and polyethylene showing in the Specifications shall be taken to mean HDPE or high density polyethylene.

These specifications are for High Density Polyethylene Pipe for Distribution Network of PE PN 10 pipes and house service connections of PN16 pipes of Dia 20 mm to 32 mm OD. All these polyethylene pipes hereinafter referred as PE-100 pipes or HDPE pipes.

4.5.1.1 Raw Material and Pressure Rating

Raw material used to Manufacture PE-100 Polyethylene Pipe shall be Virgin Natural Resin PE100 containing those anti - oxidants, UV Stabilizers & Pigments necessary for Manufacturing of pipes. Pressure rating of distribution pipelines shall be minimum PN10.

4.5.1.2 Effects on Water Quality

The PE-100 Pipes shall confirm for conveyance of Water for Human Consumption. Also the pipes intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in Internationally Reputed Laboratories and certificate of compliance to be produced for the following parameters:

- Odor & Flavor of Water
- Appearance of Water
- Growth of Micro Organism
- Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
- Extraction of Metals
- Colour of Pipes

The Colour of PE-100 Pipes shall be BLACK with BLUE stripes.

4.5.1.3 Dimensions

The pipe dimensions shall be as per latest revisions of IS 4984. The length of straight pipes and coil shall be according to agreed length or coil-size between Contractor and the Employer. The internal diameter, wall thickness and other dimensions of pipes shall be as per relevant tables of IS 4984. Each pipe shall be of uniform thickness throughout its length.

4.5.1.4 Performance requirements

The manufacturer should provide the test certificates for the following tests.

- Melt Flow Rate
- Density,
- Oxidation and Induction test,
- Hydrostatic Test,
- Pigment Dispersion Test,
- Longitudinal Reversion Test.

These tests should be performed in the in-house laboratory of the pipe manufacturer. The Employer will depute Third Party Inspection Agency to the pipe manufacturing facility of the manufacturer to inspect the pipes as per quality assurance plan approved by Engineer in charge. The cost for the tests shall be borne by Contractor

4.5.2 Other Requirements

All materials shall be new and of the kinds and qualities described in the clauses hereof appropriate to the particular item and shall be at least equal to approved samples except that alternative materials may be accepted provided the Contractor has at the time of Bidding:

a) drawn particular attention to the deviation from the Specification in his Bid and provided particulars of the alternative material offered at the time of Biding; and
b) Substantiated to the satisfaction of the Employer that the material offered is equal or superior to the material specified for the use to which it is to be put and has obtained from the Employer approval in writing to its use.

Where materials to be used for any component have not been laid down in the Specification, the manufacturer shall use only those materials in such compositions as have been proven in actual service to be the most suitable for the particular purpose. All pipes shall be smooth, clean and free from all defects.

Pipes may be joined with electro fusion (EF) couplers of HDPE, or by butt fusion.

For use in HDD (Horizontal Directional Drilling) butt fusion shall be used for sections of pipes. Sections must be joined by Electro-fusion couplings.

Only fully automatic Computerized Numerical Control (CNC) machines or computerized microprocessor based machines or Semi-Automatic CNC machines shall be used for joining. Manual machines are not allowed.

4.5.3 Standards

All materials, workmanship and components shall, where applicable and unless otherwise stated in the

Contract, comply with either:

a) a relevant Nepal, Indian, British or American Standard current on the date fixed for receipt of Bids, or

b) any other internationally accepted equivalent standards which, in the opinion of the Employer, are equal or better than the specified standards.

The following general standards shall also apply in addition to those specially indicated in the "Bill of Quantities" and other chapters of the Technical Specifications.

- ISO 12162:2000 Thermoplastic materials for pipes and fittings for pressure applications
- ISO 11922:1997 Thermoplastic pipes for the conveyance of fluids - dimensions and tolerances
- ISO 12176:2008 Plastic pipe and fittings - equipment for fusion jointing polyethylene systems - Part 2: electro fusion
- ISO 13950:2007 Automatic recognition systems for electro fusion joints
- ISO 13953:2001 Polyethylene pipes and fittings - determination of tensile strength of test piece from butt fused joint
- ISO 13954:2007 Plastic pipes and fittings - peel de-cohesion test for polyethylene electro fusion assemblies
- ISO 13955:1997 Plastic pipes and fittings - crushing de-cohesion test for polyethylene electro fusion assemblies
- ISO 13956:1995 Plastic pipes and fittings - pull-out DE cohesion test for polyethylene electro fusion saddle fusing joints
- ASTM D 3350 Polyethylene Plastic Pipe and Fittings Materials
- ASTM F 1055 Electro fusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing

- AWWA C901: Polyethylene (PE) Pressure Pipe, Tubing and Fittings, ½ inch through 3 inch for Water Service
- AWWA C906: Polyethylene (PE) Pressure Pipe, Tubing and Fittings, 4 inch through 63 inch for water distribution
- IS : 4984 - 1995 High Density Polyethylene pipes for potable water supplies Published by Bureau of Indian Standards, Manak Bhavan, New Delhi, India;
- BS 3284 : 1967 Published by British Standards Institution (BS), British Standards House, London W1, England.
- EN 12201 -3:2003(E) Plastics piping systems for water supply Polyethylene(PE) - Fittings
- EN 1553-3: Plastic piping systems for supply of gaseous fuels -Polyethylene (PE) - Part 3: Fittings

The acceptance of a Bid based upon a Standard or Code of Practice proposed by the Contractor shall only signify the Employer's general approval to the use of such Standard or Code of Practice and shall not signify acceptance by the Employer of any materials or workmanship subsequently found to be inferior to that specified in the corresponding Standard or Code of Practice.

4.5.4 Supply and Marking of Pipes

The pipes shall be supplied either as coils with a minimum inner diameter of 25 times the OD of the pipes, or also be supplied in other lengths where so agreed between the Contractor and the Employer. The ends shall be cut at right angles to the pipe axis and shall be plugged or covered.

All pipes, at every 1.5 meters, shall have the following markings:

- Kathmandu Upatyaka Khanepani Limited (KUKL)/PID
- Manufacturer's name of trade mark
- Dimensions
- Material supplier and material class (PE 100) Pipe Class (PN)
- Year of Manufacture
- Batch Production Number
- Applicable Standards Mark

Each pipe shall contain minimum three equi-spaced longitudinal stripes of width 3mm(Min) in blue colour. These stripes shall be coextruded during pipe manufacturing and shall not be more than 0.2mm in depth. The material of the stripes shall be of the same type of resin, as used in the base compound for the pipe.

The method of marking shall be such as to ensure that all of the information will remain legible after shipping, local haulage and storage in the open.

4.5.5 Allowable Pipe Deflection

Gradual changes in direction of HDPE pipelines can be accommodated by pipe deflection but every effort should be made to keep the pipe as central as possible within the trench to enable adequate compaction of side-fill. Minimum bend radius shall be no less than 34 x pipe outside diameter and the manufacturer's recommendations, provided no fitting or flange is present in the bend. If there are fittings or flanges in the bend, minimum bend radius shall be 100 x pipe outside diameter.

4.5.6 Fittings

Polyethylene fittings shall be manufactured by injection moulding complying with the standards given in the reference standards in the document. Following information shall be marked on the fittings where applicable respectively to water supply or sewerage:

- Manufacturer’s Identification
- The dimensions (nominal outside diameter and nominal wall thickness).
- In case of a bend, bending angle and in case of unequal tee branch line size and main line size.
- Designation of pipe material (i.e. PE value)
- Standard number (specification number)

- Pressure rating at relevant temperature
- Standard Dimension Ratio (SDR)
- The word “Water” and the identification mark in letter size as specified
- Certification by the Inspection Agency approved by the ENGINEER.
- Fusion time (Seconds)
- Cooling time (minutes)
- System voltage
- Production period (date of manufacturer)

Contractor is responsible for compatibility between pipe materials, fittings and appurtenances. All fittings must be PN10 (SDR 17) to be compatible with the pipelines.

4.5.6.1 Electro fusion Fittings:

Electro fusion fittings shall be used when joining polyethylene materials like couplers, reducers, tees, end caps, bends, elbows, etc. Only if absolutely necessary due to field conditions, butt fusion will be allowed, subject to the approval of the Engineer. All fittings shall be manufactured by injection moulding process, with a clear marking of the manufacturer's name, pipe connection size and working pressure rating. In addition, each fitting shall have a bar code to set the fusion procedure.

The fittings shall contain no recycled compound, and shall be homogenous throughout and free of visible cracks, holes, voids, foreign inclusions and other defects that may affect the wall integrity.

The electro fusion control box should be capable of downloading jointing reports of each weld to a computer. The reports shall be appropriately identified and provided to the engineer in both paper and electronic form. The reports shall include, as a minimum, the fusion date, time, ambient temperature, fitting type and size, user ID and manufacturer of the part.

Qualification of the fusion technician shall be demonstrated by evidence of electro fusion training, within the past year, on the equipment to be utilized for the project. The training shall be certified by the electro fusion equipment supplier.

The Contractor shall submit to the Engineer a detailed installation guideline/procedure, in accordance with the fitting manufacturer’s recommendations. This should include safety procedures, tools/equipment required, staff requirements including list of names of qualified electro fusion operators, pre-installation requirements, installation steps, fault rectification, inspection and process documentation as discussed above

4.5.7 Measurement and Payment of HDPE Pipes and Fittings

Measurement of HDPE pipelines and service connection pipes is for supply and installation is the total length in linear meters of the pipelines measured after installation, including the lengths of pipes, electro-fusion (EF) Couplers and HDPE Bends, but not including the length of any other fittings or other appurtenances.

BoQ items for pipelines shall include for finished, jointed pipelines, materials, transportation, laying, placing, jointing and appurtenances all complete and including service pipes.

HDPE Bends and EF Couplers will not be paid independently, therefore all cost of bends and couplers must be included in the Pipeline Supply and Installation BoQ item.

The measurement of supply and installation of valves, meters, service connection water meter sets, instrumentation and other fittings on HDPE pipelines shall be by number as per the BoQ supply and installation items. BoQ items for fittings shall include finished, jointed assembly into pipelines, materials, transportation, laying, placing, jointing with rubber gaskets and/or EF Couplers, and appurtenances, all complete.

Payments for HDPE pipelines and the fittings on HDPE pipeline shall be made in the following:

(i) 45% of the Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid upon delivery of procured pipes and necessary fittings for the said procured length of pipe.

(ii) 35% of the Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid after laying jointing of the pipes and fittings, its sectional pressure test, and reinstatement of respective road sections.

(iii) 20% of Contractor's quoted item rate for supply and installation of pipes and fittings shall be paid upon completion of full DMA testing and disinfection as per Technical Specifications as well as completion of any pending reinstatement works.

4.6 STRUCTURED WALL PLASTICS PIPING WORK

This specification covers pipes and fittings with non-smooth external and smooth internal surface based on Polyethylene structured wall piping system for non-pressure underground drainage and sewerage.

4.6.1 Materials.

4.6.1.1 Pipes.

The material from which the pipe is produced shall consist substantially of polyethylene (PE) to which may be added those additives that are needed to facilitate the manufacture of these pipes and fittings conforming to requirements of this standard as per Tables 31, and 32.

Table 31: Material Characteristics for PE Material in Granules Form

Sl No.	Characteristics	Requirements	Test Parameters	Method of Test, Ref to	
				Annex	IS
(1)	(2)	(3)	(4)	(5)	(6)
i)	Base density	≥ 0.930 g/cc	In accordance with IS 7328	—	7328
ii)	Melt flow rate (MFR)[1)]	≤ 1.6 g/10 min	a) Temperature — 190°C		
			b) Loading mass — 5 kg	—	2530
iii)	Thermal stability (oxidation induction test, OIT)	≥ 20 min	Temperature — 200°C	C	—

[1)] For PE rotational moulded fittings, MFR values should be between 3g/10 min and 16g/10 min.

Table 32: Material Characteristics for PE Material in Pipe Form

Sl No.	Characteristics	Requirements	Test Parameters			Method of Test, Ref to
(1)	(2)	(3)	(4)			(5)
i)	Resistance to internal pressure, 165 h[1)]	No failure during the test period	a) Test temperature	—	80°C	IS 12235 (Part 8/Sec 1)
			b) Orientation	—	Free	
			c) Number of test pieces	—	3	
			d) Circumferential stress	—	4.0 MPa	
			e) Conditioning period	—	27 ± 2°C	
			f) Type of test	—	Water-in-water	
			g) Test period	—	165 h	
ii)	Resistance to internal pressure 1 000 h[1)]	No failure during the test period	a) Test temperature	—	80°C	IS 12235 (Part 8/Sec 1)
			b) Orientation	—	Free	
			c) Number of test pieces	—	3	
			d) Circumferential stress	—	2.8 MPa	
			e) Conditioning period	—	27 ± 2°C	
			f) Type of test	—	Water-in-water	
			g) Test period	—	1 000 h	

[1)] For the above PE compound, this test shall be carried out in the form of a solid wall pipe made from the relevant grade of material.

Clean, reprocess able material generated from a manufacturer's own production according to this standard may be used if it is derived from the same raw material as used for the relevant production. Reprocess able material obtained from external sources and recyclable material shall not be used.

The structured wall of the pipe shall be formed by a corrugated outer wall and a smooth inner surface.

The joint between pipes shall be made by elastomeric sealing ring positioned in the socket of pipes or fittings, obtained by in-line extrusion during pipe production.

4.6.1.2 Fittings

The following types of fittings are permitted as per IS 16098 (Part 2).

a. Bends, swept and unwept angle

b. Couplers

c. Reducers

d. Branches and reducing branches, swept and unswept entry

e. Plugs

4.6.2 Physical Characteristics for pipes and fittings

The structured outer layer of the pipes and fittings shall be uniformly corrugated, and the inner layer shall be smooth and plain. Both layers shall be free from any visual defects such as cracks, blisters, foreign inclusions, and any other visual irregularities which may cause harm to its construction integrities. The inner and outer layer of pipes and fittings shall be colored throughout. The outside layer of the pipes and fittings should preferably be black, orange, brown or gray. Physical characteristics of PE and PP pipes should be as specified in Table 31 and 32.

Characteristics and test methods	PE	PP
Resistance to heating, over test IS 12235 (Part 2)	The pipe shall show no delamination, cracks or bubbles, test parameter refer Table 6 and able 7 of IS 16098 (Part 2)	

4.6.2.1 Mechanical Characteristics

4.6.2.1.1 Pipes and fittings.

Table 33. Mechanical characteristics pipe for PE pipes

Characteristics and test methods	PP	PE
Ring stiffness	**In accordance with Annex C of IS 16098 (Part 1) and IS 12235 (Part 9)** a) DN≤ 500: SN4, SN8, SN16 b) DN≥ 500: SN2, SN4, SN8 or SN16	
Impact strength	TIR ≤ 10% Testing parameters refer Table 10 of standard IS16098 (Part 2)	
Ring flexibility	30 percent mould split line, when applicable, at 0°, 45º and 90º from the upper plate compliant with Annex D of IS 16098 (Part 1)	
Compression rate	≤ 4 at 2 year extrapolation compliant with Annex E of IS 16098 (Part 1)	

Table 34 Mechanical characteristics pipe for pipe fittings

Characteristics and test methods	Requirements
Stiffness	**In accordance with Annex C of IS 16098 (Part 1)**
Impact Test	No cracks through the wall; jumped-off sealing elements shall be able to be restored in correct position manually, refer Annex C of IS 16098 Sec. 8.2.2
Mechanical strength or flexibility	No signs of splitting cracking, separation and/or leakage, test parameter and method refer Table 11 and Annex E of IS 16098 (Part 1)

4.6.3 Manufacturers

4.6.4 General

The method of manufacture shall be such that the forms and dimensions of the finished pipe are accurate within the limits specified in this standard. The surfaces and edges of the pipes shall be well defined and true.

4.6.5 Marking

Marking shall be labelled, printed or formed directly on the pipe or fitting, in such a way that after storage, weathering and handling the legibility shall be maintained. Marking shall not initiate cracks or other types of defects which adversely influence the performance of the pipes or the fitting.

Each pipes shall be marked at intervals of maximum 3 m, at least once per pipe, with the following information:

a) Manufacturer's name/Trade-mark;
b) Diameter series, nominal size;
c) Stiffness class;
d) Material; and
e) Lot number/batch number containing information regarding period of manufacture.

Each fitting shall be marked with the following information:

a) Manufacturer's name/Trade-mark;
b) Diameter series, nominal size;
c) Nominal angle;
d) Stiffness class;
e) Material; and
f) Lot number/batch number containing information regarding period of manufacture.

4.6.6 Dimensions

4.6.7 Diameter of Pipe

The internal diameter (DN/ID) shall be as per Table 35 . Other nominal sizes, falling within the range of Table 35 are also permitted.

For DN/IDs not specified in Table 35, the minimum inside diameter, dim, Min, shall be linearly interpolated between the adjacent values specified in Table 5.

Table 35. Nominal Sizes, Minimum Mean Inside Diameters, Thickness of Inside Layers and Socket Length

Sl No.	DN/ID Series		Minimum Wall Thickness		Socket[1] Length
	DN/ID	$d_{im,Min}$ mm	$e_{s,Min}$ mm	$e_{3,Min}$ mm	A_{Min} mm
(1)	(2)	(3)	(4)	(5)	(6)
i)	75	71	1.0	0.85	27
ii)	100	93	1.0	1.0	32
iii)	125	120	1.2	1.0	38
iv)	135	130	1.2	1.0	39
v)	150	145	1.3	1.0	43
vi)	170	165	1.4	1.0	48
vii)	200	195	1.5	1.1	54
viii)	225	220	1.7	1.4	58
ix)	250	245	1.8	1.5	59
x)	300	294	2.0	1.7	64
xi)	400	392	2.5	2.3	74
xii)	500	490	3.6	3.0	85
xiii)	600	588	3.5	3.5	96
xiv)	800	785	4.5	4.5	118
xv)	1 000	985	5.0	5.0	140
xvi)	1 200	1 185	5.0	5.0	162

[1] For selection of A_{Min} requirements for socket, refer to the pipe material and construction. For pipes longer than 6 m it is recommended that one produce a larger A_{Min} than is specified in this table.

4.6.8 Length of Pipe

The effective length of pipe, "l" shall be not less than that specified by the manufacturer (6m) when measured the length avoiding the socket length.

4.6.9 Diameters of Pipes and Spigots of Pipes or Fittings

The nominal sizes and minimum mean inside diameter for DN-ID series are specified in Table 2. The outside diameters of the DN-ID series pipes and spigots intended to have jointing dimensions as pipes and/or fittings according to this standard shall comply with the outside diameters and tolerances as specified by the manufacturer. However, the guidelines for pipes, spigots and fittings not intended to have jointing dimensions as pipes and/or fittings according to this standard, the tolerance of the outside diameter of pipes and spigots, fittings shall be:

$$d\text{em, Min} \leq 0.994 \times d\mathbf{e}$$

$$d\text{em, Max} \geq 1.003 \times d\text{e}$$

where, *d*e = nominal size of outside diameter as specified by the manufacturer of a DN-ID designated pipe. The results are to be rounded to the next higher 0.1 mm.

For these pipes, the requirement regarding the socket and spigot dimension, AMin specified in Table 2 applies. In the case where other nominal sizes other than those specified in Table 2 are selected, the requirements regarding the socket dimension *A*Min shall be linearly interpolated between the adjacent values specified in Table 2. The minimum mean inside diameter of socket, *D*i, Min shall be equal to *d*e, Max.

4.6.10 Construction and workmanship

4.6.11 Transportation

The arrangement of loading the pipes in a telescopic manner is advised, that is, smaller diameters inserted into the next higher sizes of pipes up to the height of 2.5 m in a truck. While loading the pipes into the truck, care should be taken that the spigot/coupler end should be arranged alternatively in the corresponding layer so as to avoid the damage to the coupling/socket-end.

4.6.12 Handling

Following recommendations shall be followed while handling the pipes:

a) Pipes shall be smoothly lowered to the ground.

b) Pipes should not be dragged against the ground to avoid the damages to the coupler/ pipes.

c) 900 mm and larger diameter pipes are carried with slings at two points spaced approximately at 3 m apart.

d) For smaller diameters (450 mm to 900 mm, both exclusive) one lift point shall be sufficient.

e) For diameters smaller than or equal to 450 mm, manual labour can be used.

f) Loading boom or fork lift should not be used directly on or inside pipe.

4.6.13 Pipe storage at site

- Stockpiling shall be done temporarily on a flat clear area as per IS 16098 (2).
- For avoiding collapse of stacks use wooden posts or blocks.
- Stacking shall not be higher than 2.5 m.
- While stacking, alternate the socket/coupler ends at each row of stacked pipes.

4.6.14 Construction Methods

4.6.14.1 Trench Preparation

4.6.14.1.1 Dimensions

The width of a sewer trench depends on the soil condition, type of side protection and the working space required at the bottom of trench for smooth installations. Increase in width over required minimum would unduly increase the load on pipe and cost of road restoration. Considering all above factors, the minimum trench width should be at least specified in Clause 3.1.5.5 or specified in table 36.

4.6.14.1.2 Excavation

Excavation of sewer trenches shall be as per the Clause 3.1

In the event, the presence of ground water is likely to cause instability in soil conditions, a well point system may be adopted for lowering of ground water table below the requisite trench bed level. If excavation is made deeper than necessary, the same shall be filled and compacted.

Table 36 Minimum Trench Widths (All dimensions in millimetres).

S. No. (1)	Pipe Diameter (2)	Trench Width (3)
i)	75 to 200	0.6
ii)	250	0.7
iii)	300	0.8
iv)	400	0.9
v)	600	1.2
vi)	800	1.3
vii)	900	1.6
viii)	1 000	1.8
ix)	1 200	2.0

4.6.14.1.3 Shoring/mild steel sheet piling

The protective shoring works shall be as per the Clause 3.1.5.5 and strong enough to prevent caving in of trench walls or subsidence of contagious areas adjacent to trench.

For wider and deeper trenches, a system of wall plates (wales) and struts of steel section or heavy timber section is commonly used as per the requisite structural design. In non-cohesive soils with high ground water table, continuous interlocking mild steel sheet piling may be necessary to prevent excessive soil movements due to ground water percolation. Such sheet piling shall extend 1.5 m below the trench bottom unless the lower soil strata are adequately cohesive.

4.6.14.1.4 Underground services

The underground public and private utility services exposed due to the excavation shall be effectively supported under the guidance of the owners of such services.

4.6.14.1.5 Dewatering

Sewer installation trenches shall be adequately dewatered for the placement of pipe at proper gradient till the pipe is integrated through socket and spigot joint/coupler assembly with the already laid segment. In addition, Precautions are to be taken to arrest floating of installed sewer segments against buoyant forces in case of sudden accumulation of water in the trench. The diameter wise minimum cover necessary to counteract the buoyant forces is given in Table 37.

For exceptional cases of higher level of ground water, additional anchoring at equal intervals would be necessary.

Table 37. Required Minimum Cover to Prevent Floatation

Sl No. (1)	Nominal Diameter mm (2)	Minimum Cover mm (3)
i)	75	65

ii)	100	77
iii)	150	102
iv)	200	127
v)	250	178
vi)	300	368
vii)	400	505
viii)	600	711
ix)	900	1 067
x)	1 050	1 219
xi)	1 200	1 372

NOTE — Computation is based on the pipes being completely empty, water table at the ground surface, solid density of 2 083 kg/m3 and a soil friction angle appropriate for most sand/ gravel mixtures. The average of the inside and outside diameters was used to determine solid and water displacement.

4.6.14.1.6 Bedding

As per IS16098:2003 (2),

a) Normally, even for the maximum combined loading (wheel load + backfill), any form of cement concrete structural bedding would not be necessary.

b) For maintenance of sewer slopes the initial backfill envelop with sand or gravel (as computed through structural design of buried flexible conduit) over a single BFS would be sufficient.

c) In the event, anchorage becomes imperative the transverse concrete anchorage blocks spaced at suitable interval shall also act as chairs for defining and maintaining the sewer slopes.

The thickness of bedding shall be 100 mm up to 400 mm ID plastic pipes and 150 mm for pipes above 400 mm ID pipes. The compacted bedding shall compose of crushed stone and stone/sand mixtures (as per ASTM-D2321, Class 1 B) with gradations selected to minimize migration of adjacent soils; contain little or no fines, 50% or more of gross retained by 4.75 mm sieve opening and more than 95% retained by 0.075 sieve opening. Bedding material shall be dry and low grain-sized, well graded and with maximum dimension of the particles as defined in the Table 38 below:

Table 38: Maximum grain-size of the soil used for the bottom

Nominal size DN	Maximum size of the grains (mm)
DN < 100	15
100 ▪ ▪DN < 300	20
300 ▪ ▪ DN < 60	30
600 ▪ ▪DN	40

4.6.14.2 Laying and Jointing

4.6.14.2.1 Laying

For shallow trenches, they will be placed manually on the initial backfill envelop directly.

For deep trenches with shoring/mild steel sheet piling

a) Make the trench reasonably free from ground water and other liquids.

b) Place the pipe on the top-level cross-struts of the timber shoring/mild steel sheet piling frame work.

c) Dismantle one/two cross struts and lower the pipe to the immediate lower layer of the cross- struts and re-fix the struts immediately.

d) In the same manner, reach up to the initial back filling and place the pipe at proper slope.

e) Ensure anchorage, if any, after laying.

4.6.14.2.2 Jointing

Various methods for jointing such as regular coupler made by online process, spigot and sockets are used.

The moulded socket will have a suitable internal surface with profiles ribs for insertion of the next pipe into it. The socket end of the pipe to be inserted will have corrugated outer layer. On first valley segment of corrugated pipe (destined to be pushed into the coupler) one elastomeric rubber ring needs to be placed which is pushed into the coupler socket. This provides sufficient gripping lock and leak proof joint.

Similar system is also used for fabricated accessories or moulded fittings required such as tee, bends, elbows, reducer end caps for the purpose of installation of the system related to drainage/sewerage.

For quality connections following steps are to be ensured, failing which the performance aspects are to be severely compromised:

a) The non-coupler end needs to be thoroughly cleared and shall be free from any foreign material.

b) Use a clean rag or brush to lubricate the non- coupler end with lubricant.

c) Clean and lubricate the coupler end of the pipe to be laid in similar manner.

d) Lubricate the exposed gasket in the same manner with pipe lubricant.

e) Keep the lubricated non-coupler end free from dirt, backfill material, and foreign matter so that the joint integrity is not compromised.

f) Push the coupler into non-coupler and align properly. Always push coupler end into non- coupler end.

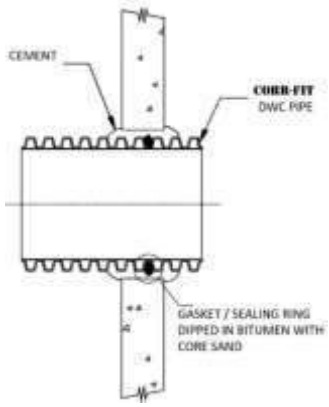
For smaller diameter pipes simple manual insertion shall be sufficient. In every methodology, it should be ensured that the coupler end is adequately 'homed' within non-coupler end to ensure installation and tight joining seal. Therefore, prior to insertion always place a homing mark on appropriate corrugation of the non-coupler end.

4.6.14.2.3 Jointing different pipe types or sizes

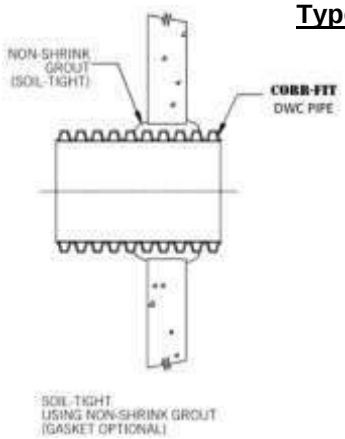
Sewerage/drainage system often encounters connecting pipes of different materials/sizes, etc. The fittings or adapters specifically designed for the purpose are available.

A selection of fittings designed to make the transition from one material directly to another are also available. In few cases, fitting may need to be used in combination with separate manufacturer's gasket or coupler to give proper effect to the transition.

Type A



Type B



4.6.14.3 Manholes and Catch Pit Connections

Plastic Pipes are compatible with all types of manholes, recommended techniques for installation with concrete/brick mason manhole is shown below. Manufacturer specified pre-fabricated appurtenant structures made of thermoplastic materials shall also be available for onsite user-friendly installations. Similar methodology shall be followed for integration of catch pits.

4.6.14.4 Sewer Connections

Other connecting lines shall be integrated with the already laid system in the same manner as of original sewer lines.

4.6.14.5 Construction of Backfill Envelope and Backfilling of the Trenches

These pipes and well compacted backfill envelope work together to support soil and traffic load.

In general, material used for construction of backfill envelop around the pipe comprises the following:

Hunching or side-backfill

Initial backfill; and

final backfill.

The material for backfill envelop shall be as per the structural design of flexible buried conduit. It can be the same material that were removed in the course of excavation or it can be fine sand/course sand/gravel depending on the over burden and superimposed load, but it should be the concrete which invariably induces undesired rigidity in the system.

The remaining portion of backfilling shall be the materials that were removed in the course of excavation. These materials shall consist of clean earth and shall be free from large clod or stone above 75 mm, ashes, refuse and other injurious materials.

After completion of laying of pipes, etc, first the backfill envelope shall be constructed as per design around pipe. Voids must be eliminated by knifing under and around pipe or by some other technique and compacted with necessary watering, either by hand rammers or compactors to a possible maximum level of proctor density.

Precautions shall be taken against floatation as per the specified methodology and the minimum required cover.

4.6.14.5.1 Hunching and initial backfill:

The side- backfill and initial backfill shall compose (as per ASTM-D2321- Class II) of either of the following:

Clean, Coarse-grained soil: Well-graded gravels and gravel-sand mixtures; little or no fines, 50% or more of gross retained by 4.75 mm sieve opening and more than 95% retained by 0.075 sieve opening.

Clean, Coarse-grained soil: Well-graded sands and gravelly sands; little or no fines. 50% or less of gross retained by 4.75 mm sieve opening and more than 95% retained by 0.075 sieve opening.

Material shall be dry and low grain-sized, well graded and with maximum dimension of the particles, as approved by an engineer.

Work in around pipe by hand to provide uniform support. After the pipe is laid, place the pipe zone backfill in layers on each side of the pipe. The height of the side-backfilling shall be at least 150 mm over the upper side of the pipe and 100 mm over the upper side of the joint section. Each layer shall be compacted according to the required compaction degree. The height of each layer shall be defined according to the chosen compaction methods, as described in the table. This table gives the recommended maximum layer thickness and the number of passes required to achieve the compaction classes for the various types of equipment. Average thickness for backfill layer are 30 cm. Where it is expected that ground water may flow through the granular embedment the provision of barriers such as clays tanks should be considered. For long-length

installations, backfill the pipeline in more steps. Avoid to backfill during the hottest hours of the day in order to prevent excessive thermal elongations.

Initial backfill shall be installed and compacted to a minimum of 150mm above pipe crown. OMC to a density of at least 90 % of modified AASHTO maximum density hand tampers or vibratory compactors shall be used.

4.6.14.5.2 Final backfilling

The remaining part of the backfill may be made with excavated material. No mechanical device should be used for the very first layer of the remaining backfill in order not to damage the pipe. The rest of the backfill can be mechanically compacted (where required) as long as the compaction level achieved as per Clause 3.1.5.10.

4.6.15 Tests of Pipes

In order to ensure the strength of pipes as per specified standard IS 16098 (Part 2), the contractor has to carry out tests according to Engineer's instruction. Acceptance tests are carried out on sample selected from a lot for the purpose of acceptance of the lot in accordance with.

- Certification on display and reference norms. The performances are defined in the certificate of analysis, which contain the list of the tests defined by the norm. Internal tests are also performed at steady intervals. Each raw material lot is tested in order to check its properties which must be within the ranges defined by the standard.
- For each production lot, the certificate of analysis contains test reports such as:
- Dimensional check on Internal diameter, outer diameter and the “e5” wall thickness;
- Vertical deflection test according to IS16098 (2) (Ring stiffness test)
- Ring flexibility test at high deflection rates without cracks or buckling;
- Impact resistance test without cracks
- In addition to the above mentioned tests, other tests are carried out steadily on the products and are included in the technical production documentation.
- Marking shall be made at least each 2 meters of pipe; it will be according to the norm

4.6.16 Measurement and Payment of Structured Wall Plastic Piping Works

Measurement of pipe should be done in unit length and payment will be made finished jointed pipes including cost of pipe, transportation, laying, placing, jointing with rubber seal all complete. Payment will be made of finished jointed unit length according to the BoQ clause after completion of backfilling, pressure testing and reinstatement of roads and paved areas. MECHANICAL WORKS

4.7 VALVES

4.7.1 Valves General

Valves shall be designed to meet the operational and environmental conditions as specified in the particular section of the specification.

Those for use in sewage, water, gas, air, or oil systems shall be as specifically detailed for the application. Unless otherwise specified, valves shall be provided to suit the maximum working pressures including all surge pressures.

All valve bodies shall give the following information:

- Manufacturer's name
- Hydraulic operating pressure
- Size of valve
- Direction of flow `Arrow'

All valves, spindles and hand wheels shall be positioned to give good access for operational personnel. It shall be possible either to remove and replace or to recondition seats, gates or gland packing which shall be accessible without removal of the valve from the pipework or, in the case of power operated valves, without removal of the actuator from the valve.

Extension spindles shall be supplied wherever necessary to achieve the specified operating requirements. Where extension spindles without hand wheels are fitted, such as below operating platforms, the extension spindle shall terminate 75mm below the operating platform access level with a securely fixed female tapered square section suitable for T-key operation. The Contractor shall supply a set of T-keys, at least two for each discrete operational area. The T-keys shall be fabricated from mild steel, be free of all weld splatter or sharp edges, have a solid male socket, be 1m long, and with the cross handle 600mm total length.

Valves buried or installed in underground chambers where access to a hand wheel would be impractical shall be operated by means of extension spindles and/or keys.

The operating gear of all valves and penstocks shall be such that they can be opened and closed by one man against an unbalanced head 15 % in excess of the maximum specified service value and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 40 kg. Where the effort required to operate a valve exceeds this figure then a reduction gearbox shall be provided

All hand-wheels shall be arranged to turn in a clockwise direction to close the valve or penstock, the direction of rotation for opening and closing being indicated on the hand-wheels. Hand-wheel diameters shall not exceed 450mm.

The hand-wheels shall be coated with black plastic and incorporate facilities for padlocking in either the open or closed position.

Lever operated quarter turn valves shall have the lever parallel with the axis of the pipe when the valve is open.

Power operated valves shall include equipment for manual operation by means of a hand-wheel or other suitable device which shall be interlocked with, and fixed to, the power unit.

Headstocks and valves shall be fitted with mechanical position indicators to show the amount which the valve is open or closed in relation to its full travel, i.e. closed 0.25, 0.50, 0.75 and fully open.

Valves shall be operated safely in accordance with the properties of the whole system. Valve bodies shall be made from A536 60-40-18 or A536 65-45-12 spheroidal cast iron. The wall thickness of the valve body shall be in accordance with the minimum dimensions required by AWWA C304, and disks shall be manufactured from ASTM A536 60-40-18 spheroidal cast iron.

Actuator mechanisms for butterfly valves operated manually or by motors shall be of the gear box type.

Gear box mechanisms shall be protected against excessive torque with on-off limit switches and other related accessories.

For power operated valves, gear boxes shall be operated by a mechanical pawl and the valve shall be capable of being manually operated independently of the motor.

Valves shall be supplied with their adjoining flanges for incorporation in the pipework system.

Facing rings, seating rings, wedge nuts and all other trim used for valves shall be of corrosion resistant grade bronze or stainless steel.

The valve stem, thrust washers, screws, nuts and other components exposed to the water shall be of a corrosion resistant grade of bronze or stainless steel.

Valve bodies and other components of plastic or other non-metallic materials shall be compatible with the fluid being handled and be of robust industrial design.

All valves of the same size and pressure rating shall have the same face-to-face dimensions and the same flanges and be fully interchangeable. Operating mechanisms of valves of the same size and type shall be interchangeable

4.7.2 Air Valves

Air valves shall be provided for installation at high points or changes in gradient in pipelines and elsewhere as shown on the drawings, to fulfil the following functions:

- To exhaust air from a pipeline automatically when it is being filled with water, the air being released at a sufficiently high rate to prevent back pressure restriction of water inflow rate.
- To ventilate a pipeline automatically when it is being emptied of water, the air inflow rate being sufficiently high to prevent the development of vacuum conditions in the pipelines.
- To release air accumulating in pipelines automatically during normal working conditions.

4.7.2.1 Types

Air valves shall be of one of the following types:

- Double orifice type with a large orifice which allows large volumes of air to be exhausted from or admitted into a system as it is filled or drained, and a smaller orifice which automatically vent small pockets of air as they accumulate at points in a system while is operating and pressurized.
- Single large orifice type for automatic ventilation or exhaust of pipeline.
- Single small orifice type for automatic release of air under normal working pressure.

Large orifice air valves, including those incorporated in double orifice air valves shall be constructed so that the air flow actively holds the valve open during the discharge of air at all flows up to and including sonic velocities. They shall, when coupled to their respective isolating valves, be capable of admitting to or exhausting from the pipeline to which they are connected the required quantities of free air without the pressure differential across the combined air valve and isolating valve exceeding 0.5 bar.

Small orifice air valves, including those incorporated in double orifice air valves shall be capable of opening and discharging up to not less than 0.5 m^3/min of free air when the pressure in the pipeline is at the maximum working pressure for which the valve is designed.

All material of valves shall be completely compatible to eliminate corrosion, electrolytic actions and dezincification.

4.7.2.2 General Specification

The nominal pressure range shall be PN 16 unless indicated otherwise in the Drawings or Bill of Quantities. Body ends shall be flanged (PN 16) with raised faces and drilled BS EN 1092-2 (ISO 2531).

The materials for the valves shall be as follows:

- Body cover and cap: Ductile Iron SG 400-15 to BS 2789/BS EN 1563”1997; Grade 500/7
- Small orifice: Ductile iron with gunmetal seat (BS 1400 LG2 or equivalent)
- Small orifice float: Rubber covered or other approved
- Large orifice: Ductile iron with rubber seat
- Large float: Vulcanite covered or other approved

Body and other uncoated ferrous parts painted with fusion bonded epoxy 250 micron thick and all cover bolts shall be of SS304 and gaskets and seals of EPDM

Air valves shall be designed so that each float seats against its orifice or causes the orifice to be closed without leakage at all pressures between 0.2 bar and the specified test pressure. Balls and seats shall be designed so as to minimize the risk of adhesion of the ball to the seat. They shall be of a type proven by experience to be suitable for the specified duties.

Each air valve shall be provided with an isolating valve. Air valves with a connection not exceeding 25 mm diameter to the main pipeline shall each have an integral lever-operated isolating ball valve. All other air valves shall have a separate resilient seated, double flanged, butterfly valve with lever operation.

Each small orifice or double air valve shall be fitted with a test cock in the valve body to permit easy verification that the small orifice air valve is operating properly and that its orifice is not blocked.

All air valves except for 15 mm and 25 mm air valves shall be of double ball / orifice type. The small ball shall operate when the pipeline is under normal operating conditions, and the large ball shall operate when the pipeline is being filled or emptied. The balls shall not close the valve when air is being drawn in or discharged.

The 15 mm and 25 mm air valves shall be ductile iron of the single ball / orifice type and shall be provided each with a brass ferrule or nipple, cut with the appropriate size of thread to ISO 7-1 for making a watertight screwed joint with the main.

Air valves of 100 mm and above shall have flanged connections.

4.7.2.3 Tests

Test certificates shall be provided with each valve showing.

a) Hydraulic testing to at least 1.5 x working (rated) pressure or high pressure strength test
b) Low head leakage tests
c) Small orifice testing
d) Large orifice discharge test

During the tests the air flow rates shall be measured by orifice plates in accordance with BS 1042. Pressures (positive and vacuum) shall be measured by Bourdon tube gauges in accordance with BS 1780, or by means of a mercury-in-glass manometer. The temperature of the flowing air shall be measured in accordance with BS 1041: Part 1 and Part 2. The barometric pressure shall also be measured.

4.7.2.4 Marking

Marking shall be as per section 6.1 AWWA C512 or EN 1074-4.

4.7.3 Gate Valves

4.7.3.1 General Specifications

Gate valves shall be resilient seated double flanged and comply with BS EN 1171. All valves shall be suitable for use with potable water. Valves complying with BS 5163 are acceptable provided that they also comply with BS EN 1171.

Valves shall be provided with renewable seats and it shall be possible to replace these without removing the valve body from the pipework.

Unless otherwise detailed on the Drawings, gate valves in chambers, and other similar locations shall be provided with hand-wheels. Valves which are to be buried in the ground shall be provided with extension spindles, protection tubes, spindle caps, spindle supports and surface boxes.

Where specified, resilient seat type valves shall be provided. The valve shall have an unrestricted opening when fully open

Specific Clauses of BS EN 1171 are amplified as follows:

1. Type: Solid with non-rising stem
2. Body: Ductile Iron SG 500-7 as per BS EN 1563 (GGG 400 - DIN 1693) of PN 16
3. Wedge: Ductile Iron SG 500-7 as per BS EN 1563 encapsulated in EPDM (food grade approved by WRAS or equivalent certification authority)
4. Face to face dimension: Shall be as per ISO 5702 series, BS 1563, EN 558 Series 3
5. Flanged and drilled to BS EN 1092-2, ISO 7502-2 PN16
6. Nominal Pressure: PN 16
7. Bypasses: Gate valves shall not be fitted with bypasses

8. Painting: The valve body and other uncoated ferrous part shall be painted with fusion bonded epoxy paint of thickness minimum 250 microns thick applied by electro-static method (food grade approved by WRAS or equivalent certification authority). Coating shall be tested by high-voltage method for perfect cover.
9. Corrosion protection: All valves shall be internally and externally lined and coated by epoxy powder applied hot by electro-static method, complying in general with DIN 30677 Part 2, coating thickness shall be minimum 250µm.
10. Internal bolts, nuts and screws: Stainless steel
11. Marking: Each gate valve shall have the following marking.

On Body: Nominal Diameter in mm (DN)

Nominal Pressure in bar (PN)

On Identification Table: Reference of Valve -Manufacturer Name/Logo

Closing direction

Year and Manufacturer -number

Reference Standard

4.7.3.2 Operation

Gate valves shall be provided with ductile iron hand wheels or square heads for tee key operation and shall be designed as per BS EN 12570:2000

The direction of operation shall be clockwise to close the valve.

Buried valves shall be supplied with stem nut coupling, sleeves and extension spindles with adjustable length according to the requirements on Site. The extension spindles shall be made of hot dip galvanized iron, coupling sleeves of galvanized ductile iron, connection pins of Cr and Ni steel.

The top of the extension spindle (key rod) shall be fitted with cast iron surface box according to DIN 4056 or similar with pre-cast concrete support of 380 mm diameter and 65 mm thickness or as otherwise shown in the drawings. A suitable PE guard tube including cover shall protect the spindle itself.

Valves to be installed above ground or in valve chambers shall be provided with hand wheels of cast iron hand wheels for diameters less than 300 mm, and for diameters of 300 mm or above, with actuators. Handwheels shall have smooth rims and have a diameter to enable two men to operate the valve. The direction of opening and closing shall be marked on the handwheel.

4.7.3.3 Test Certificate

The Supplier shall provide a test certificate confirming that the valves have been tested in accordance with EN 12266-1/BS 5150 and stating the actual pressures and medium used in the test. In addition, the Supplier shall ensure that the Purchaser has access to the manufacturer's works at all reasonable times for the purposes of inspecting the assembled valves and witnessing testing.

The reduction gears shall be made of steel with machined teeth and unless otherwise provided, they shall be enclosed in a cast iron or fabricated steel sealed housing with oil seals and shall operate in an oil bath. The pinion shaft and screw stems shall be made of alloy steel. The pinion shaft shall be provided with bronze sleeves.

The thrust bearing at each end of the pinion shaft shall have external fittings to permit lubrication with grease. The screw stem shall have a thrust bearing of the ball or roller type which can be lubricated with grease through an external fitting.

The gear box shall indicate the position of the disc, shall be suitable for installation in a wet chamber.

4.7.4 Butterfly Valves

4.7.4.1 General Specifications

Butterfly valves shall be suitable for frequent operation as well as for operation after long periods of idleness in either the open or closed position.

Valves of sizes below DN 300mm shall be operable manually with mechanisms of the gear box type and hand wheel.

All valves of DN 300 and above shall be furnished with manually operable gear box mechanisms and a complete electrical actuator system attached to the gear box. Electrical actuator shall be complying relevant ISO/National Standards. Valve manufacturer shall confirm suitability /compatibility of actuator proposed for operation of valve. All valves shall be PN16 unless indicated otherwise in the drawings or bill of quantities.

Where required, butterfly valves of 500 mm or greater diameter shall have a by-pass system. Particular attention shall be given to the pipework both upstream and downstream of all butterfly valves to ensure that the disc cannot foul the adjacent pipe.

Valve seats which extend over the face of the flanges to secure the seat in place, or which require surface grinding and/or hand fitting of the disc; or designs which require the adjoining pipe flange to retain the seat in place and resist line pressure, are not acceptable.

Butterfly valves shall comply with latest version of BS EN593 and following features:

- Double flanged, double eccentric long type and shall have integral standing feet.
- Face to face dimensions to EN 558-1 GR 14-short (DIN 3202-F4).
- Nominal pressure rating PN16 unless indicated otherwise in the Drawings or Bill of Quantities.
- Body and disk shall be of ductile iron EN-GJS-400-18 according to EN 1563 (GGG 400 - DIN 1693).
- Shaft, body seat, bolts and pins shall be made of stainless steel 304 (minimum 1.4021) (or 316 (minimum 1.4462).
- Flanges drilled to BS EN 1092-2 (ISO 2531).
- Endless profile sealing ring and O-rings shall be of EPDM or NBR suitable and approved for potable water.
- Drive mechanism of butterfly valves shall consist of a ductile cast iron casing with a crank or worm gear consisting of a bronze nut and a steel worm. Grease shall be provided for lifetime of the valve.
- All valves shall be operatable manually and also supplied with electrical actuators. Electrical actuator shall be complying to relevant ISO/National Standards and SCADA compatible. Valve manufacturer shall confirm suitability /compatibility of actuator proposed for operation of valve.

Valves shall be bubble tight at rated pressures in either direction and shall be satisfactory for applications involving throttling service and for applications requiring valve actuation after long periods of inactivity. Valve disc shall rotate 90 degrees from the full open position to the tight shut position.

Materials shall be as follows:

- Body: Ductile iron SG 400-15 to BS 2789
- Body sealing ring: Stainless Steel SS304
- Disc: SG 400-15 ductile iron to BS 2789
- Seal retaining ring: Stainless Steel SS304
- Shaft: Stainless Steel 304
- Internal bolts, nuts and set screws: Stainless Steel

- Body and disc painted with fusion bond epoxy 250 micron thick
- Hand wheel for manual operation shall be designed as per BS EN 12570:2000

Marking: Each butterfly valve shall have the following marking.

- On the Body:
- Nominal diameter in mm (DN)
- Nominal pressure in bar (PN)
- Type of Ductile Iron
- Manufacturer's Name or Logo
- Model code
- Fusion date

On the Corrosion Free Label:

- Nominal diameter in mm (DN)
- Nominal pressure in bar (PN)
- Maximum operating pressure (PFA)
- Closing direction
- Model code
- Manufacture's Name or Logo

On the Disc:

- Nominal diameter in mm (DN)
- Nominal pressure in bar (PN)
- Type of Ductile Iron
- Manufacturer's Name or logo
- Model code

4.7.4.2 Test Certificate

The Supplier shall provide a test certificate confirming that the valves have been tested in accordance with EN 12266-1 and stating the actual pressures and medium used in the test. In addition, the Supplier shall ensure that the Purchaser has access to the manufacturer's works at all reasonable times for the purposes of inspecting the assembled valves and witnessing testing.

The reduction gears shall be made of steel with machined teeth and unless otherwise provided, they shall be enclosed in a cast iron or fabricated steel sealed housing with oil seals and shall operate in an oil bath. The pinion shaft and screw stems shall be made of alloy steel. The pinion shaft shall be provided with bronze sleeves.

The thrust bearing at each end of the pinion shaft shall have external fittings to permit lubrication with grease. The screw stem shall have a thrust bearing of the ball or roller type which can be lubricated with grease through an external fitting.

The gear box shall indicate the position of the disc, shall be suitable for installation in a wet chamber.

4.7.5 Check Valve

Functions: To prevent reverse flow when pump suddenly stops.

Design criteria

General

Valve shall be of non-slam, dashpot with counterweight loaded type and shall block the counter flow in order to mitigate the water impact. when counter closed, in case water hammering of max pressure 10kg/cm². The check valve shall consist of a body, disc, stem, seat and dashpot.

Body

The body shall be made of cast steel or equivalent and be of streamlined shape in order to reduce the head loss. The cross-sectional area shall be larger than the diameter of flow pipe. The check valve shall be designed for the horizontal piping and the normal pumping operation. The center of gravity for disc stem boss shall be designed to relieve the impact, and the dashpot shall be installed on the body.

Disc

Material shall be supplied ductile cast iron or approved equivalent material. Disc shall be supplied steam lined shape to be reduced head loss related to head of fluid when free open.

Shaft

The shaft shall be made of Stainless Steel (ANSI 410 or above) and whose diameter shall be designed to withstand more than 150% of twist loading placed from the disc.

Seat

The seat shall consist of Body seat and Disc seat. Disc seat shall be made of EPDM, and Body disc shall be made of bronze casting or stainless steel304. Seat shall be able to disassemble and assemble in field. The fixture of seat shall be fitted without any leakages.

Bearing

The bearing shall be of the sleeve type that fits into the boss of body. The material shall be made of the bronze casting or equivalent.

Shaft Seal Device

The part of body and shaft shall be applied with V-Packing or O-Ring in order to prevent the leakage. The shaft seal shall be designed to assemble with packing box without disassembly.

Hydraulic damping system

The hydraulic damping system shall be of the adjustable type, which consists of the cylinders, pistons, piston rods, piston press rams, piston-pulling springs, speed control units and the pressure relief valves. Also, the damping system shall be able to adjust the mounting position for the piston press ram of the piston rod in the desired position within the field.

Materials

Body	Cast Steel (A216-WCB, or BS1504 161 Gr480, or SCW410) or Eq.
Disc	Ductile Cast iron (A536-65-45-12, or BS2789 Gr.420/12, orGCD450) or Eq.
Shaft	Stainless Steel (ANSI 410 or STS410) or Eq.
Seat ring	Stainless Steel (A240-304 or BS1501-304S15 or STS304) or Eq.
Cylinder	Cast steel (A27-60 or BS3100 Gr. A1 or SC42) or Eq.
Piston	Forged steel (A105, or BS1503 221-490, or SF45) or Eq.
Piston rod	Forged steel (A105, or BS1503 221-490, or SF45) or Eq.
Counterweight	Cast iron (A48-CL30, or BS1452 260, or GC200) or Eq.

Configurations

(i) Accessories per unit

Floor stands	1 set

Hydraulic damper	1 set
Counter Flange	1 set
Other necessary part	1 set

(ii) Spare parts per unit

Bolt & Nut	1 set
Other necessary part	1 set
Others	

Except as otherwise indicated, it shall be applied to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment is guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

4.7.6 Discharge Valve

Functions: For pump interlocking and discharge water flow control.

Design criteria

(i) General

The butterfly valve shall be of short body type with double flange, which includes the manually operated worm gear, stem cap, gear box and body flange mating. (Or shall be made with the 'tongue and groove joint' method.)

(ii) Body

The body shall be made of cast iron or approved equivalent. The rib shall be provided and installed if the reinforcement of body is necessary. The leg shall be of integral type and be installed at 400mm above. The seat and disc shall be provided in accordance with the conformity criteria.

(iii) Disc

The disc shall be made of cast iron or approved equivalent. The disc shall be parallel to the direction of flow when the valve opens. The disc shall be of streamlined shape and provided with the thickness, which is smaller than 2¼ of valve diameter.

(iv) Shaft

The valve shaft shall be made of stainless steel or approved equivalent. The valve shaft shall be configured with either one valve stem that goes through inside or two valve stems inserted from both sides. In case of two valve stem configuration, the size of shaft shall be 1.5 times larger than the disc.

(v) Valve Seat

Seat shall be designed for waterproof under the maximum differential pressure. If the seat material is composed of metal, the disc shall be applied with EPDM. If EPDM is applied on the body, the disc shall be made of metal. The EPDM seat shall be installed with care to avoid any issues. The valve installing at 800mm above shall be able to replace the EPDM parts without disassembly.

(vi) Motorized actuator

The motorized actuator, which is able to remote, if necessary, shall be of the integral type as included the strong control with simple system and fast response speed, no out-of-order for long time operation, case, bevel gear, limit switch, torque switch, manual handle, manual & MOV reserve device, field & remote selector switch, open & close switch lamp, digital aperture gauge, and terminal box. The motorized actuator shall have high torque under 3P, 400V, 50Hz and the maximum torque, which is 2.5 times greater than the normal operation. And the actuator shall be able to run for 30min under the overload. And no other issues shall be occurred from the frequent start and stop sequences. The motorized actuator shall be designed with F class insulation rating without revealing the rotating parts while the face of casing and flange shall be interconnected each other. The operation shall be shut down if the actuator is overloaded due to the device malfunction occurred by sudden errors. When the motor coil is overloaded, the actuator shall be protected by the temperature sensor. The motor shall be protected even if the problem is occurred from 3P. The actuator shall be able to operate even in the 10 percent of decrease for power supply.

Materials

Body	Cast iron (A-48 CL35 or BS1452 Gr.300 or GC250) or Eq.
Disc	Cast iron (A-48 CL35 or BS1452 Gr.300 or GC250) or Eq.
Shaft	Stainless Steel (A276 403, or BS 420 S29, or STS403) or Eq.
Seat	Bronze casting or Stainless steel304

Configurations

(i) Accessories per unit

Connection spindle	1 set
Limit switch	1 set
Torque switch	1 set
Space heater	1 set
Counter Flange	1 set
Other necessary part	1 set

(ii) Spare parts per unit

Bolt & Nut	1 set
Fuse and lamp	1 set
Other necessary part	1 set

Except as otherwise indicated, it shall be applying to general specification.

4.7.7 Diaphragm Valve

Diaphragm valves shall be of the straight-through design with minimal flow resistance and glandless construction conforming with the requirements of ASME B16.10, ASTM A961-04 and ASTM A126-04 and suitable for use with sewage sludge, chemicals or other corrosive liquid.

The valves shall be made up of two durable body parts and the diaphragm. All parts shall be replaceable, and the valves shall be easily maintained.

The diaphragm shall be molded in a reinforced, flexible material of a grade to suit the specified duty and liquid content of the system. In the open state the diaphragm shall lift clear and not obstruct the flow of liquid. The internal surfaces of the valve body shall also be lined with material compatible with diaphragm duty.

Diaphragms shall be completely leak-tight and suitable for pressures up to 10 bar.

The valves shall be operated by hand-wheel unless otherwise specified on the Drawings. Hand-wheels shall have adequate leverage to give the closure effort required and a facility to lock in any position.

Where indicated on the Drawings diaphragm valves shall be supplied with extended spindles or extensions for pedestals.

4.7.8 Ball Valves

Ball valves shall conform to AWWA C507 for carbon steel valves and be suitable for the working pressure.

The valve ball and stem shall be stainless steel. Operation of the valve shall be by bar handle directly on stem unless otherwise specified on the Drawings.

The valve body shall be fitted with stainless steel bolts complete with gasket to ensure leak tightness of body joint.

4.7.9 Plug Valves

Plug valves shall have carbon steel body and cover with stainless steel bolts, tapered plug and stem of the non-lubricated or soft seated type complying with the requirements AWWA C517-05.

The tapered plug shall be self-adjusting on separate seats providing positive seals at two or three-way port body styles and suitable for pressures up to 10 bar. The seat material shall be as recommended by the manufacturer for the specified pipe duty.

The valve stem shall be fitted with a long-life seal capable of continuous adjustment under conditions of wear.

The valve shall incorporate, when specified on the Drawings, elements of design to prevent the build-up of static electricity.

Entry to the plug valve shall be convenient for replacement of worn seats and maintenance of other parts. The valve shall provide external indication of seat wear.

Operation of the valves shall be by lever unless otherwise specified on the Drawings.

4.7.10 Flap Valves

Flap valves shall be circular aperture, single door and double hinges, flanged mounted, PN16 flanges drilled to BS EN 1092-2 (ISO 2531).

Sealing faces must be set to 0.1mm feeler gauge non-acceptance to provide an effective seal.

4.7.10.1 Materials:

- Frame - Ductile Iron BS 2789
- Door - Ductile Iron BS 2789
- Sealing faces - Copper Alloy.
- Hinge links - Ductile Iron BS 2789
- Fasteners Stainless Steel to BS EN10088 : 1995 grade 1.4401 (316).
- Hinge Pins - Stainless steel to BS EN 10088 : 1995grade 1.4401 (316).

All ferrous metal parts shall be painted with epoxy paint 250 microns thick.

4.7.10.2 Tests

Flap valves shall be tested with a head of 5 m for free operation in opening and closing and for leak tightness. A certificate shall be provided with each valve.

4.7.11 Electric Actuators

Penstocks and valves as demanded in these specifications shall be operated by means of electrically driven actuators with integral reversing starters.

Each actuator shall be fully weatherproof (IP56) and fitted with an anti- condensation heater, upper and lower limit switches and torque switches. Where actuators are installed in below ground chambers or other locations which could be flooded then the actuator enclosure shall be rated IP68 and suitable for being submerged under the maximum head of water that may occur at that particular location.

All local controls shall be protected by a lockable cover. The electrical supply available is400 volts, 3 phases, 4 wire, 50 Hz, and the unit shall incorporate a 400/220 to 110 volts transformer for control circuits.

Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The operating gear of all penstocks shall be capable of opening or closing the valve or gate against an unbalanced head equal to the maximum working pressure. All actuators shall have adequate torque margin to operate the valve under all conditions including seating and unseating loads and sticking after long periods of non-use.

The gearbox shall be oil or grease filled, and capable of installation in any position.

Alternative hand operation shall be possible, and the hand-wheel together with a suitable reduction gearbox, if necessary, shall be of adequate dimensions for easy operation by two men. The motor drive shall be automatically disengaged when under manual operation. Hand-wheels shall be rotated clockwise to close the valves and shall be clearly marked with the words "OPEN" and "CLOSE" with arrows in the appropriate directions. The rims of hand-wheels shall have a smooth finish.

All actuators with the exception of rising spindle penstock actuators shall be equipped with indicators showing the position of the valve or penstock. A transparent PVC cover shall be fitted to protect the thread of the rising spindle type penstocks.

All operating spindles, gears and headstocks shall be provided with adequate points for lubrication.

The motors shall be provided with integrally housed starters and shall be sized to provide an adequate margin to prevent overloading. The motor torque rating shall be at least 10 percent greater than the maximum torque requirement of the actuator at rated voltage

The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall also be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase 110-volt operation. The heaters shall be switched "ON" when the starters are "OFF" and shall be switched "OFF" when the starters are "ON".

Where remote indication of valve position is required, for instance on flow control valves, then the actuator shall provide a 4-20mA signal.

Each starter shall be equipped as follows:

- 2 No. Three Phase (TP) magnetically operated line contactors with no-volt release and electrical and mechanical interlock.
- 1 No. TP Thermal cut-out device.
- 1 No. 400V-110V, Control Circuit Transformer fully protected by fuses on primary and secondary circuits.
- 1 No. Set of "Open", "Close" and "Stop" buttons.
- 1 No. Local-Off-Remote switch with padlocking facilities.
- 1 No. Set of Torque and limit switches for "Open" and "Close" positions.
- 3 No. Sets of Auxiliary limit switches in each direction.
- 1No. Valve position indicator
- 1 Set. Indicating lamps indicating “open”, “closed” or “in transit “Thermal Insulation

4.8 CONTROL VALVES

Control valves may be Pressure Sustaining Valves, Pressure Reducing Valves or Altitude Valves.

Their specifications are stated in the clauses related to Outlet Management Units and Reservoir Management Units.

4.9 SERVICE/HOUSEHOLD CONNECTIONS

4.9.1 Documents/Procedure/Consumer Survey

Contractor to collect and consumer information for each consumer connection to be installed, using handheld devices (e.g., tablets or smart phones) and load the data onto the database on the Employer's Server. Consumer survey to be undertaken with approval of the Employer and Engineer (i) immediately after mobilization of contractor during the Joint survey and also (ii) undertaken when provided the consumer connection (and revenue meter). Data should be submitted to the Employer, Engineer. App shall be provided by the Employer.

Costs of undertaking the consumer survey shall be considered to be included within the Contractors quoted rates and no separate payment shall be made.

4.9.2 Customer Survey Questionnaire are attached at Annex 1. Materials

Service connections material shall include but not be limited to the following:

- Electro Fusion Tapping Tee Saddle (PN16) as per required size of connection pipe.
- Electro Fusion Coupler (PN16) diameter as per Service Connection size.
- HDPE Pipe (HSC) (PN16) diameter as per service connection size.
- Female Threaded 90 deg. Compression elbow with Metal Threads (SS304) diameter as per Service Connection Size.
- Galvanized Iron Pipe (GI) diameter as per Service Connection Size.
- GI Elbow and GI Nipple diameter as per Service Connection Size.
- Brass Corporate stop cocks with magnetic locking key PN 10 for installation in the service pipe diameter as per Service Connection Size.
- Classic Rotary Piston Type Volumetric Revenue Water Meter with AMR Compatible of diameter as per Service Connection Size with strainer.
- Brass Corporation Stop without Locking Key
- Brass non-return valve
- All other materials as necessary for complete and workable installation as per the specification and drawings (Drawing Sheet no. TP-2 Service Connection).

All material shall be tested at 10 bar for body and 10 bar completely assembled.

Prior to the complete ordering of the required service connection materials, certain number of service/household connections set (all of different sizes) shall be assembled at site and be subject to a test pressure of 14 bar (nominal working pressure 10 bar), all in the presence and to the approval of the ENGINEER

Service Connections shall be installed with materials as specified, according to ISO or EN Norm.

Connections to the distribution system shall be made with pipe saddles corresponding with the main pipe's material (SFR) and outside diameter.

Drillings shall be made with special equipment, specially designed pipe drilling machines for under pressure drilling.

The cover of the connection pipe shall be 70 cm minimum, if required the connection has to be lowered to the required depth.

The revenue water meters shall be generally installed inside a compound (compound border). The water meters shall be sealed with a copper wire and lead seal

4.9.3 Electro-fusion Tapping Saddle Tees with Under-clamp

EF tapping tee fittings manufacturers must have relevant ISO quality certifications.

EF tapping tee is of top loading type. EF Tapping Tee Fittings must comply with the requirements of BS EN 12201-3 or ISO 4427-3 standards and to be certified by any international certifying body for compliance with

BS EN 12201-3 Standard. Material of construction for – Body -- Virgin compounded PE 100 Black polymer, Composite cutter – Brass & Polymer. The grade of raw material of EF Tapping Tee used must be suitable for drinking water like WRAS, UK NSF International or equivalent. The polymer used should comply with the requirements of BS 3412 and/or BS EN 12201-1. Pressure rating will be SDR 11 (PN 16) suitable for fusing to PE 100 PN 10 Pipes manufactured in accordance with ISO 4427-2/ IS 4984 standard or as per National Standards.

EF tapping tee shall be of top loading type and EF shall be with only a single heating coil to fully electro-fuse the fitting to the adjoining pipe or pipe component as applicable. The heating coils shall be terminated at terminal pins of 4.0 millimeter diameter.

No heating element shall be exposed and all coils are to be integral part of the body of the fitting. The insertion of the heating element in the fitting should be part of the injection moulding process and coils inserted after the injection moulding process or attached to the body of the fitting as a separate embedded pad etc. are strictly not acceptable.

The brand name, size, raw material grade, SDR rating and batch identification are to be embossed as part of the injection moulding process. Each fitting should also be supplied with a barcode sticker for fusion parameters attached to the body for setting the fusion parameters on an automatic fusion control box. The barcode sticker should also include the fusion and cooling time applicable for the fitting for the manual setting of a manual fusion control box.

EF Tapping Tee should be Voltage-regulated type designed to fuse at a fusion voltage of 40 volts AC.

The heating elements should be designed for fusion at any ambient temperatures between -5°C to +45°C with auto temperature compensation using automatic Barcode reader fusion machine i.e. without need for any manual compensation of fusion time for different ambient temperatures.

A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of each fitting near the terminals. The fusion indicators should not allow the escape of the molten polymer through them during or after the fusion process

EF Tapping Tee shall have such spigot length to enable second fusion of a socket fitting in case the first fusion fails.

EF Tapping Tee shall have in built composite cutter with cutting edges to cut the pipe for making suitable bore.

Installation:

Mark the required area for scraping by placing the tapping tee of the bagged fitting alongside the pipe end without removing packing of the fitting.

Carefully scrape the marked area of the pipe in axial direction over length using a hand scraper.

Wipe the scraped surface of pipe with a suitable degreasing agent & tissue paper.

Place the under clamp properly with provided screws until both side of the fittings (saddle and clamp) are fully tightened.

Connect leads of EF Machine (control unit) with connector pins.

Read the bar code on the fitting with bar code reader (scanner) of the Electro fusion machine. Confirm parameters and start fusion.

Cool the fitting up to minimum cooling time as indicated on the fitting / barcode.

Remove cap rotate the cutter clockwise with the help of Allen key to make a hole on the pipe. Once hole is made, rotate the cutter anti-clockwise till it stops to rotate and gets locked in the groove.

The torque required to operate the cutter after fusion on the PE mains should not exceed 45 N-m.

Jointing of spigot outlet of EF Tapping Tee and EF Coupler shall be carried out as per IS 7634 Part 2 clause 3.2.3.1

EF Tapping Tee Fittings to be individually packed in sealed PE bag so that they can be used instantaneously at site without additional cleaning process. The protective packing should be transparent to allow easy identification of the fittings without opening the bag.

Stop-cocks (service valves) shall be suitable for a direct installation in the service pipe and shall allow a temporary shut-off of the house connection line in case of emergency. The upstream stop cocks valve must be of the magnetic locking key type according to BS 6675:1986. The valves must be made of brass according to EN 1213:2000 , EN 12288 or equivalent.

4.9.4 Stop-cocks.

Stop-cocks (service valves) shall be suitable for a direct installation in the service pipe and shall allow a temporary shut-off of the house connection line in case of emergency. The upstream stop cocks valve must be of the magnetic locking key type according to BS 6675:1986. The valves must be made of brass according to EN 1213:2000 , EN 12288 or equivalent.

Stop-cocks shall be of the resilient seated gate valve type with integrated or adopted restraint push-on outlets for connection to GI pipes and female threads for pipe connection and shall be suitable and approved for above ground installation and for the use with potable water.

4.9.4.1 Product marking.

All stop cocks shall be clearly, legibly and indelibly marked as followed:

On body (cast on):

- Nominal size.
- PN designation.
- Trademark.

On steel plate at handle (engrave):

- Standard.
- Trademark.
- PN designation.
- Open/close arrow.

4.9.4.2 Material of Construction

- Body, bonnet, disc, stem Brass rode, grade CW617N.
- Handwheel Cast iron.
- O-ring. NBR.
- Gasket, bush PTFE.
- Nut Brass, grade HP59-1.

4.9.4.3 Pressure testing

The pressure rating of stop cocks which shall be PN10.

4.9.4.4 Performance requirements

The compression fittings shall be tested as per EN-12288. Following Test methods shall be performed

- shell design strength test.
- Obturador design strength test.
- shell tightness test
- seat tightness test

4.9.5 Non return valve (NRV)

A non-return valve is an automatic valve whose main function is to prevent water backflow, thereby preventing reverse flow in the flowmeter and contamination of the distribution network from the customer's internal pipeline.

Non return valve should be of type foot check valve or swing check valve.

4.9.5.1 Product marking.

All non-return valve shall be clearly, legibly and indelibly marked as followed:

On body (cast on):

- Standard.
- Nominal size.
- PN designation.
- Trademark.

4.9.5.2 Material of Construction

- Body, bonnet, disc, stem Brass rode, grade CW617N.
- O-ring. NBR.
- Gasket, bush PTFE.

4.9.5.3 Pressure testing

The pressure rating of stop cocks which shall be PN10.

4.9.5.4 Performance requirements

The compression fittings shall be tested as per EN-12288. Following Test methods shall be performed

- shell design strength test.
- Obturador design strength test.
- shell tightness test
- seat tightness test

4.9.6 Galvanized Iron (GI) Pipes and Fittings (15/20/25/30/40/50 mm)

Galvanized pipes and fittings (in accordance with the appropriate EN standards or equivalent standards) shall only be used as directed by the Engineer.

Galvanizes iron pipes shall be manufactured according to DIN 2441 with threaded sockets in accordance with DIN 2441, ISO 65 or BS 1387, Heavy Series or similar with a spigot and a socket end.

The pipes shall be supplied threaded in accordance to DIN 2999 or BS 21, and shall have the screw threads clean, well cut and square with the axis of the pipe and be free from excessive burrs.

The end of each socket shall be chamfered internally.

The galvanization shall be by hot-dip process according to DIN 1706 and shall satisfy the copper sulphate test procedure according to DIN 50952.

All pieces shall be straight, cleanly finished, free from cracks, surface flaw lamination and other defects and shall have a reasonably smooth surface. The overall pipe length, with one socket fitted, is to be 6 m plus or minus 150 mm

4.9.7 REVENUE WATER METERS FOR SERVICE CONNECTIONS

4.9.7.1 General

Revenue water meters refer to the meters for the measurement of water supplied to residential, commercial and industrial plots having a service connection ranging from15mm and up to 40 mm diameter.

All water meters shall be AMR compatible, Volumetric Rotary Piston direct transmission, liquid filled register, designed to be equipped at any time with an external module for remote reading with the essential features of household water meters described in the following sections are sought for supply and installation.

Water meter shall be internationally proven brands like Diehl / Honeywell / Itron / Sensus / Zenner or equivalent and superior. The equivalent vendor/brand should have monetary turnover. The credentials for the particular/proposed model/make/item that of the said brands indicating the satisfactory performance shall be submitted for the Engineer's approval. The manufacturer must be registered to ISO9001-2008 and ISO 14001:2004 accredited equivalent brand should have monetary turnover and credentials to that of the said proven brands. The manufacturer must be registered to ISO9001-2008 and ISO 14001:2004 accredited.

4.9.7.2 Materials

Only the best quality and type of materials shall be used, which shall be suitable for the purpose intended. Unless otherwise specified, materials shall be selected by the supplier. The materials shall be appropriate both mechanically and chemically to the operating conditions. In connecting units, they shall be mechanically chemically and electrochemically compatible with one another and with the environment.

Materials shall be selected to the adequate resistance against abrasion and corrosion. Where necessary, protective coating and lining shall be applied.

All materials in contact with the potable water shall be non-toxic and shall not affect the quality of the potable water at any given time.

4.9.7.3 Design and Construction

Design and construction shall be conforming to ISO 4064: 2005 requirements for cold water meters. The meters shall be suitable for cold water up to 50°C (Working Range 0 to 500C) and pressure-rating of minimum PN 16. Pressure loss shall be on a minimum and as per ISO 4064.

Main construction features of the meters are as follow:

- All water meters shall be provided with an efficacious replaceable strainer in the inlet fitting. The strainer screen shall be rigid, fit snugly, be easy removable and have an effective straining area at least double that of the inlet.
- The register is a semi-dry liquid filled register (condensation-free totalizer), made of engineering plastic for all gears and drums.
- The register has 8 rollers with 4 digits for m3 (black) and 4 for submultiples (red). Maximum reading must be 9999 m3; minimum reading must be 0, 02 liters.
- Easy to read thanks to large digits with minimum height of 4.4 mm. A plastic lid has to protect the register rollers from dirt.
- Registration shall be in cubic meters.
- All meters shall be provided with wire and lead seals, both to upper and lower body.
- The meter should not have any internal or external calibration device. The accuracy curve and the position inside the tolerance channel must be assured by design.
- The piston of the measuring chamber has a special profile to absorb without damage particles present in water in case of network maintenance
- All parts shall have smooth surface, special the parts in contact with water to prevent encrustation. The water meter shall be suitable for out- and indoor connection for tough conditions.
- Each delivered part shall be new and not used before and supplied according to technical specifications descript.

The water meter shall be designed for a lifetime of 10 years of normal operating conditions.

4.9.7.4 Markings

The Marking requirement shall be as per clause no. 6.8 of ISO 4064-1(2005)

4.9.7.5 Meter Performance

Required Performance and accuracy shall be as per ISO 4064: 2005 as indicated below. The range of measured flow rates is sub divided into 3 reaches. The limits being defined by the following flow rates:

Table 39: Revenue Water Meters Performance Error Limits

Identification	Description Value	Remarks
Q1	Minimum flow rate for reliable registration	Error permission +/- 5%
Q2	Limiting flow rate for increased accuracy of registration	Error permission +/- 2%
Q3	Nominal flow rate for continuous or limiting function.	Error permission +/- 2%
Q4	Maximum flow rate at which the meter shall function for a limited time without exceeding a metering error	Error permission +/- 2%
H in bar	Pressure loss in Q3	Not Exceeding 0.63 bar
P	Maximal permissible pressure	Min. requirement 16 bar

4.9.7.6 Warranty

Warranty starts from the day of delivery and written acceptance by the client and shall be minimum 2 years after issuance of completion certificate. This includes:

- Meter performance,
- Materials, and
- Function.

4.9.7.7 Essential Features

All water meter shall be volumetric water meters, Rotary Piston, liquid filled register with direct transmission. The two ends shall be threaded connection and the inlet and outlet shall have a common axis. They shall have water tight dismantling coupling on each side to allow easy removal of the instrument from the pipe works.

Installation of the water meter can be done in horizontal and vertical position without hampering meters' performance.

The water meter shall be suitable for out- and indoor connection for tough conditions and shall afford reasonable safeguards against destruction. Special regards shall be given to the strength of glass & the cover-lid.

The dial shall be easy-read in cubic meters. The body as well as all parts in water contact shall be in corrosion free materials and approved for drinking water and to be a short construction the connection shall be in thread connection according to ISO. Adequate connecting nipples for the inlet as well as for the outlet together with all necessary seals shall be provided.

The meter body must be manufactured from brass metal (containing a minimum of 50 to 60% of copper) The meters shall have the following minimum performance characteristics:

Table 40: Revenue Water Meters Performance Flow Limits

ND, mm	15	20	25	30	40	50
Nominal Flow rate Q3 m^3/h	2.5	4.0	6.3	10	16	25
Maximum flow rate Q4 m^3/h	3.125	5.0	7.875	12.5	20	31,5
Minimum flow rate Q1 liter/h	15.625	25.000	39.375	62.5	100	156.25
Measuring range R=Q3/Q1	160	160	160	160	160	160

4.9.7.8 Testing

Pattern Test Certificates:

Towards approval of meter manufacturer, contractor shall submit all pattern test results as per ISO 4064- 1/3 which is tested/certified by an international / national accredited test laboratory accredited to ISO: 17025

Factory Pre Shipment Inspection:

Upon vendor approval, Contractor shall submit manufacturer's quality assurance plan for testing water meters for performance testing / dimensional checking/ marking requirements etc to be witnessed by the Employer/ Employers Representative. Sampling/ acceptance criteria during testing shall be as per ISO/National Standards like BS/IS/Nepalese Standards

It is required that quality and compliance with these specifications shall be demonstrated for all materials and equipment by appropriate tests performed during the various phases of the work of production.

The minimum test pressure shall be the specified nominal pressure plus 50%. This pressure shall be applied increasing from 0 to maximum event over 15 minutes.

The test pressure shall be held without pressure drop for at least half an hour without any sign of leakage. Shop testing shall be run with water of not more than 40-degree C and not less than 10-degree C temperature. Shop testing shall sufficiently cover the entire range of the capacity to demonstrate that the characteristics are stable.

The arithmetic mean of all readings for one performance point shall be within the specified limits.

4.10 WOLTMANN BULK CONSUMER FLOW METERS

4.10.1 General

Bulk measuring points shall be provided for large commercial and industrial consumers which need diameters above 40mm. The water meter shall be installed in the distribution main or in the service line, connecting the distribution main and the consumer water tank. Each bulk measuring point shall be equipped with a bulk water meter.

4.10.2 Water Meter

4.10.2.1 Application

Water meters are to operate with potable water of maximum temperature of 50 ºC and working pressure up to 16 bar.

4.10.2.2 Type and Construction

The flow measuring mechanism shall be helical vane (Woltman type). Axis of vane shall be parallel to the axis of the pipe. Measuring mechanism shall be removable from the meter body with the body remaining mounted in the pipeline.

The counter (register) shall be dry, sealed against ingress of water and dust, with dehumidifying capsule to prevent condensation, and flap (cover) to protect against mechanical damage. It should be possible to rotate the counter against the meter body into at least two different positions to facilitate read-out.

The drive between the measuring mechanism and the counter shall be by a magnetic coupling. Construction of this magnetic drive shall allow for ancillary equipment (e.g. pulser or dial extension piece) to be sandwiched between the body and counter without stopping the flow or depressurizing the pipeline.

The read-out shall be one centre sweep pointer and at least seven (7) digits counter, four (4) black figures (left hand set) and three (3) red figures (right hand set). Meters shall be calibrated to read in cubic meters.

Every meter supplied shall comprise a reed switch pulse transmitter unit for data output.

All wetted body parts shall be made of materials resistant to corrosion. The body shall be made of DI GGG40 to DIN 1693 or 420/12 to EN 1563. The measuring mechanism shall be of 316 stainless steel and high grade plastics.

The body of the meter shall be of robust construction, able to withstand rough handling, and it shall allow for free standing in horizontal position. It shall be adequately protected against hostile environment: relative humidity up to 100% with condensation, ambient temperature up to 40 °C.

The body of the meter shall be externally coated with approved blue fusion bonded epoxy to minimum dry film thickness of 300 microns and internally coated with approved nontoxic fusion bonded epoxy to minimum dry film thickness of 300 microns.

The meter shall be clearly marked with at least following data:

- Name or trade mark of manufacturer.
- Nominal size of meter.
- Meter serial number.
- Units of registration.
- At least one arrow indicating the direction of flow.

This data can be either grouped together or distributed on body and dial, and they must be easily legible.

Each flow meter shall be subject to pressure/leakage test of 1.5 times the nominal pressure before leaving the manufacturer's works. Each meter shall be accompanied by a manufacturer's test certificates. The ENGINEER shall be entitled to inspect, examine and witness tests on meters.

The following parts shall be delivered with the meters, taking into account that if the number of meters is not a multiple of ten the quantity of parts shall be rounded off upwards.

- One data-logger counter (register) for every ten pieces of the same counters with a minimum of one for the same counters.

4.10.2.3 Performance

All definitions for flow as per ISO 4064-1 shall apply.

Nominal flow rates shall at least meet the requirements of ISO 4064-1, Table 2.

Accuracy of meter and its metrological characteristics shall at least meet the requirements of Class B, ISO 4064-1, Table 5. Preference will be given to the meters which pre-sent better accuracy and better metrological characteristics than those required by the standard.

Each meter shall have a manufacturer's guarantee certificate giving date of manufacture, specification, quality control approval (in accordance with ISO 9000) and three (3) years guarantee from the date of installation.

4.10.2.4 Installation

The flanged connection shall be drilled according to ISO 7005-2 raised face. The flange pressure rating shall be as given in the particular specification or data sheet.

A straight length of pipeline shall be provided upstream and downstream of the water meter to prevent flow turbulence from affecting the accuracy of the measurement.

The straight length at the inlet of the water meter shall be at least 10 times the meter nominal diameter and the length at the outlet shall be at least 5 times the meter nominal diameter.

The installation of the water meter shall be such that it is possible to remove the meter at any time and replace it with the appropriate length of the spool piece.

The water meter shall be installed as shown on the DRAWINGS, inside a chamber as stated in section 3.2.5.7 about Valve chambers.

4.10.2.5 Miscellaneous

One copy of the meter technical manual shall accompany every twenty pieces of each type of meter, with a minimum of one copy.

Each meter shall be accompanied by manufacturer's certificate stating among others: date of production, serial number, type, nominal diameter, nominal pressure, other specification data if applicable, test data if requested.

The water meter shall be supplied complete with bolts, nuts, washers and gaskets.

Rubber gaskets shall be EPDM elastomer or equivalent approved in accordance with ISO 4633 suitable for drinking water supply. The gasket shall be minimum 3 mm thick and shall be metal reinforced for pressure rating of 16 bar and higher. The dimensions of the flange gaskets shall be to ISO 7483.

The nuts, bolts, washers shall be of steel having minimum tensile strength of 800 N/mm2 hot dipped galvanized or cadmium plated. Nuts and bolts shall be suitable for the specified pressure rating. Nuts and bolts shall be to ISO 4014 and 4032 and washer to ISO 887.

The upstream side of the water meter shall also be equipped with 12.5 mm (½") dia. brass ball valve, brass connector and brass plug to take small amounts of water samples.

4.11 ELECTROMAGNETIC BULK COMPANY FLOW METERS

Electromagnetic Bulk flow meters are installed at the inlet of a District Metered Area DMA, and are of use for the water company for Non-Revenue Water reduction campaigns and other matters, therefore they shall be connected to the SCADA System.

The electromagnetic bulk flow meters will be connected to the SCADA system via cable through the RTU of the nearest OMUs, as long as the distance between the DMA bulk electromagnetic flowmeter's chamber and the OMU's chamber does not exceed 30 meters. Therefore, the electromagnetic bulk flow meters must be equipped with a cable longer than 40 meters for this connection. The electromagnetic bulk flow meters shall be equipped with an inbuilt earthing system; if this is not provided, an external earthing system must be installed.

As a redundant communication system, the DMA bulk electromagnetic flowmeter chamber shall be also equipped with a datalogger, as specified in clause 6: Outlet Management Units.

4.11.1.1 General Specifications

Meters shall have a modular design. It shall be possible to site the transmitter / electronic elements of the device either directly onto the meter or in a remote location not less than 2 meters from the body of the meter. It shall be possible to wall mount the transmitter and such fixing shall not prejudice any water tightness of the same transmitter.

Transmitter / Register: The output of the meter shall be digital LCD or equivalent and shall be water tight to IP68. The readout shall be capable of supplying the following information:

- Actual flow

- Total Flow
- Max Flow
- Min Flow
- Pipe Empty
- Flow direction.

Registration shall be in cubic meters.

The flow meter primary shall incorporate an electrode (or electrodes) to detect when the pipe is not full. The detector output shall control circuits within the converter to open circuit the analogue signal and initiate an indication of the "pipe not full" condition.

Pressure: The working pressure (maximum admissible pressure) shall not be less than16 bar and shall conform to the testing in accordance with ISO4064 or equivalent. The meter shall be tested at 25 bar with no leakage. The supplier shall provide test results to prove that the meters perform to the accuracy specified above.

Head loss: The loss of pressure through the meter must conform to ISO 4064 or equivalent.

Coatings: Materials shall be selected to have adequate mechanical, chemical and electrochemical resistance against abrasion and corrosion. Where necessary metallic parts of the meters shall have corrosion resistant coating applied suitable for a tropical humid environment. Materials shall be selected to have adequate mechanical, chemical and electrochemical resistance against abrasion and corrosion. Materials in contact with the water shall be non-toxic and shall not affect the quality of the water.

Power Supply: The meter shall be powered by internal or external battery using low voltage of 24V or less. The meter shall be completely autonomous and shall require no external power supply connected to the mains. The meter shall be capable of operating for a minimum of 5 years using one battery pack without re-charge. Where a battery pack is external to the meter the bidder shall ensure that the power supply is waterproof to IP68 and can operate in water. For external battery packs the bidder shall propose anti-theft measures (ways of securing the batteries). Batteries must be capable of operating in severe conditions between -20ºC to +50 ºC.

4.11.1.2 Markings

Each meter shall be marked on the casing or display with the following information:

1. At least one arrow cast onto the body indicating direction of flow
2. Nominal size
3. Nominal flow rate (Qn) preferably on counter housing
4. Model identification
5. Year of manufacture
6. Serial number
7. Manufacturer's name

4.11.1.3 Characteristic flows and temperature

The meters shall be of class temperature minimum T50.

The meters shall comply with OIML R 49/MI-001, Class 1 (water meters with Q3 ≥ 100 m3 /h) and Class 2 for the balance:

- The maximum permissible error for the upper flowrate zone (Q2 ≤ Q ≤ Q4) is ± 1 %, for temperatures from 0.1 °C to 30 °C, and ± 2 % for temperatures greater than 30 °C.
- The maximum permissible error for the lower flowrate zone (Q1 ≤ Q < Q2) is ± 3 %.

Ratio R (Q3/Q1) in m3/h must be bigger than 160.

Registration of flow velocities up to 7 m/sec shall be possible (Q4).

The tenderers shall include with their tenders a technical data sheet with information regarding the above performance.

4.11.1.4 Packing

Each meter shall be mounted on a pallet secured against movement, with protection against damages; especially the housing of the counter shall be covered. In case there is sufficient space, more than one piece can be mounted.

4.11.1.5 Warranty

Warranty starts from the day of delivery and written acceptance by the client and shall be minimum 2 years after issuance of completion certificate. This includes:

1. Meter performance,
2. Materials, and
3. Function.

4.12 DI FITTINGS

Slip-on type couplings shall include the following couplings:

a) Straight flexible couplings;
b) Stepped flexible couplings;
c) Flange adapters
d) Dismantling joints.

Slip-on type couplings shall be procured from approved suppliers and suitable for use with ductile iron pipes manufactured to ISO 2531. These shall be capable of withstanding the test pressures appropriate to the pipes for which they are supplied.

The preparation of pipe ends for slip-on type couplings shall be in accordance with the requirements of and the tolerances specified by the joint manufacturer. Couplings shall be installed fully in accordance with the manufacturer's recommendations.

Gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings of all types shall be furnished by the manufacturer of the pipe coupling and shall be designed as an integral system by the pipe coupling manufacturer. Gaskets shall be designed for the coupling and appropriately sized to provide a watertight seal at the design pressure and temperature. Gaskets, bolts, nuts, glands, end rings and hardware for pipe couplings shall be shipped with the pipe coupling and shall be clearly labelled indicating the origin of the material, place and date of manufacture. Manufacturer's printed installation instructions shall be packaged with each pipe coupling.

The supplier shall follow the manufacturer's recommendations as to the methods and equipment to be used in assembling the joints. In particular, the supplier shall ensure that rubber rings are correctly positioned and free of twists. The rubber rings and any recommended lubricants should be obtained only from the coupling manufacturer.

All nuts, bolts and washers used in the construction of the coupling shall made of steel and Galvanized Flanges which mate with pipes, fittings and valves shall be drilled to BS EN 1092-2 (ISO 2531) Gaskets and jointing rings shall comply with Clause 6.4.2.

4.12.1 DI Collar (Mechanical Coupling) large tolerance

Standard/design:

- Broad tolerance couplings for ductile iron pipes with a large DN
- PFA of 16 bar
- Angular deflection of approximately 6° per joint (12° between two pipes)

Material:

- Fixed body shall be of ductile iron 500-7 according to En-1563
- Sliding body shall be of ductile iron 500-7 according to En-1563
- Tie bars shall be of carbon steel class 8.8 or galvanized steel

4.12.2 Dismantling Joint

4.12.2.1 General Specifications

Dismantling piece to facilitate easy installation/removal of pipeline components, such as valves etc.

There are 2 types of dismantling pieces covered under this specification:

- the non-rigid type and
- the rigid type.

When installed, the non-rigid type shall permit axial and angular movement during operation. The rigid type shall not allow any movements.

4.12.2.2 1006.7.2 Materials

- Body and flanges: EN-JL-1040 (GG25)
- Sealing ring: rubber Sh A45, wastewater resistant
- Bolts / nuts: steel grade 4.6/5

4.12.2.3 Coating

- Corrosion protection (inside and outside):
- All cast iron parts double coating with red brown plastic enamel or equivalent, waste water resistant

4.12.3 Universal Clamp coupling -Single band -Standard range (Repair clamps)

Standard/design

- Applicable for permanent repair of damaged pipe with holes, cracks and breaks. The clamps shall be used for the repair of Ductile Iron DN 800-1400 mm
- The clamps should be Stainless Steel for permanent Pipe repair according to AS 4181 or equivalent standard.
- Flexible outside collar to be strapped and tightened to a pipe or conduit for closing a leak in its side by compressing a resilient seal encircling pipe.
- The clamps shall be able to install without releasing the pressure of the pipe and require only simple tools to fix it. All sharp surfaces of the clamp shall be finished to avoid harm to installer.

Material:

- Body Material = 3D Stainless steel Z7 CN 18.09 type
- Gasket = 3D EPDM
- Clamp Material = 3D Ductile Iron
- Bolt Material = 3D Steel Class 6.S

4.13 FIRE HYDRANTS

Fire hydrants can be standby column hydrants (above ground installation) or underground (buried) installation. The diameter of the hydrant is related to the pipeline to which it is connected:

- DN 100 for Primary Pipelines, DN > 300mm
- DN 80 for Distribution Pipelines, 140mm< OD ≤ 315mm
- DN 50 for Distribution Pipelines, OD ≤ 140mm

DN 100 and DN 80 fire hydrants may be standby column or underground type. DN 50 fire hydrant is always underground.

4.13.1 Column Fire Hydrant

The column fire hydrant shall be dry-barrel fire hydrant complying either with:

- EN 1074-1 and EN 1074-6.
- AWWA C502 and AWWA C550.

Main valve seat opening shall be at least 115 mm. The nozzle section shall consist of two (2) x 2 ½" hose nozzles and one (1) x 2 ½" pumper nozzle, all of bronze alloy material. Thread types shall be as approved by the Engineer.

Hydrants shall have non-corrosive drain valves.

Hose and pumper caps shall be cast iron chained to the hydrant.

Hydrants shall be so designed, that in the event of accident, or breaking of the hydrant above or near grade level, the main valve will remain closed.

Operating threads shall be sealed from water at all times, when the valve is either in the open or closed position. The operating nut shall be made of bronze.

The hydrant shall be connected to the water supply system including an isolating valve and be fitted with an inlet flange in accordance with EN 1092-2. All fire hydrants shall be rated at PN 16 and flanges drilled to BS EN 1092-2(ISO 2531) Fire hydrant body shall be made of ductile iron SG 400-15 as per BS 2789

Internal and external coating shall be epoxy as per EN 1074-1 or AWWA standards. External colour shall be fire red. Marking shall be as per section 6.1 of AWWA-C 502 or EN 1074-6.

4.13.2 Underground fire hydrant

The underground fire hydrant shall be of PN 16 class complying BS 750:1984 Type 2 (Screwed-down type with 2 ½" outlet, thread type as approved by the Engineer) and Inlet flange universally drilled to BS EN 1092-2 PN 10/16 and to BS Table D/E. The hydraulic test shall comply to 1.1 x PN 16 for seat and 1.5 x PN 16 for body. Hydrant spindles shall be of stainless steel. Spindle nuts and body seating shall be of gunmetal or high tensile brass. Valve seats shall be of the resilient type

4.13.3 Hydrant Specifications

The hydrant shall use for water to a maximum temperature of 70ºC. The fire hydrant shall comply with following flow rate requirements:

Table 41: Hydrants Flow Rate Requirements

ND, mm	15	20	25	50	80	100	150
Nominal Flow rate Q3 m^3/h	2.5	4.0	6.3	22.71	49.96	95.38	196.44
Maximum flow rate Q4 m^3/h	3.125	5.0	7.875	36.34	79.49	143.07	295.23

Minimum flow rate Q1 liter/h	15.625	25.000	39.375	908.4	1362.6	1816.8	3406.5
Measuring range R=Q3/Q1	160	160	160	25	36.67	52.50	57.67

4.14 PRESSURE AND FLOW DATALOGGERS

4.14.1 Pressure Dataloggers

Pressure dataloggers shall include built-in pressure transducers or sensors and will be installed at several locations, called Pressure Test Points, in the project area. The minimum quantity of Pressure Test Points shall be 3 per District Metered Area DMA: one at the highest point, one at the lowest point and one at the furthest point from inlet OMU. A fourth pressure transducer is also installed in the OMU.

Dataloggers shall be installed in every Air Valve of the primary pipes.

For the technical requirements of the pressure transducers, please see clause referred to Outlet Management Units OMUs.

4.14.2 Flow Dataloggers

Flow dataloggers shall be installed at all Woltman bulk consumer meter locations or Electromagnetic company bulk flow meter locations which are not coincident with an OMU (an OMU will have its own datalogger installed with the RTU). These shall be rated IP68. It shall be compatible with the Woltman/Electro Magnetic bulk meters supplied under this contract. Output shall be volume in liters or m3. Equipment shall include all cables and connections to the data loggers.

4.14.3 Technical Specifications of dataloggers

Data loggers shall be supplied under this contract to record pressure or flow, at source reservoirs, primary mains and the distribution system. Specifications for the data loggers are as follows:

- Minimum of one input for pressure or flow, compatible with supplied transducers: Loggers shall be single units able to record at least one flow and one pressure channel simultaneously (two channel units) and shall be equipped with at least one internal pressure input and one digital input.
- Input for pressure should be either Analog or built-in pressure transducer.
- . Input for flow should be digital (pulse input).
- . Unit of pressure: bar
- . Unit of flow: m3/h
- Robust and waterproof to IP68. Casings shall be water tight to IP68. Casing may be constructed of high-density plastic or metal to ensure a design life of no less than 5 years.
- Programmable and downloadable using standard manual cable connections or remote connection with a computer (netbook or equivalent). There should be at least a USB connection or remote connection (Bluetooth, RFID…). Download cables and software shall be supplied to allow the correct and efficient communication between a computer with Microsoft Windows) and the loggers. Download cables shall be connected directly with a USB port and without any additional converter. The software shall be capable of data analysis as described herein.
- In addition to local communication, the loggers shall be able to transmit data to selected servers using the wireless broadband communication standards: GSM 3G/4G,NB-IoT or LTE-MAll hardware and software shall be compatible with computers running on the Windows system requested by the Employer according to the computers to receive the data.
- Each logger shall have a real time clock which can be synchronized with the computer used for data download.

4.14.4 Performance requirements

- Recording interval: Programmable from 1 Minute to 24 hours. It shall be possible to program the start and stop times of loggers.
- The loggers shall be capable of determining flow direction depending on the provision of the meter
- Data Storage: minimum 35,000 discrete readings and be supplied with an appropriately sized memory.
- Power Supply: Internal battery (lithium) with equivalent life of at least 5 years under normal operating conditions and at an ambient temperature of 25°C and average logging frequency.
- Operating Temperature: 0-50 degree Celsius

4.14.5 Software

Software shall be provided to allow all programming and downloading of data loggers, including, but not limited to:

- Start and Stop Times
- Cyclic/Non-cyclic Logging
- Location and Installation Information
- Channel Selection/Use
- Logging Interval/Schedule
- Data Download
- Data Analysis, including but not limited to the following.
- Time series plots of all channels
- Maximum and minimum value determination
- Average value determination
- Average flow rate calculations between flow volume recording intervals
- Alarms for low battery, and exceed acne of flow norms for specific times

All data should be exportable to Microsoft Excel. Software shall include security for all programming functions (i.e., programming shall be restricted to authorized personnel). Lifetime licenses shall be provided to allow use of the data logger software.

All necessary communication software and hardware interfaces to allow transmission of data to seven (7) computers stations in different locations shall be provided by the Contractor.

4.14.6 Marking

All loggers shall be marked in an indelible manner with the following:

- Manufacturer's Name
- KUKL/PID
- Mode Type
- Serial Number (Continuity from earlier… An Engineer)
- Supplier Contact details
- Production period (date or code) e.g. 0714

The supplier shall furnish all goods and supplies and conduct performance testing as specified herein.

4.14.7 Manuals & training of KUKL operators

For each model of loggers, the supplier shall furnish 3 (three) hard copies and 1 (one) soft copy (PDF format) of complete operation and maintenance manuals.

Training shall be provided in the installation and maintenance of the transducers and data loggers, and in the use of the software for programming and data downloading.

4.14.8 Warranty

Loggers shall be designed for a lifetime of at least 5 years under normal operating conditions. The Contractor shall provide the datalogger with a battery life of 5 years since the taking-over certificate, therefore the procurement should be done so that the equipment arrives at site close to the Functional Guarantee Tests of the DMAs. The Contractor shall change the battery of the datalogger on his own cost if the period time from purchase to installation is more than 1 year.

The Supplier shall provide 1 (one) year warranty on the loggers against material defects, workmanship and design defects. In case of loss of accuracy, power or any defect with the logger, including defects in connections and download systems, the Supplier shall replace the defective logger with a new one within 15 (Fifteen) days of instruction from the Purchaser against the above stated warranty condition.

4.14.9 Connection

In case of built-in pressure sensor, the logger shall be furnished with a flexible pressure hose connector of either push fit, hydraulic clutch or BSP 1/2 in thread type with Quick-release coupling on logger-end. A pressure hose of no less than 1m linear length shall be supplied with necessary fittings to connect directly to the logger. The free ends shall be fitted with the connectors and all necessary adapters to result in a male BSP 1/2 in threaded coupling. As each data logger has a digital channel, 1 piece of digital cable (military connector or equivalent conform to IP68 at one-end and base wires on the other end) to be supplied with each data logger to connect the cable to various different pulse units and pulse outputs. Each digital cable should have a length at least 1.8 meter (no spare cables need to be supplied) and 20% female quick release fittings should be supplied.

Analog inputs (for pressure) shall be connected using waterproof multi-pin electrical connectors. A push fit cover shall be provided for the connector when not in use.

Digital inputs from reed switches or other shall be connected using waterproof multi-pin electrical connectors. A push fit cover shall be provided for the connector when not in use.

4.15 PLANT FACILITIES INSULATION

1) General

All items of thermal insulation work covered by this specification shall be carried out by an approved specialist.

Thermal insulation shall not commence until the whole of the installation has been completed and tested asset out in the relevant sections of this specification. All insulation work shall be carried out in accordance with ASTMF683.

All insulation materials shall be asbestos free.

2) Pipework

All pipework carrying hot liquids or gases etc., within plant rooms shall be individually insulated with plain preformed rigid glass fiber or mineral wool sections.

All insulated sections shall be adequately secured using 19 SWG galvanized lacing wire or self-adhesive tape bands at 300mm centers.

All insulated pipework shall then be enclosed with fabricated aluminum cladding or poly-isobutylene sheeting or approved equal as applicable. All cladding shall be firmly secured and sealed to form a continuous vapor seal. External cladding shall be fully protected against the ingress of water.

Where bends and offsets occur in pipework, the insulation shall be tailored to suit.

3) Others

Proprietary items, such as boilers, heat exchangers, hot water cylinders and associated ducts etc. shall be insulated in accordance with the manufacturer's recommendations.

Water feed tanks mounted externally shall be insulated using polystyrene or rigid isocyanate foam slab secured with approved adhesive reinforced with 25mm mesh galvanized wire netting and super coated with two coats of fiber filled bitumen emulsion troweled smooth and even having scrim cloth or hessian embedded in the final coat.

All valves, flanges, unions and other items requiring access for operation and maintenance shall be insulated with quick release removable casings.

The Contractor shall provide full details of the lagging system he proposes to use. Details shall be provided of type and thickness of insulation material, method of securing/fixing sections together with type and thickness of cladding material.

Unless otherwise specified for heat retention purposes all parts that under normal working conditions are hotter than 60oC or colder than -5oC shall be adequately guarded by lagging or other approved means.

4.16 OVERHEAD TRAVELLING CRANES, MONORAILS AND LIFTING GEAR

4.16.1 Overhead Travelling Cranes and Monorails

Overhead travelling cranes shall be either of the double beam or single beam type. Cranes shall be in accordance with appropriate ISO or ASME Standards, with hoist units designed in accordance with FEM Class II ratings.

The cranes shall have a rated capacity of 1.5 times the maximum load, which they will be required to lift. Crane configurations shall be such that they are able to provide a vertical lift to all items of plant, which they are required to cover.

The bridge structure shall be manufactured from single lengths of rolled steel sections or fabricated from steel plate to form continuous box section girders with box section end carriages, gusset plates, cross member and bracing bars (if required) welded to the main cross girders to form a rigid bridge assembly. Steel for crane beams shall be in accordance with ASTM A36 or better.

The hoisting unit shall be mounted in a trolley assembly, which travels on the upper flanges of the girders. For single beam and monorail type cranes, the hoisting unit may be suspended from the bottom flange of the beam.

The crane end carriages shall be fabricated in the form of steel box sections, sufficiently stiffened throughout to withstand the torsional stresses imposed. End carriages shall be designed so as to enable the track wheels to be withdrawn easily.

The rail wheels shall be of the double flanged type with a flange to rail clearance of not greater than 10 mm on each side of each rail to allow for deviations from the normal track dimensions. Wheels shall be manufactured from high tensile low alloy steel to ASTM A27-70-36 or better.

The longitudinal travel motors shall be arranged to drive positively at least one wheel on each end carriage. The individual end carriage motors shall be synchronized to start and stop together.

Crane rails shall be of standard section and shall be manufactured wear resistant austenitic manganese steel. Suitable energy absorbing stops shall be provided at each end of both rails to prevent over-run.

Steel wire rope shall be manufactured from flexible 180 kgf/mm2 cold drawn, galvanized carbon steel and be of round strand 6 x 37 construction fiber core. The hoisting ropes shall have a 6 :1 safety factor on the specified safe working load.

Rope drums and pulleys shall be manufactured from carbon steel in accordance with ASTM A27-70-36. The rope drum shall be parallel to the long travel.

The crane hooks shall be single type manufactured malleable steel to ASTM SAE 1020. The hook shall be provided with a spring-loaded retaining clip to prevent lifting slings from accidentally becoming detached from the hook. The hook shall pivot through 360 degrees by means of a suitably rated ball thrust bearing.

All bearings and gears shall have a design life of 10,000 hours. All gearboxes shall be protected against dust and moisture and all other rotating parts shall be protected by removable guards.

When cranes are required to operate in chlorine drum stores, chemical buildings or other corrosive environments, the crane materials and coatings shall be resistant to corrosive attack resulting from the environment in which the crane is operating.

All cranes and other lifting devices shall be clearly marked with their maximum safe working load in tones in figures not less than 150 mm high on both sides of the main beam.

The maximum deflection under full load shall not exceed 1/1500 of the span.

Power to the crane shall be provided by down-shop conductors manufactured from high conductivity hard drawn copper. Conductors shall be completely shrouded such that they have no exposed current carrying surfaces.

The crane shall be controlled by means of hold-on push buttons with interlocks to prevent opposing functions operating. The control box shall be of the flexible pendant type with the weight of the pendant control box being supported by independent flexible wire ropes, which shall be earthed. The pendant shall be supported such that the operator may control hoisting from any position across the entire crane span.

The main hoist shall have two speeds. The normal lift shall operate at 1.8 m/minute with a creep control of 0.2 m/minute. Cross travel and long travel shall be 10 m minute and15 m/minute respectively.

After erection, all cranes shall be site tested in accordance with the relevant standards. These tests shall include a load test to 125 % of the rated safe working load and demonstration that the crane can operate over its full working range with the test load. The crane beam shall be checked to ensure that the maximum beam deflection when the test load is at the center of the span shall not exceed that specified in the relevant standards.

On completion of these tests, a certificate shall be issued by a competent person confirming that the crane has passed the required tests and is safe to use. Until the certificate is issued, the crane shall not be used for any purpose.

4.16.2 Maintenance Hoist

Functions: To maintenance the mechanical equipment.

Design criteria

The manually driven portable monorail gantry crane shall have a chain pulley block, geared trolley, gantry structure with wheel supports at its base. It shall be designed in the way so as to facilitate the installation and maintenance activities.

(i) Gantry Structure with crane legs

The gantry structure shall be the truss type, which is provided with I-beam as a tracking beam at the top and support the legs with necessary bracing on the either side. The crane legs shall be made of welded structural steel. The connection between the crane leg and the I-beam on upstream side shall be connected with the rigid bolt, and the pivoted pin joint or the semi-rigid bolted joint for the downstream side. The gantry structure legs shall be provided with a pair of wheels and fixing device.

(ii) Girders

The girder (I-beam) shall be provided at the top of gantry crane legs. The allowable deflection for the supporting beam structures under the normal design load shall not exceed more than 1/850 of the span.

(iii) Chain pulley block and geared trolley

The chain pulley block shall be suitable for lifting the loads in the vertical direction by manual operation. The chain pulley block shall be lightweight, easily portable for installation, and easy for operation. The chain pulley block consists of top and bottom hook fittings. And the hook-on top of chain pulley block shall be hung on the hook of geared trolley equalizer pin. The lifting hook shall be of the swiveling type which rotates freely during the lifting, and the rigging hook shall be placed on the other end.

The length of chain shall be over 2 times greater than the total head and have the sufficient margins when the hook reaches down to the designated point.

The release prevention mechanism shall be applied to prevent the loads from falling off the hoist.

The manual grease lubrication shall be applied to the bearings and the grease sealing shall be applied where the grease refueling is not available.

The monorail trolley shall be mounted on the end flange of tracking beam (girders) in the appropriate size. The trolley shall consist of gears, wheels and hand chain. The reciprocating motion of geared trolley shall be available when the sufficient power is acting on the hand chain. The geared trolley shall be easily towed with the specially designed contoured wheels through the I-beam of gantry structure. The trolley shall be adjustable to fit into the flange widths of beam.

Material

The materials shall be suitable for the own purposes and comply with the latest standards or the approved equivalent standards. The specific materials shall not be designated. And the use of alternative materials with corresponding or higher quality and properties shall be subject to the approval of Engineer.

Frame	Shape and steel plate or Carbon Steel or eq
Gears	Cr-Mo alloy Steel or eq.
Hook	Forged Steel (A105, or BS1503 221-490, or SF45) or Eq.

Coating

The coating shall be applied in accordance with the terms of coating and painting from general specification.

4.16.3 Test & inspection

Following type of tests shall be performed on the lifting arrangement.

(i) Proof test

The chain pulley block shall be subjected to the proof load of 1.5 times the working load limit through the lifting length with ensuring that the load is acting on every part of the block mechanism and each gear tooth. When the test is carried out through the operation of hand chain wheel by power, the load shall be lifted and lowered by hand through the distance to prove satisfactory working of the mechanism of the block.

(ii) Load test

The load test for chain pulley block shall be carried out between 100% through 125% of the working load limit during the lift and release.

(iii) Type test

Any breakage or distortion of material shall not be occurred from the test during the load release.

(iv) On-site testing and inspection

- Main dimension & appearance inspection
- Test run
- Performance Testing

Configurations

(i) Accessories per unit

Hoist & parts	1set
Portable lifting frame	1set
Hand chain	1set
Load chain	1set
Geared trolley with hand chain	1set
Gantry frame with wheels	1set
Standard & Special Tools	1set
Lubricating tools	1set
Other necessary parts	1set

(ii) Spare parts per unit

Grease (18 lit.)	1set
Other necessary parts	1set

Except as otherwise indicated, it shall be applying to general specification.

4.16.4 Environmental Conditions

1) Location

Elevation 1,270 meters to 1,402 meters above sea level.

2) Temperature

Extreme Temperature Range : -3.3°C to +36.0°C

Ambient temperature for the design of electrical equipment shall be 45°C

3) Humidity

Maximum : 84%.

Minimum : 37%

4.16.5 System Design Parameters

The electrical equipment's / items selected for this work shall be suitable for operation of technical parameters specified below:

Table 42: Hoist System Configuration requirement

Particulars	Parameters
Incoming Power Supply	AC, 11KV, 3Ph, 50 Hz
Plant power distribution voltage	AC, 400 V, 3Ph, 4 wire, 50 Hz
Lighting and space heating	AC, 230 V, 1Ph, 2 wire
Switchgear control circuit	DC, 110 V, 1Ph, 2 wire
AC control	AC, 230 V, 1Ph, 2 wire
Potential transformer secondary's	AC, 110 V, 3Ph, 50 Hz
System earthing	Solidly earthed
Voltage Variation	± 10% of rated voltage
Frequency Variation	± 5% of rated frequency
Voltage drop shall be limited as follows	Maximum Allowable System Voltage Drop
Service/Branch Feeders	2%
Branch circuits	3%

4.17 STEELWORK, ACCESS PLATFORMS AND HANDRAILING

1) General Requirements

The Contractor shall provide and fix all the steelwork, including stairways, ladders, handrailing, checker plate and open mesh flooring, frames and curbing as detailed in the specification as shown on the drawings or as required to give access to all item of plant for operation or maintenance.

All steelwork access platforms, and handrailing shall be constructed in mild steel and shall be heavily galvanized after manufacture as specified in galvanization clause, except where otherwise specified. After installation all handrailing and steelwork shall be painted in accordance with paint system P8.

All platforms, galleries and stairways necessary to permit safe access to the plant for operation and maintenance, shall be provided and installed by the Contractor.

For all prefabricated metalwork, including multiple duct covers, external ladders, open mesh flooring, checker plating, handrailing, staircases, structural steelwork and the like, the Contractor shall submit fabrication drawings for the acceptance of the Employer prior to the manufacture of any of these items.

A fixed stairway shall be provided as primary access to each elevated working surface where either:

- the frequency of use is at least weekly; or
- materials, tools or other equipment normally must be carried for operation or maintenance; or
- there is potential for exposure to injurious chemicals or material at the elevated working surfaces; or
- any work activity requires two or more people to gain access at any one time.
- Where a dedicated emergency escape route from an elevated walking / working platform is required, a fixed stairway shall be provided.

A secondary means of egress (which may be a fixed ladder or fixed stairway) shall be provided for each elevated working surface if:

- the location is 3m or more above ground, floor or deck level and has 20 m2 or more area; or if
- there is a potential hazard or injurious chemical exposure that could block access to an exit.

The secondary means of egress shall not be more than 25m horizontally from an area where operating or maintenance personnel may be working and shall be located such that an alternative route of escape to a place of safety is provided.

Dead ends in elevated work areas shall not be over 7.5m long.

Minimum headroom above all walkways, platforms, ladders, working / walking surface shall be 2.1m.

2) Hand-railing

Hand-railing shall be of galvanized mild steel of circular hollow section. Hand-railing shall include galvanized mild steel toe boards, 100 mm. high by 3 mm thick.

Hand railing shall be double rail 1100mm high. Standards shall be 38mm diameter solid forged steel with 60mm diameter solid forged steel balls at handrail locations. Standards shall be fixed at maximum 1800mm centers to metal work or 1500mm to concrete. Handrails shall be 33.7mm tubular steel. All components shall be hot dip galvanized to ASTM A 123/A123M.

Where openings in the hand railing are required to facilitate removal and replacement of pumps or mixers or similar items of Plant, such openings shall be designed to open away only from the area being protected and the moveable section shall be securely fixed in position at all other times.

Hand-railing and fixing shall be designed to withstand a horizontal force at handrail level of85 kg per meter run. The deflection of rails shall not exceed 0.8 % of their span between standards and the deflection of standards shall not exceed 0.8 % of their height.

All mounting flanges drilled for not less than three bolts with two bolts on a line parallel to and on the walkway side of the line of the hand-railing and vertical flanges drilled for not less than two bolts the line

through the bolts being vertical. Fittings shall be screwed or secured with grub screws. When provided in sections, hand-railing shall be jointed together with purpose made fittings secured by screws or grub screws.

All ladders, stairways or other openings shall be guarded on three sides by hand-railing conforming to the requirements stated above. Access to the ladders or openings shall be guarded by two removable galvanized hanging chains.

The Contractor shall ensure that unless specified to the contrary all hand-railing shall be of uniform appearances and manufacture.

3) Open Mesh and Checker Plate Flooring

Open mesh flooring and gratings shall generally comply with relevant standards except where otherwise specified hereinafter. Such flooring and gratings shall be of rectangular mesh and non-slip and shall be mild steel and galvanized as specified herein.

Flooring shall be provided to span between the supporting members. Where necessary intermediate support members shall be provided and fixed.

Toe plates shall be provided around all cut-outs except where ordered by the Employer.

Both the load bearing and transverse bars in rectangular flooring panels shall be positioned symmetrically around the center lines of the panels in both directions, so that when the panels are fixed in extensive areas or in long runs, the bars of all panels are in line.

Checker plate flooring shall be of the non-slip type, not less than 10 mm thick measured excluding the raised pattern. The flooring shall be secured to its frame by stainless steel countersunk set screws.

All flooring shall be designed to carry a loading of 400 kg/m^2 or such greater loading as is specified, and the deflection shall not exceed 0.2% of the span and shall be provided with curbing at the edge of walkways.

All flooring shall be removable and set flush in frame of similar material. Where frames are to be fixed over openings the frames shall be provided with lugs for building in.

Floor panels shall be sized to not exceed 25kg for single person lift and provided with appropriate cutouts to permit its removal without disturbing or dismantling spindles, supporting brackets, cables or pipework. Where there is adequate space for movement around the panel, 35kg for a two-person lift. The design shall prevent any possibility of overturning of individual panels. Where openings are required for access to valve or penstock operating spindle caps or other items, the holes in the flooring shall have a binder plate and if the access opening is greater than 50mm circular or square, it shall be provided with a flush hinged plate or flush removable cover.

Intermediate supporting members to give the required rigidity to the spanning edges of individual flooring sections over the wider openings and trenches shall be provided and bolted to suitable built-in fixings. The members shall also be removable to afford clear access to the openings and trenches.

Lifting keys shall be supplied for each location.

4) Stairways

Stairways shall be detailed, fabricated and erected to the dimensions shown on the drawings and designed and detailed to carry a load of 350 kg/m^2. Treads shall be open mesh fixed to the stringers, not directly to concrete. Sloping hand-railing shall be as specified for horizontal hand-railing but with the top rail 900 mm vertically above the line of pitch and standards vertical and spaced at not more than 1500 mm measured parallel to the line of pitch.

Staircases shall be constructed to the size and position shown on the drawings or as instructed by the Employer. They shall be steel hot-dip galvanized at works after manufacture and shall comprise stringers supporting the open work stair treads and shall be supplied complete with handrails and stanchions to dimensions similar to above.

Staircases shall generally have risers of 190 mm and goings of 270 mm. Stairs widths shall be a minimum of 1.1 m for general use or 0.8 m for infrequent use. A minimum headroom of2.1 m shall be provided. The maximum number of risers between landing shall be 16. Landing length shall not be less than 1.1 m.

5) Ladders

Ladders shall be fabricated of mild steel and galvanized as specified. The stringers shall be flat section not less than 65 mm x 10 mm spaced 380 mm apart and shall be flanged and drilled for wall fixing at both ends. The stringers shall be radiused over the top where they shall be not less than 600 mm apart. Ladders over 3000 mm long shall have additional intermediate stays at not more than 2500 mm.

Where ladders reach platforms, the stringers shall be extended to a height of 1100 mm above platform level to allow safe access on to the platform.

Rungs shall be 20 mm diameter solid at 250 mm centers shouldered at each end and securely riveted into countersunk holes. Rungs shall be not less than 230 mm from the wall.

All ladders over 2.3m above ground level shall have safety cages which shall be constructed of three flat vertical strips supported by flat hoops, with a diameter of 750 mm. The hoops shall be at approximately 700 mm centers and the first hoop shall be 2300 mm above ground. Where vertical ladders rise from elevated platforms then protection shall be provided against falling from platform level.

Where the rise exceeds 6000 mm, an intermediate landing shall be provided. Ladders shall not be permitted as a primary route for escape.

4.18 COVERS FOR CHAMBERS

All Covers and frames shall be manufactured, from cast Iron / ductile iron or polymer composite (ASTM D 3039), and be coated to the approval of the Engineer. Covers and frames shall be heavy duty and conform to IS1726-1991. Covers to be used in surfaces, which are subject to heavy vehicular, shall be class D, according to EN 124.

All covers shall be fitted to the frames and tested manufactures work, and covers and frames shall be similarly numbered in a legible and permanent manner in a position which will not be visible when fitted in place, and shall be of such construction as to minimize ingress of sand.

The contractor shall insure that the covers are fitted to the appropriately numbered frames after the frames have been fitted.

The name of employer, year of manufacture and any actional markings shown on the drawing shall be embossed in all covers.

All Cover shall be lockable. Two pairs pf keys for use with each type of cover shall be handed over by the contractor after completion of works.

5 ELECTRICAL WORKS

5.1 EARTHING AND BONDING

The provision of an earthing system for all or part of the electrical or instrumentation installations shall comply with the IEC recommendations or with other Internationally recognised standards.

General Requirements

The earthing system shall always be considered in relation to the following; design and functionality of which shall be coordinated with respect to the maximum allowable impedance and the anticipated earth fault current:

a. Connection to the general mass of earth

b. Earthing conductor to the main earthing terminal
c. Cross bonding to other services and systems
d. Circuit protective conductors
e. Equipotential bonding
f. Functional earthing

Where lightning protection is involved, it shall be referred to section below.

Earth Electrodes

The connection to the general mass of earth shall be carried out using copper rod, strip, or plate electrodes, or multiples of the same, which shall be connected to the electrical installation by means of an earthing conductor.

In addition, a loop of bare copper strip or a bare copper cable of 150 mm² shall be buried around the foundations of every building and shall be welded to the steel reinforcing bars of the floor slab, using copper conductors of the same cross section area. Welded connections to reinforcing bars shall be provided every 10 metres at least.

The soil resistivity shall be measured at the proposed location and prior to the sinking of earth electrodes, from which the number of earth electrodes and their positions shall be predicted before installation. Where the soil resistivity exceeds 100 Ohm-metre, or where it is foreseeable that corrosion or drying of the soil will adversely affect the resistivity, advice shall be sought from the Employer as to whether bentonite or similar should be imported in an attempt to improve the soil resistivity, and hence better predict the number of earth electrode positions necessary to guarantee a given earth electrode resistance.

The absence of buried services shall be established, down to the intended driving depth, before penetration of the ground occurs.

Earth rods

These shall comprise molecular bonded, copper-clad, high tensile steel rods with rolled threads, of typical dimensions: 16 x 1200 mm minimum. Where identified, solid copper rods shall be substituted in locations of particularly aggressive soil conditions.

Rods shall be fitted with a separate driving stud, and shall be sunk into the ground in 1200 mm lengths using percussive power hammer. A single earth rod shall not normally exceed 6 m in length, and the separation between adjacent earth rod positions shall be a minimum of 1.5 times the longest earth rod length.

Earth rod couplers and fittings shall be proprietary items manufactured from high strength copper alloy, with any setscrews of phosphor bronze.

Earth strips

These shall comprise long runs, up to a maximum of 50 metres, of bare copper tape with minimum dimensions 25 x 6 mm, laid in the ground with at least 1000 mm cover of backfilled soil. Adjacent runs of earthing strips shall be separated by a minimum of 1000 mm.

Earth plates

These shall typically comprise 900 x 900 x 3 mm solid copper plates buried vertically in the ground, with at least 1000 mm cover of backfilled soil. Adjacent earthing plates shall be separated by a minimum of 2.5 m.

The joint between the earthing conductor and the earth plate shall be protected from moisture and deterioration.

Earthing conductors

Earth electrodes shall be interconnected using bare copper tape, sized according to the anticipated fault current, but not less than 25 x 6 mm. The final earthing conductor connecting the earth electrodes to the electrical installation main earthing terminal shall be copper tape or stranded conductor of cross-sectional area larger than 70 mm², and be sheathed in green/yellow PVC insulation. Underground conductors shall be provided with marker tape before backfilling.

Every earth electrode position shall be provided with an inspection pit arranged so as to allow access to its earthing conductor connection. The inspection pit shall comprise a chamber mounted at finished ground level and fitted with a removable lid, and shall be of concrete construction where it will be located in a pathway or an area of hard standing.

Where it is proposed to interconnect an MV earthing system to an LV earthing system, this shall only be carried out where the resultant resistance to earth of both systems connected together is 1 Ohm or less. The size of the interconnecting conductor shall not be less than that of the earthing conductor on the MV side.

Where the earthing system is to be used as the earth reference for an instrumentation system, the impedance to earth shall be 1 Ohm or less.

Earthing conductors shall be jointed in such a manner that their cross-sectional area is not reduced, and that robust, reliable, and waterproof joints are obtained. Earth tapes shall be bolted using two bolts, or riveted using four rivets. Stranded conductors shall be exothermically welded.

Earthing Terminals and Earth Bars

An earth bar, of proprietary manufacture, shall be provided at the origin of the electrical installation, which shall act as the main earthing terminal for the electricity supply. It shall comprise a tinned copper bar supported off the building structure on barrel insulators, and have at least one disconnecting link.

The earthing conductor(s) from the local earth electrodes system, shall be connected to the disconnecting link(s), and the cross bonding, equipotential bonding, functional earthing, and circuit protective conductors shall be connected to the fixed portion of the earth bar. Two spare terminations shall remain on completion of the installation. All conductors connected to the earth bar shall be identified as to their purpose.

Where the supply of electricity is distributed to another site or building, a subsidiary earth bar, as specified above, shall be provided locally to the sub-distribution equipment and shall act as the main earthing terminal for that site or building.

The main earthing terminal shall be considered as the point of connection to which all earths shall be referenced, including the following:

a) “Clean” earths; to which are connected instrumentation system earths
b) Functional earths; e.g. from telecommunications equipment
c) Surge protection earths; with direct connections from lightning protection units and hazardous area barriers

As required, separate earth bars, insulated from surrounding earths, shall be provided throughout the installation for the termination of instrumentation and functional earths. These earth bars shall be

individually and separately connected back to the main earthing terminal at the origin of the installation, within a given site, area, or building.

Circuit Protective Conductors and Bonding

All circuit protective and bonding conductors shall be sized in relation to the maximum prospective earth fault current in that part of the installation, subject to the minimum values dictated by the relevant approved standard.

Where the passage of higher frequency currents is likely to occur, where VSD, Soft Starters, power electronic equipment, or radio equipment are installed, protective and bonding conductors shall be formed from braided copper strap of an appropriate cross-section.

Cross Bonding:

Cross bonding shall include all metallic pipes, ducts, and services entering a building or site, the structural steelwork, and the lightning protection installation.

Circuit Protective Conductors (CPC):

The rigid steel conduit or cable armouring may be used as the sole CPC subject to its impedance being sufficiently low. If in doubt, an additional CPC shall be installed in accordance with a minimum cross section of 50% of the circuit phase conductor.

Where a cable is connected to equipment containing power electronics, the cable armouring or screen may be used to form all or part of the CPC, but no constituent core of the cable shall be so used.

The CPC and any gland earthing tab shall be connected to the earth terminal of every junction box, equipment, and accessory termination.

Equipotential and supplementary equipotential bonding:

Metallic cable support systems shall be electrically continuous throughout their length, and where there is any possibility of a joint developing an unacceptably high contact resistance, e.g. due to inadequate bolted metal to metal contact, bonding links shall be fitted across each joint.

The metallic cable support system shall be connected to the CPC at each end and where ever it is convenient along its length, and shall also be bonded to all other adjacent metallic non-electrical services.

Extraneous conductive parts, within 2 m of a circuit or piece of electrical equipment, and which are likely to introduce earth potential, shall be connected to the CPC. This shall also apply to the framework supporting floor gratings, trench covers, enclosure panels, and metallic frames. Metallic gratings, covers, enclosures, panels, etc. need not be individually bonded to their supporting framework where there is the likelihood of substantial metal-to-metal contact being maintained.

Where the protective or finished surface coating of any equipment, plant, or structure has to be removed in order to make a low impedance earth connection, the damaged area shall be made good in such a way that the corrosion and moisture resistance of the affected area is no worse than that of the original surface coating.

Instrument and Signal Earths:

Instrument earths shall be connected in a strictly individual and radial manner to clean earth terminals or bars, as shall equipment functional earths be connected to functional earth terminals or bars.

At the origin of every circuit, any screen, shield, drain wire, or spare cores within the cable shall be solidly connected to appropriate earth terminals.

At any intermediate termination of a circuit, the screen, shield, drain wire; or spare core, where it is separate from the CPC, shall be insulated with sleeving, and together with any spare cores, shall be connected to insulated terminals, to which the insulated screen, shield, drain wire, and any spare cores of the subsequent length of cable shall be connected; thus maintaining screen, shield, drain wire, and spare core continuity throughout the circuit.

Where necessary, an insulating gland shall be used to prevent the earthing of the screen or the shield with the armouring.

At the field termination of the circuit, the screen, shield, drain wire, or spare cores, shall be connected to insulated terminals; alternatively, the screen, shield, drain wire, shall be cut back and the cable crotch insulated with a length of silicone rubber over sheath.

Where cables carry low-level high frequency signals, or are installed where there is a significant risk of high frequency interference; (e.g. in signal circuits connected to equipment containing power electronics), they shall have their screens or braids capacitive connected to earth in a proprietary manner.

5.2 LIGHTING

Illumination levels

Interior lighting levels after one year shall be at least:

a) Office areas: 200 lux
b) Pumps and control rooms: 300 lux
c) Circulation inside structures and buildings: 50 lux
d) Exterior lighting levels after one year shall be at least:
e) Exterior operator locations: 50 lux
f) Access roads: 15 lux

Emergency lighting

Emergency lighting shall be installed to comply with the requirements of the local authorities or European regulations. On completion of the installation, a Completion Certificate as required by the enforcing local authorities shall be provided.

Emergency luminaires shall be self-contained and complete with internal batteries and appropriate legends in accordance with the Health and Safety regulations, safety signs and signals.

Enclosure shall be rated IP 55 or better. Battery operation shall last for 30 minutes or longer.

Supplies to emergency luminaires shall be taken from the main switchboard. Key operated test switch shall be provided locally for each emergency lighting circuit, in such a manner that the emergency lighting can be energised without affecting the operation of the mains powered interior lighting.

Emergency lighting test switches shall be incorporated into the general lighting control arrangements and shall be clearly identified.

Emergency lighting fixtures shall be installed wherever required and as directed by the local enforcing authorities.

Exterior lighting

Lighting columns for road or area lighting purposes shall be of a tilt-over or of a lowering mechanism design, to facilitate maintenance of luminaires. All the necessary raising and lowering gear shall be provided and shall be from the same manufacturer as the columns.

Lamps shall be LED.

If discharge lamps must be used, they shall be high pressure sodium for roads and outdoor areas.

Switching of external lighting shall be automatic using photoelectric cell and shall also be manually controlled from a switchboard. A manual/auto changeover switch shall be provided.

Design of the lighting poles shall meet the Architectural requirements.

Interior lighting

Interior lighting fixtures shall be industrial type fitted with LED.

5.3 STANDBY POWER GENERATOR

In order to avoid interruptions of the facility operation, a standby power generator (diesel fuelled) shall be provided to take over the electrical supply of the whole treatment plant (diesel storage tank for 1 week to be included). The power generator shall be located in the “Power/heating plant building” or alternatively in an ISO-standard container unit for outdoor installation.

A proper ventilating system has to be planned and considered in the Contractor’s offer in order to guarantee a continuous uninterruptedly operation of the generator set.

- The set is to deliver with all necessary equipment
- The set has to be well balanced
- The set has to be modified for tropical climate
- The diesel engine is flange-coupled to the generator, the torque is transmitted through a flexible expansion coupling
- The set includes the necessary devices for control and protection of the diesel engine and the generator, alarm signalling and distribution of electric power
- The generator has a brushless excitation and voltage regulation system
- • The power unit is equipped with an automatic control device, which provides an automatic start-up and shutdown, alarm, signalling of the condition of the diesel engine and the generator, and an automatic synchronisation and stable parallel operation with the electric mains.

- All needed protection relays, short interruption detection, voltage monitoring relays etc have to be installed.
- Integrated ground fault indication
- The diesel engine is equipped with heavy duty air cleaners and bypass-type oil filters
- Starting system: 24 V dc electric starter,
- 24 V dc battery charger
- Cooling System
- Optimised for maximum efficiency and minimum noise.
- Propylene glycol coolant for greater environmental protection designed for ambient temperature of 40ºC
- Intake air filtration system

Custom Switchgear

- Designed and built to meet severe customer requirements.
- Equipped for total remote automatic monitoring and control for stand alone, paralleling or emergency standby applications
- Motor-operated circuit breaker for automatic paralleling
- Convenient Shore Power connection provides power to interior lighting, jacket water heaters, battery charger and alternator anti-condensation space heaters.

Operator Panel Features

- Emergency stop switch
- Indicating lamps for remote start, Not in Auto, common shutdown, and common warning
- Fault reset switch
- Panel lamp/lamp test switch
- Exercise switch and indicating lamp
- Manual run/stop switch
- Off/Manual/Auto mode select switch
- Graphical display panel with pushbutton switches capable of displaying up to 9 lines of data approximately 26 characters wide, as well as graphical characters
- Analog AC metering panel for simultaneous monitoring of 3-phase AC voltage and current, kW, power factor, and frequency. Voltage, current and kW are scaled in % of nominal values. All values are colour-code to indicate normal, warning and abnormal operating conditions

Standard Features

- Isochronous governing
- 3-phase sensing voltage regulation with single and three phase fault current regulation
- AC output protection including over/under voltage, over/under frequency, overcurrent, short circuit, and overload (kW)
- Engine control and monitoring system with displays for oil pressure, oil temperature, engine coolant temperature, engine speed, battery voltage and other values
- Generator set protection system including AC output protection alarms, engine pressure, temperature warning, shutdown functions, low coolant temperature, low coolant level, low fuel level, failure to crank, failure to start and over speed
- Operator adjustments for time delay, start/stop, engine speed, and over speed
- Technician setup menu
- Status and data display functions including engine operating hours, kW hour productions, AC metering functions and fault history

Additional Features

- Alternative temperature alarms
- Analog signal 4-20 m A for generator power (kW)
- Set of potential-free contacts for remote signalling (gen. Running, fault, etc.)
- Lightning protection device

5.4 AUTOMATION AND INSTRUMENTATION (A&I)

5.4.1 PROGRAMMABLE LOGIC CONTROLLER (PLC)

5.4.1.1 General Specifications

The Control Units will be modular and prepared to function in an industrial environment. They will be able to work with either local or remote I/O modules.

The control units must be able to operate continuously in a temperature range of 0 to 50°C and a humidity of up to 95% without affecting their useful life.

Controller and any other card of the Control Units (power supplies, I/O, communication cards, etc.) may be disconnected for inspection and replacement without disturbing the operation of the rest of the system or of other cards in the same rack, and safely for people and equipment.

The Controller must have a wide range of predefined functions and blocks for control and calculation, in order to perform complex mathematical calculations, control process in open and close loops, digital/analog signal processing, etc.

Communications between Control Units at control and monitoring level will be done through an Ethernet network (of at least 100 Mbit/s).

Control Units will be able to synchronize their internal clocks through the monitoring network. The Control Unit must be able to communicate simultaneously at least with the following field buses:

- Profibus DP and PA.
- Modbus and Modbus TCP/IP
- HART

The control units allow integration of equipment and instrumentation through field bus. (Profibus, Hart, Modbus, Ethernet/IP etc.). Also allow communication transparently through the engineering tools provided with devices connected to the field bus.

The control system will allow changes in the hardware configuration during normal operation without causing disturbances in the operation of the plant.

Control units will allow programming changes while the control application is running. It will also be possible to dump data or programs in any of the installed non-volatile memory cards while the control application being running.

Controllers will have non-volatile memory cards where programs, configuration data, control units, status information and also process data will be recorded.

The amount of memory of the controllers will be chosen so that the final occupation does not exceed 30% of total capacity once the entire final control application and all its associated data have been loaded, for the first phase of the plant.

The control units have a self-test and diagnostics system and will be able to manage diagnostics from other devices of the control system.

The controller shall support all five IEC 61131-3 programming languages:

- Sequential Function Chart (SFC)
- Functional Block Diagram (FBD)
- Ladder Diagram (LD)
- Structured Text (ST)
- Instruction List (IL)

The controller configuration and programming software shall be accessible from a single user interface. The software shall allow the user to develop and then download the application and system configuration locally via USB, serial port or Ethernet interface, and over the communication network via TCP/IP, Modbus, Profibus and Profinet etc. protocols.

The IEC61131-3 applications shall include the following functions:

- PID feedback control
- Controller data logging functions
- Timers, counters, mathematical functions, memory functions
- Standard Ladder Logic functions such as coils and contacts
- Boolean logic functions
- Bit transfer functions
- Block transfer functions
- Scaling function
- Totalling function
- Flow function
- File manipulation functions
- Alarm grouping functions
- Database manipulation functions
- Communication manipulation functions

On-line monitoring of user application data including function block and ladder logic application code shall be included to facilitate debugging of programs.

The programming software shall support on-line monitoring and forcing of any variable in the application database. Forcing shall write a value to the register and prevent modification of the variable content by the application software. A global command to remove all forcing shall be included. There shall be a physical indication LED on the controller when any application variable values are forced.

In addition to forcing, the software shall be capable of writing a value to any object in the controller database but continue to allow communication protocols or application software to modify the contents of the object.

The IEC61131-3 interfaces shall provide coupling to the following controller facilities:

- Database functions: read/write attributes of the controller objects
- System command functions

- Protocol functions including routing manipulation

5.4.1.2 Remote I/O stations

Remote I/O stations will be modular and will be ready to operate in an industrial environment.

The types of components used (power supplies, racks, I/O cards, communication cards, etc.) will be the same in every remote station of the plant, in order to minimize the amount of spare parts and allow a quick repair in case of system failure.

The remote stations are supplied with at least 20% of free slots.

The failure of a component in any remote station must not affect other components or cause any control system failure.

Remote stations will have a self-diagnostic system that will send their information to the monitoring system for management purposes.

Remote stations shall comprise a 3G-4G Router GPRS Modem with the following specifications:

a) The Modem should support Quad band HSPA+/UMTS: 850/900/1900/2100MHz
b) The Modem should have SMA female port for antenna. The Modem shall be delivered with antenna having 2 dB gain
c) The Modem should not have any moving part (fan etc).
d) The Modem shall be managed from serial console, Telnet and Web interface.
e) The Modem should have min. 1xethernet port (10M/100M). Ethernet port should support auto-adaptive, MDI/MDI-X,
f) The Modem should have min. 1 serial port (RS485 or RS232 15KV ESD protected).
g) The Modem's serail port should support protocols below
h) MoDBus serial protocol. The Modem shall be able to convert Modbus serial data to Modbus TCP. ModBus TCP protocol can be transmitted over GSM network.
i) Virtual com: (Can be configured as virtual com port.)
j) Transparent. (can transmit data coming serial port transparently)
k) The Modem should have a DMZ and VRRP feature.
l) The Modem should support protocols listed below;
m) ICMP, IP, TCP, UDP, DHCP, PPP, ARP, Telnet, DNS, SSH, VRRP, HTTP, HTTPS, static routing,
n) Network Address Translation (NAT) and Port Address Translation (PAT).
o) The Modem should have CHAP/PAP support.
p) The Modem shall be able to feature State Packet Inspection (SPI), filtering multicast, filtering PING packet, preventing DoS attack.
q) The Modem shall be fed with 9-26VDC power supply.
r) The Modem should operate between -20-70°C
s) The Modem should have Signal strength, power status, fault and alarm LED indicators.
t) The Modem should have test least EMC level 2.
u) The Modem should have at least IP30 protection.
v) The Modem should have test reports for standards listed below;
w) Anti-shock/ Drop/ Vibration, IEC60068-2-27/ IEC60068-2-23/ IEC60068-2-6.
x) The Modem should have EMC protections listed below;
    a. EN61000-4-2,level 2
    b. EN61000-4-3,level 2

c. EN61000-4-4,level 2
d. EN61000-4-5,level 2
e. EN61000-4-6,level 2
f. EN61000-4-12,level 2

5.4.1.3 Inputs and Outputs Cards

I/O cards will be preferred with hot swapping capability. In any case, the replacement of a card at a station must not cause failure of any other part of the control system and will only involve the loss of operation of the part of the operation of the plant controlled by the station.

Stations will be designed for installation in a room. They will have ventilation with temperature control.

All I/O cards, regardless of their type, will have the following characteristics:

- Global and per-channel diagnostic functions, which will be transmitted to the monitoring system.
- LED status signalling per channel.
- All channels input / output shall be electrically insulated with respect to power and control bus card.
- All I/O channels shall be electrically insulated from each other.
- Must be fully configurable via software, without having to manipulate the hardware.
- In the control units and remote stations, I/O connection cards will be made through pre-wired base terminals that will have a connector on the side of the card that facilitates fast connection or directly through cards with terminal blocks.
- Cards can be replaced without disconnecting the field wiring.
- There will be 20% spare I/O signals of each type.

The I/O signals must fulfil the following minimum requirements:

Digital Inputs

All digital inputs will be 24V DC.

For each channel there will be a power connection individually fused. The fuse will always be electronic and internal to the card in the case of remote stations, while for control units must be conventional and external to the card. The voltage supplied is 24V DC.

On each card, inputs may be divided internally into channels of 8 items or less.

Digital outputs

All digital outputs will be 24 V DC.

In the control units, I/O cards will be connected to pre-wired relays bases, so that the final output of the control box is a potential-free contact.

Relays will be of the plug-in type and SPDT at least.

The characteristics of the contacts are:

a) Voltage: 5V to 250V AC/DC
b) Current: 5A AC / 2A DC

Analogue inputs

Generally, analogue inputs to be used in the control units are of standard 4-20 mA type, although it may be possible to assemble cards with Hart communication protocol.

Each analogue input channel can be configured individually for active loops (the instrument will have its own power supply) or passive loops (the instrument will be supplied through the measurement loop).

There will be a power connection individually fused for each channel. The fuse will always be electronic and internal to the card for the case of remote stations, while for control units it may also be conventional and external to the card. The supplied voltage is 24V DC.

Analogue input channels will have detection of out-of-range fault, open circuit detection and short-circuit detection.

Analogue outputs

Generally, analogue outputs to be used in the control units are of standard 4-20 mA type, although it may be possible to assemble cards with Hart communication protocol.

The minimum resolution of analogue inputs is 16-bit. Voltage will be supplied to the loop by the control station, and it will be 24V DC. In case of remote stations, the voltage will be supplied directly by the card, while in control units and nonlocal remote stations, the voltage may be taken from a power supply. In the latter case, for each channel there will be a connection for power supply individually fuse protected.

Analogue output channels will have detection of out-of-range fault and open circuit detection.

5.4.2 INSTRUMENT SPECIFICATIONS

5.4.2.1 General

Prior to ordering of equipment and commencement of installation work all relevant drawings, documents etc. shall be approved by the Engineer.

The contractor shall guarantee that all measuring devices are installed vibration free.

The instrumentation shall fulfil the requirements of the process and shall be fully compatible with the monitoring and control system offered. An over-voltage protection is required for each measuring circuit in accordance with the standards IEC 1024-1 “Protection of Structures against Lightning” and IEC 1312-1 “Protection against LEMP”.

All instrumentation- equipped with analogue output signal- should have a feature such that when the instrument is in faulty condition, the 4-20mA output turns either to 0mA or 22mA. Ultrasonic level sensors, pressure transmitters and magnetic inductive flow meters and as otherwise indicated below should have Hart protocol embedded. All hardware interfaces and software for HART communication must be supplied for connection with portable computer. The ultrasonic level sensor should be supplied with software for parameter adjustment, sensor diagnostics and echo curve display.

5.4.2.2 Field Instruments

Sensors shall be manufactured from durable, corrosion free material, suitable for humid saline environment, the local climate and the liquid controlled.

Sensors shall have minimum protection classes IP 65 or IP 67/IP68 if subject to immersion and cable or others fed through entries shall not violate the classification.

Sensors shall be connected to a measuring transducer. The transducer shall be equipped with an output of 4 - 20 mA and one adjustable limiting value switch for dry protection, overflow, etc. This switching contact shall be incorporated into the relay technique of the control.

Supporting steelwork shall be adequate and allow access for maintenance, repair or replacement and shall not hinder the proper functioning of the instrument.

Control units shall be suitable for rack mounting and shall be installed in an appropriate control room. Field control units shall be housed in appropriate field cabinets with a window for control lamps or indicators. The protection class shall be at least IP 65. Field cabinets shall have a roof as protection against the elements.

Analogue outputs shall be provided with linear proportionality to the depth range.

5.4.2.3 Instrument Cable

Conductor

Twisted pair conductor

< 18 AWG , 1.0mm^2 or recommended wire size by equipment manufacturer

Shielding

Stranded tinned copper conductor

polyethylene insulation

25% Overlap

100 % Coverage

Electrical

300/600 Voltage grade

Resistance @ 20 C < 12.3 ohms/kM

Fire Retardant

IEC 60332

Wire Color

Gray

5.4.2.4 Level Indicator Transmitters

Sensor: Ultrasonic Level Sensor - Remote Type

Minimum measuring range: 5 m (may vary on application)

IP Protection: IP 66 or better

Cable length: 10m or greater

Transmitter: (Level to Flow Converter)

Supply voltage: 220-250 vAC

Output: 4-20mA HART ; 4-20mA

IP Protection: IP 65 or better

Mounting: Panel Mounted

Accuracy: 0.25% of FS' or better

Display: LCD with backlight

Displays multiple parameters level, flow, totalizer

Configurable through HART protocol and local keypad

Units for level cm, m, inch, feet

Preprogrammed formulas must cover most common

Accesorias:

Mounting Bracket

User Manual and Troubleshooting

Certificate of factory calibration

5.4.2.5 Ultrasonic Level Indicator

Sensor: Ultrasonic Level Sensor - Remote Type

Minimum measuring range: 10m (may vary)

Operating temperature: 10°Cto 60°C

IP rating: IP 67

Cable length: 25m

Transmitter:

Supply voltage: 220Vac

Output: 4-20mA HART ; 4-20mA

IP rating IP 65 or better

Accuracy: 0.25% full scale or better

Display: LCD with backlight

Ambient temperature: 10°Cto 60°C

Units in meters

Accessories:

Mounting Bracket

User Manual and Troubleshooting

6 OUTLET MANAGEMENT UNITS

The Outlet Management Units are placed in the primary pipelines at the inlet of the District Metered Areas (DMA), controlling the incoming pressures and discharges, more precisely sustaining pressure in the primary network via SCADA, and also serve as control points, in order to guarantee an equitable distribution of the available water in the secondary networks. Therefore, their main functions are:

- Assure that the primary network is continually pressurized even if the water supply network experiences intermittent water supply.
- Reduce downstream pressure.
- Allow remote On and Off switching of water distribution service.
- Measure and monitor flows entering the DMA, upstream pressure (primary network), and downstream pressure (DMA).

OMUs are composed of concrete chambers, piping and fittings including bypass, isolation valves (gate or butterfly), automatic control valves, strainers, electromagnetic flowmeters, pressure sensors, power by photovoltaic solar panels and batteries mounted on poles and signal wiring, control system, and telemetry.

6.1 AUTOMATIC CONTROL VALVES

6.1.1 Scope

This technical specification determines minimum technical requirements for automatic control valves to be installed in OMUs. The automatic control valve shall be a combination of pressure sustaining and pressure reducing valves unless otherwise stated on the Drawings.

6.1.2 Coordination

Automatic control valves and control systems shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers and manufacturers under other sections of these Specifications and where applicable, with related existing equipment. All automatic control valves and control devices shall be in full conformity with the Construction Drawings and Specifications, and with the instructions and recommendations of the valve manufacturer and the related equipment manufacturer.

Related equipment and materials may include, but not be limited to PLC, RTU, supervisory control equipment (SCADA), telemetry, conduit, cable, and piping, as described in other Sections associated with the project and shown on the Drawings.

Interconnection wiring diagrams shall be prepared between the related equipment and the equipment furnished under this Section. Interconnection wiring shall provide all functions specified herein and/or shown on the Drawings.

6.1.3 Technical requirements

6.1.3.1 General

The automatic control valves defined in this specification shall be suitable for operating flooded or in an underground vault under humid conditions, without affecting their regular operation. The water that will flow through these valves will be potable water at temperature between 4 and 40 ºC.

The automatic control valve shall be a combination of pressure sustaining and pressure-reducing valve. To protect the primary network from depressurization, the valve shall maintain a minimum pressure upstream. When the upstream pressure becomes equal to the pilot setting of the pressure sustaining control, the valve throttles to maintain constant inlet pressure. Whenever required, the valve shall also maintain constant downstream pressure regardless of changing flow rate and inlet pressure.

The automatic control valves to be supplied must be new; therefore, recycled materials are not accepted. All the parts that make up the control valve must have a uniform surface, free of dents, depressions, protrusions, porosities, fissures, cracks, discontinuous cuts, burrs, incrustations, or sharp edges.

Valve parts must be designed and manufactured with sufficient tolerances to allow interchangeability of parts between units of the same size and type produced by the same manufacturer. Once assembled, valves manufactured to this specification should be tightly fitted and function without problems.

Any valve component in direct contact with potable water must be certified by NSF / ANSI 61, WRAS, or similar.

6.1.3.2 Main Control Valve

The main valve shall be a globe-type, single chamber, full bore, diaphragm actuated by a hydraulic pilot and integral controller that accepts a remote set-point command input and makes set-point adjustments to the pilot. The valve shall comply with the latest revision of ANSI / AWWA C530-12, EN 1074-5 standard or approved equivalent.

The design of the valve shall be such that it carries a sealing mechanism, which provides flow-through seats and allows linear operation of the valve assembly. Additionally, the valve body shall facilitate easy removal of the inner valve assembly for inspection and repair.

The valve body and bonnet shall be ductile iron ASTM A536 grade 60-40-18 or 65-45-12, DIN EN 1563 EN-GJS-400-15 (GGG-40), or EN-GJS- 500-7 (GGG-50) and must withstand a working pressure of up to 16 bar.

For connection to the water main, the valve end connections shall be flanged. Flanges shall conform to the dimensions and drilling of ISO 7005-2 PN16. The length of the valve between flange and flange shall comply with the standard ISO 5752.

The valve body shall be suitably drilled and tapped to facilitate mounting of the valve bonnet and may have suitable holes for accepting bonnet location dowels. The valve body shall allow for a minimum of four NPT holes for mounting of accessories.

Valve bonnet shall be a flanged cover bolted to the primary valve body to retain the inner valve assembly and may include the stem guide bushing and stem cap. The valve bonnet shall be suitably designed to form a leak-tight cover when bolted to the valve body and allow for linear travel of the inner valve assembly. It shall have a minimum of two NPT openings to allow for mounting of accessories for the operation of the valve assembly. The valve bonnet pressure rating shall be the same as that of the valve body. The valve bonnet may be suitably machined and drilled to allow mounting of the bonnet cover or stem cap.

Valve bonnet cover or stem cap shall be a structural component that is mounted on top of the valve bonnet and may contain a bushing to guide the stem; when bolted to the valve bonnet, it forms a sealed operating chamber between the diaphragm and itself. The stem cap shall be of a material similar to the valve bonnet and shall be secured to the valve bonnet with suitable attachment to form a leak-proof joint. The stem cap shall be designed to retain the pull-down-packing-gland sealing system or O-ring seals or bearings, if used for valve manual position indicator.

Valve stem shall be a 316 stainless-steel stem designed to mount moving parts, such as disc retainer, piston, resilient disc, and diaphragm as an assembly and provide guidance of the assembly. Valve stem shall be a one-piece or two-piece stem extending through the bearing in the valve bonnet and or seat ring guide. Valve stem shall have a minimum diameter to support the valve assembly under extreme opening and closing conditions. Connection between the operating components or the inner valve assembly shall be clamped securely by means of a threaded nut or other secure means.

The seat ring shall be a 316 stainless-steel component that may or may not include the bottom guide and is installed in the valve body forming a leak tight seal against a resilient disc upon closure. Seat ring shall be threaded, held in place with stainless steel machine screws, or clamped in the valve body. Seat rings shall have a sealing material between the body and the ring to prevent leakage. The resilient disc shall be of an elastomeric material that may be reinforced.

Diaphragm shall be a flexible, elastomeric fabric reinforcement (EPDM or NBR) that seals the valve body cover-bonnet volume from the valve body volume to allow an operating pressure to be developed in the valve body cover. Diaphragm and piston seals shall be designed to withstand the maximum operating pressure of the valve. The diaphragm shall be cycle-tested for 10,000 cycles without any visible signs of damage.

Pistons shall be ductile iron ASTM A 536 grade 60-40-18 or 65-45-12, or DIN EN 1563 EN-GJS-400-15 (GGG-40) or stainless steel AISI/SAE 304 or 316.

All main valve fasteners (bolts, nuts, studs, cap screws) shall be supplied as AISI 18-8 or 304 stainless steel. All bonnet bolts shall be fitted with stainless steel washers to prevent damage to the bonnet coating.

All internal and external ferrous components, including all mating surfaces, shall be coated with a WRAS or NSF-61 approved fusion bonded epoxy to a minimum of 200 µm DFT-Dry Film Thickness. Coating colour shall be RAL 5005 o RAL 5017.

Due to the potential for noise, vibration and erosion damage from cavitation, the valve manufacturer shall provide, upon request, a computerized sizing and cavitation analysis, using independent third-party software. Cavitation analysis shall provide the status of cavitation based on customer supplied parameters as to valve size, flow rate requirements and pressure conditions. The cavitation analysis shall also provide information as to Cv factor, percent of valve lift, cavitation index and noise level.

The valve manufacturer shall be able to supply cavitation control trim which shall be engineered to be optimized to the actual operating parameters of the control valve application and warranted to perform correctly and prevent main valve cavitation damage under the stated conditions. Orifice plates or other non-engineered cavitation control devices shall not be used to prevent or minimize valve cavitation.

6.1.3.3 Actuated Hydraulic Pilots

Two Actuated Hydraulic Pilots will be supplied with the Control valve: one Pressure Sustaining Pilot located upstream and one Pressure Reducing Pilot located downstream. The pressure sustaining pilot must be supplied with an actuator to be commanded from the SCADA System. The pressure sustaining pilot will work in intermittent supply. This actuator will be moved to the pressure reducing pilot in continuous supply.

The function of the actuated hydraulic pilots is to adjust the position of the valve to ensure correct control of the water supply in the upstream primary network by appropriate adjustments of the Pressure Sustaining settings and correct pressure in the secondary distribution network downstream (even may be programmed for reducing pressure at low demand daily periods like night time to minimize leakages) via the SCADA system. For this purpose, the Contractor shall supply and install the hydraulic pilots integrated with an electronic controller, that accepts a remote setpoint command input and makes setpoint adjustments to the pilot.

The hydraulic pilot shall be a 2-way, diaphragm actuated spring-loaded, pressure-sustaining pilot valve designed to control hydraulically actuated valves. The pilot valve modulates to keep a steady, preset pressure upstream of the valve's location. As the upstream pressure rises above the adjusted value, the pilot valve opens to allow water flow between its inlet and outlet ports, thus allowing the water in the main valve's chamber to be vented out to the downstream, causing the main valve to open. As the upstream pressure falls below the set value, the pilot valve throttles the internal passage, restricting the flow out of the main valve's control chamber, restricting the valve's opening, or causing it to close.

The pilot body and spring casing shall be constructed of ASTM B62 bronze. The pilot trim, consisting of a seat ring, stem, and inner valve, shall be constructed of AISI 316 stainless steel. The pilot elastomer: diaphragm, inner valve, and seals, shall be of EPDM or NRB. The adjustable pilot spring range shall be supplied with a spring range of 3 to 35 mWC or 7 to 56 mWC according with the need of the specific site.

The pilot tubing shall be supplied as ASTM B280 seamless copper or PTFE lined flexible braided stainless steel. The pilot fittings shall be supplied as ASTM B16 brass. According with the design of the pilot, the Contractor shall supply an adjustable ASTM B16 brass needle valve closing speed control, B16 brass pilot isolation ball valves with stainless steel handle operator, and a pilot strainer ASTM A351 CF8M stainless steel with a 40-mesh or 80-mesh 316 stainless steel screen. The external pilot strainer shall have a removable plug for easy maintenance access to the pilot screen and have provision for installation of a ball valve for pilot screen flushing.

Actuator shall be suitable for use on a nominal 10 to 32VDC power supply. The actuator shall include the electric motor, reduction gearing, torque overload measurement, travel limiting devices, communication ports, and control circuitry within a self-contained, sealed enclosure.

The actuator shall respond to a 4-20mA current signal or Modbus RTU 485 to position the regulator/pilot adjustment screw and change the regulator setpoint. A 4-20mA feedback signal shall be available to indicate actuator response to the control signal. Both analog input and output of the actuator shall be optically isolated to prevent noise and distortion due to ground loops.

The actuator shall have built-in Electrostatic Discharge Protection (ESD) rated at 1 kV at 5 milliseconds to protect the control circuitry from damage due to voltage transients and surges. The actuator shall have reverse polarity protection to prevent damage to the control board in the event the input power polarity is reversed.

The actuator shall be programmable via USB or any other data connector, and it shall be equipped with an IP68 rated port. The software shall have a save and load function to allow the programming parameters to

be saved, and then to be either loaded to other actuators or kept as a programming/maintenance record for the installation site of the actuator.

Each actuator must be performance tested with the regulator/pilot. The test certificate shall include the calibrated range, sample data from the test outlining the accuracy at each test point, and overall accuracy of the actuator with the supplied regulator. The test points shall be at 4mA, 8mA, 16mA, and 20mA control signals.

The actuator shall be suitable for indoor and outdoor use. It shall have an operating temperature from -3°C to 45°C, up to 100% relative humidity.

The actuator shall be O-ring sealed and watertight to IP68. The motor and all other electrical internal components shall be protected from ingress of moisture and dust with the use of an IP68 rated plug/receptacle assembly. All wiring shall be done without removing the housing. Removing the housing for internal wiring shall not be permitted.

Mandatory Options

Control valves shall come with the following options:

- Pilots shall have dual parallel strainers with required valving to allow cleaning of strainers while control valves are in operation.
- Air release valve.
- Pressure sensors and manometers assembled at factory for direct measurement and reading of upstream and downstream pressures.

6.1.4 Inspection and Testing

Work performed in accordance with this specification shall be subject to inspection by the Employer. The Employer shall have access to places where valves are being produced or assembled or where tests are being conducted. The Employer shall be granted full access for inspection and observation of tests.

The Employer shall have the option to select the preferred valve test media, either water or air. Prior to shipment, valves and pilot systems shall be factory tested to demonstrate the ability to fully stroke from close to open and then from the open to close position.

Valves shall be shop tested for seat leakage for duration of 2 min. There shall be no indication of leakage past the valve seat during this test period. The test pressure shall be either the hydrostatic pressure equivalent to working pressure or air pressure no less than 90 psig (621 kPa). The test pressure shall be applied to the seat in the fluid flow direction.

One valve of each size, body style, and class shall be hydrostatically tested at 1.5 times the rated pressure, with the valve at 50 percent or partially open position, allowing testing of the operating chamber and the stem seal areas. During the hydrostatic test, the manufacturer may make special provisions to prevent damages to the valve resulting from this test. During the hydrostatic test, there shall be no leakage through the valve body, the end joints, or the stem seals, nor shall any part of the valve have any permanent visible deformation as a result of this test. The test duration shall be 2 min.

Any valve or part that the Employer may reject as not conforming to the requirements of this specification shall be made satisfactory or replaced

6.1.5 Markings

Markings shall be cast on the body with raised letters or provided on a corrosion- resistant plate. The markings shall show the valve size, manufacturer, pressure class, model number or serial number and year of manufacture. The minimum size of cast letters shall be ¼ in. Corrosion-resistant plates shall have a minimum letter size of ⅛ in. etched, stamped, or engraved on the plate.

6.1.6 Shipping

Valves shall be complete when shipped. The manufacturer shall carefully prepare valves for shipment. Cavities shall be drained of water. Valves shall be bolted or otherwise fastened to skids. Unpainted steel and iron-machined surfaces shall be coated with a corrosion inhibitor. Full-face flange protectors made of waterproof material of at least the outside diameter of the flange shall be fastened to each flange to protect both the flange and the valve interior. Small valves may be fully packaged at the manufacturer's option. Components shipped unattached shall be adequately protected and identified to allow correct field assembly.

6.1.7 Affidavit of Compliance

The Contractor shall furnish a sworn statement that the inspection and all specified tests have been made and that the results comply with the requirements of this specification.

6.2 STRAINERS

6.2.1 Scope

This technical specification determines minimum technical requirements for strainers to be installed upstream of OMUs Control valves and Bulk Flow Meters.

6.2.2 Technical Requirements

Strainers shall be of adequate design to prevent objects such as stones and pebbles from entering and causing physical damage to the downstream control valve. Unless otherwise shown on the Drawings, strainers shall be of same diameter as associated control valves. Strainers shall be from same manufacturer as control valves.

Strainers shall be "tee" type so that screens can easily be removable for maintenance purposes. Arrow indicating flow direction shall be clearly visible on strainer body. Fasteners shall be made of stainless steel.

Strainers shall be WRAS-approved for potable water applications.

Other specifications are:

- Strainers shall be flanged, PN16-rated, sized and drilled to EN 1092 latest revision.
- The strainer should be designed for minimum weight and pressure loss. Head loss at maximum flows shall not exceed 3.0 psi.
- The screen shall be made of perforated stainless steel and shaped to give maximum rigidity against flow steam forces
- An access cover plate shall be provided.
- The effective straining area shall be at least double that of the inlet.
- Housing and cover shall be ductile iron. Raised letters indicating flow direction will be clearly visible.
- Casing bolts, nuts, screws and washers shall be stainless steel

6.3 PRESSURE SENSORS

6.3.1 Scope

The Contractor shall furnish and install pressure transducers for the measurement of pressure in the inlet and outlet of the outlet management units. Pressure sensors shall be suitable for working in direct contact of drinking water, complete and operable in accordance with requirements of the Contract Documents and in conformance with the manufacturer's recommendations.

One Pressure Sensor must be installed upstream independent from the Control Valve (so that in case of any removal of the control valve the pressure can still be monitored) and the second sensor downstream may be

installed in the Control Valve Body or also independent from the control valve, to the election of the Contractor.

6.3.2 Coordination

Pressure transducers and control systems shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers and manufacturers under other sections of these Specifications and where applicable, with related existing equipment. All pressure transducers and control devices shall be applied in full conformity with the Construction Drawings and Specifications, and with the instructions and recommendations of the pressure transducers manufacturer and the related equipment manufacturer.

Related equipment and materials may include, but not be limited to PLC, process transmitter, supervisory control equipment (SCADA), telemetry, conduit, cable, and piping, as described in other Sections associated with the project and shown on the Drawings.

Interconnection wiring diagrams shall be prepared between the related equipment and the equipment furnished under this Section. Interconnection wiring shall provide all functions specified herein and/or shown on the Drawings.

6.3.3 Documentation

All submittals shall be in accordance with the Submissions by the Contractor in the General part of Specifications and requirements specified herein.

- Manufacturer's product literature, specifications, performance capabilities, features and accessories, materials of construction, illustrations, and data in sufficient detail to demonstrate compliance with Specification requirements. Manufacturer’s literature and data shall be marked to clearly delineate all applicable information and crossing out all inapplicable information.
- Electrical wiring schematics for pressure sensor and signal converter/transmitter. Interconnection wiring diagrams between signal converters/transmitters and related equipment and materials.
- Detailed operation and maintenance manual for all equipment and components specified herein and incorporated into the work.
- Certificate of approval of pressure sensor material for contact with drinking water (NSF/ANSI 61, KTW, DVGW, ACS, WRAS).
- Pressure transducer certificate of calibration issued by a competent body with at least three points.
- Manufacturer´s warranty.

6.3.4 Technical Requirements

Minimal technical requirements for pressure sensors are:

- Sensor type: Metallic o ceramic capacitive
- Measurement range: 0-16 bar
- Accuracy: ±0.5% of calibrated span
- Working temperature, ºC:5 to 24
- Ambient temperature, ºC:-3 to 36
- Process connection: Thread ISO 228 G ¼, 316L Stainless steel
- Housing: 316L Stainless steel
- Electrical connection: M12 plug or Valve plug – IP68 with 10 m cable
- Output signal: 4 to 20 mA (2-wire)
- Power supply: 10 to 30 V DC

6.3.5 Marking

Markings shall be provided on a corrosion-resistant plate. The markings shall show the manufacturer, sensor pressure range, model number or serial number and year of manufacture. Corrosion-resistant plates shall have a minimum letter size of 2 mm etched, stamped, or engraved on the plate.

6.3.6 Cabling

The interconnection between the junction box 1 and the RTU must be with a JZ 500 C BLACK 2x0.75² cable.

The interconnection between the pressure sensor and the junction box 1 must be with a 2x0.5² (BK-RD) shielded cable.

Technical Data

- PVC cable per DIN VDE 0285-525-2-51 / DIN EN 50525-2-51
- Temperature range /flexing -15°C to +80°C/fixed installation -40°C to +80°C
- Nominal voltage U0/U 300/500 V
- Test voltage 4000 V
- Breakdown voltage min. 8000 V
- Minimum bending radius flexing 7,5x outer Ø fixed installation 4x outer Ø

6.3.7 Warranty

Unless otherwise stated in the bidding documents, the manufacturer shall guarantee all equipment against defects in material and workmanship for a period of two years from date of project acceptance. During the warranty period, the manufacturer shall provide all labor and material required to repair or replace defective equipment at no cost to the Employer.

6.4 ELECTRO MAGNETIC FLOW METER

See appropriate clause referring to this instrument in this document.

6.5 ELECTRICAL SUPPLY AND INSTALLATION

6.5.1 Scope and General Requirements

The general character and the scope of work to be carried out under this contract is Illustrated in Drawings, Specifications and Bill of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Engineer. The Contractor shall furnish all labour, materials and equipment as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances, and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The scope of work shall generally comprise, but not limited to the following:

- Solar photovoltaic system (PV system) mounted on pole.
- Interconnection PV system to electrical enclosure.
- Cabling system, conduits, grounding system and electrical enclosure.
- Battery, charge controller.
- Any other items specified in Schedule of Quantities.
- Full compliance with all requirements described in or implied by this specification and with the Conditions of Contract as well as Schedule and Drawings issued as part of the contract documents.

- Minor civil works like drilling and punching holes and openings in concrete walls, slabs, chasing of brick walls, fabrication of supporting structures, drainage of water from cable trenches, cleaning and clearing of all debris due to electrical installation.
- Excavation, scaffolding and back filling for direct burial of cables and earthing conductors as applicable.
- Preparation of as-built drawings.
- The extent of work services under the contract includes all items shown on the drawings, indicated in companion with specifications, notwithstanding the fact that such items have been omitted from the price schedule. All equipment and services which are required to complete the intent of the contract shall also be deemed to be within the scope of the contract.
- Training of Employer's Staff.

Note: Solar Photovoltaic power system, interconnections, batteries, etc., as the above bullet points above are to be provided for OMU and DMA Chambers and equipment as indicated diagrammatically on Drawing No. TP-15.

Pressure Test Points will be battery powered, with a battery life of 5 years as stated in clause 6 Outlet Management Units.

Where electrical actuators are required for butterfly valves, the Contractor is responsible to provide working drawings for approval and arrange and install an electrical connection from the power supply grid.

6.5.2 Standards

The design manufacture installation and testing of all materials and equipment shall comply with the latest Local Authorities Specifications. Whenever an item is not specified by Local Authorities, relevant recommendations of the Institute of Electrical and Electronics Engineers (IEEE), International Electro Technical Commission (IEC) apply. Specifically, the following standards/regulations/codes shall be acceptable:

- Nepal Standards (Electrical, Electronics, Telecom, and IT)
- NBC 207: Electrical Design Requirements for (Public Buildings)
- National Fire Protection Association (NFPA)
- International Electro Technical Commission (IEC) Standards
- Institute of Electrical and Electronics Engineers (IEEE) Standards Association

Standards for materials and the design of equipment are quoted throughout this specification and the Contractor shall produce copies of these Standards as required and instructed by the Engineer. If the Contractor offers equipment, which is not manufactured, in compliance with these Standards the equipment offered should be at least equal in performance and quality to that required by the relevant Standard.

In the event of the Contractor offering materials or equipment which differs from that described in this Specification, the Contractor shall include for all the costs involved in checking the design, any necessary redesign, drawings, and the modifications to other equipment of the affected system.

While making an offer, the Tenderer should specify the name of the Manufacturer he intends to use for the supply of each equipment material. In offering such material or equipment or light fitting he shall include with his tender the detailed information necessary to demonstrate quality. The presentation of such data shall take the form of a comparison sheet giving on one column the critical parameters required by the relevant Standard and/or equipment specified and an adjacent column giving the standards of the equipment offered in the Tender. Where manufacturers names are particularly specified for any item, the contractor must choose from the specified manufacturer(s).

The term "materials" as used in this Specification refers to any basic engineering equipment which forms part of the installation, but which in itself does not form a unit which can be specified with an output performance.

Materials are related to a Standard whenever applicable and it is deemed that such reference, without further amplification, includes the whole of the current Standard. With the approval of the Engineer,

alternative and equivalent National or International Standards may be used, but these must be declared and agreed at the time of Tendering.

6.5.3 Materials

The Engineer's consent shall be obtained prior to commencement of the work for the following:

- Layout of wiring
- Sizes of Cables
- Make of the materials, fittings / fixtures, etc. which shall be of the approved make.

All the materials shall be new from the fresh stock and shall conform to IEEE/IEC standards specifications. When standard does not exist, such material / sample shall be submitted for contract supervisor approval, with Test Certificate from Government accredited laboratories.

The Contractor shall produce, on demand, such details as called for by the Engineer to prove the genuineness of the material. Rejected materials must be replaced by the contractors within 7 (seven) days.

6.5.4 Workmanship

The work shall be carried out keeping in mind the aesthetic requirement of individual site and matching of final work with the surrounding by proper finishing as necessary to maintain uniformity. Good workmanship is an essential requirement of this Contract.

6.5.5 Certification

Comply with all relevant statutory instruments and regulations current at the date of tender and the following:

The installation shall be in conformity with the By-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the By-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation

On completion of the installation, a certificate shall be furnished by the Contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The Contractor shall be responsible for getting the entire installation for the system duly approved

6.5.6 Testing and Commissioning

Carry out all tests, adjustments and commissioning described in this Specification to give an effective working installation to the satisfaction of the Engineer. The Contractor shall establish a database of all tests and test results and ensure that this is kept up to date. A record of the test results/ progress shall be recorded at each site meeting.

Adequate notice shall be given to allow the Engineer to study, assess and review any test procedures to be witnessed. The minimum notice required shall be forty-eight (48) hours.

The Contractor shall submit a full method statement indicating the tests, and testing procedures to be carried out/ witnessed etc. Details of all instrumentation used shall be recorded.

6.5.7 Autonomous Power Supply

6.5.7.1 Scope

This specification determines the technical requirements for the autonomous power supply for instrumentation, control valve, and communications.

According to the system design, the sizes of the main components are as shown below:

Component	Size
PV array	165 Wp / 12 VDC
Battery	200 Ah / 12 VDC
Charge controller	20 A / 12 VDC

Above sizes are provided for bidding purposes. The Contractor shall demonstrate prior to ordering the power supply equipment that above sizes are adequate to supply power and provide sufficient autonomy to the electrical equipment proposed by the Contractor and approved by the Engineer.

6.5.7.2 Solar Photovoltaic Modules

Reference standards

The PV modules shall conform to the following standards:

- IS 14286: Crystalline silicon terrestrial photovoltaic (PV) modules — design qualification and type approval.
- IEC 61215 / IEC 61646: c-Si (IEC 61215): Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval Thin Film (IEC 61646): Design, Qualification & Type Approval
- IEC 61730-1: Photovoltaic Module safety qualification- Part 1: Requirements for construction
- IEC 61730-2: Photovoltaic Module safety qualification- Part 2: Requirements for testing

Technical requirements

Solar PV modules should be of the crystalline silicon type. Detailed specifications of the solar PV modules are given below:

- Cell type: Polycrystalline
- Efficiency: >= 16%
- Fill factor: >= 70%
- Warranty: Panel output (Wp) capacity to be >=90% at the end of 12 years and >=80% of at the end of 25 years.
- Module frame: Non-corrosive and electrically compatible with the mounting structure material
- Termination box: Thermo-plastic, IP 67, UV resistant
- Blocking diodes: Schottky bypass diodes
- Module minimum rated power: The nominal power of a single PV module shall not be less than 165Wp
- Identification tag for each solar module: Shall be provided inside the module and must be able to withstand environmental conditions and last the lifetime of the solar module.
- Identification tag data:
    - Name of the manufacturer with logo
    - Month and year of manufacture
    - Model No (Should consists of the voltage and rate wattage)
    - Module serial number
    - Country
- Power output rating: To be given for standard test conditions (STC). I- V curve of each module shall be submitted.

The Bidder shall carefully design & accommodate requisite numbers of the modules to achieve the rated power submitted to Employer. Employer shall allow only minor changes at the time of execution.

The rated output power of any supplied module shall have tolerance of +/- 3%.

The peak-power point voltage and the peak-power point current of any supplied module and/or any module string (series connected modules) shall not vary by more than 2 (two) per cent from the respective arithmetic means for all modules and/or for all module strings, as the case may be.

Manufacturer Warranty

- Material Warranty is defined as: The manufacturer should warrant the Solar Module(s) to be free from the defects and/or failures specified below for a period not less than twenty-five (25) years from the date of sale to the original customer.
- Defects and Nonconformity to specifications due to faulty manufacturing and/or inspection processes. If the solar Module(s) fails to conform to this warranty, the manufacturer will replace the solar module(s), at the Employer's sole option.

6.5.7.3 Charge Controller

Reference Standards

The Charge Controller shall be MPPT type. Charge controller should conform to IEC 62093 / IEC 60068 as per specification. Expected features of the Charge Controller shall be as follows:

Technical Requirements

- Technology: MPPT
- Battery Voltage Support (V): 12V/24V
- No of MPPT Channels: Min 1
- Battery Type Supported: LMLA/VRLA
- Min Charging Efficiency (%): 94%
- Charge Controller Rating: 20A-12V/24V
- Max. PV input power: 390W/12V
- Input Voltage Range (Voc): 100 V
- Weight: 3 kg
- Manufacturer Warranty

The charge controller should be warranted for a minimum period of 5 years from the date of installation. The warranty card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

6.5.7.4 Batteries

The battery bank should be housed in a vented compartment that prevents users from coming in contact with batteries terminals. This compartment should be strong enough to accommodate the weight of the batteries. A mechanism to prevent opening and entry of the batteries should be provided.

The entire enclosure must be constructed to last at least twenty years without maintenance and should be protected against corrosion. The battery Bank enclosure should have a clean and neat appearance.

Reference Standards

The batteries shall be solar photovoltaic batteries of flooded electrolyte, low maintenance, lead acid and made of hard rubber container. VRLA/GEL batteries as per the relevant IEC and IS standards & Local Authorities specifications can be used.

Storage batteries should conform IEC 61427 / IS 1651 / IS 13369 as per specifications.

Technical Requirements

- The batteries shall use 12V and battery capacity is to be designed at C/10 rate with end cell cut off voltage of 1.75 V per cell.
- Battery terminal shall be provided with covers.
- Batteries shall be provided with micro porous vent plugs with floats.
- Charging instructions shall be provided along with the batteries.

- Suitable carrying handle shall be provided.
- A suitable battery rack with interconnections & end connector shall be provided to suitably house the batteries in the bank. The features and dimensions of the battery rack shall be provided along with the bid document.
- The batteries shall be suitable for recharging by means of solar modules via incremental / open circuit regulators.
- Bidders shall mention the design cycle life of batteries at 80%, 50% and 20% depth of discharge at 25 deg. C.
- The batteries shall be designed for operating in ambient temperature of site in Kathmandu.
- The self-discharge of batteries shall be less than 3 % per month at 20 deg. C and less than 6% per month at 30 deg. C
- The charge efficiency shall be more than 90% up to 70% state of charge. The topping up frequency shall be 12 – 18 months.
- Offered batteries shall comply to the following:
  - 20 % of DOD: 6000 cycles
  - 50 % of DOD: 2200 cycles
  - 80 % of DOD: 1200 cycles
- The Battery Bank shall be designed to provide 2-day autonomy. Bidder to provide battery sizing details along with their offer.
- There will be one battery bank comprising of capacity 12V/200Ah for 165Wp PV system.

Manufacturer Warranty

The batteries shall be warranted for a minimum period of 5 years from the date of installation. The warranty card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

6.5.7.5 Mounting Frame

Photovoltaic array must be mounted on a stable, durable structure that can support the array and withstand wind, rain, and other adverse conditions. The modules will be fixed on structure with fixed arrangement.

The module mounting structure shall have adequate strength and appropriate design suitable to the locations, which can withstand the load and high wind velocities. Stationary structures shall support PV modules at a given orientation, absorb and transfer the mechanical loads to the surface properly.

Reference Standards

The materials used for structures shall be hot dip galvanized mild steel per IS 2062 or aluminium of suitable grade minimum alloy 6063 or better.

The minimum thickness of galvanization for hot dip galvanized mild steel should be at least 80 microns as per IS 4759.

Technical Requirements

Each structure with fixed tilt should have a tilt angle as per the site conditions to take maximum insolation which will be approximately equal to the latitude of the location facing true South with a North – South orientation. The structure tilt angle can vary from 0 degree to 15 degree based on the design.

The PV module mounting structure shall have a capacity to withstand a wind velocity of 100 km/h.

Suitable fastening arrangement with a concrete pillar should be provided to secure the installation against the specific wind speed.

The bolts, nuts, fasteners, and clamps used for panel mounting shall be of Stainless-Steel SS 304.

No welding is allowed on the mounting structure Aluminium structures used shall be protected against rusting either by coating or anodization.

Screw fasteners shall use existing mounting holes provided by module manufacturer. No additional holes shall be drilled on module frames.

Minimum distance between the lower level of PV Module and the ground shall be 3m from the ground level.

The PV modules area shall be accessible for cleaning and for any repair work.

Warranty

The structure shall be installed to withstand operating environmental conditions for a period of minimum 10 years.

6.5.7.6 Earthing

Reference Standards

The Solar PV Plant should have a dedicated earthing system. The Earthing for array shall be made as per the provisions of IS:3043-2018 "Code of practice for earthing (Latest Revision)," that governs the earthing practices of a PV system and IS 732:2019 "Code of practice for electrical wiring installations (Latest Revision).

Technical Requirements

Earthing System shall connect all non-current carrying metal receptacles, electrical boxes, frames, chassis, and PV module mounting structures in one long run. The earth strips should not be bolted. Earthing strips shall be interconnected by proper welding.

The earthing conductor should be rated for 1.56 times the maximum short circuit current of the PV array. The factor 1.56 considers 25 percent as a safety factor and 25 percent as albedo factor to protect from any unaccounted external reflection onto the PV modules increasing its current.

In any case, the cross-section area or the earthing conductor for PV equipment should not be less than 6 mm² if copper or 10 mm² if aluminium. For the earthing of lightning arrestor, cross-section of the earthing conductor should not be less than 16 mm² of copper or 70 mm² if hot-dipped galvanized iron. The complete earthing system shall be mechanically & electrically connected to provide independent return to earth.

Masonry enclosure with the earth pit of size not less than 400 mm x 400 mm (depth) complete with cemented brick work (1:6) of minimum 150mm width duly plastered with cement mortar (inside) shall be provided. Hinged inspection covers of size not less than 300 mm x 300 mm with locking arrangement shall be provided. Suitable handle shall be provided on the cover by means of welding a rod on top of the cover for future maintenance.

Earth pit shall be constructed as per IS: 3043-2018. Electrodes shall be embedded below permanent moisture level. Earth pits shall be treated with salt and charcoal if resistivity of soil is more than 20-ohm meter.

Earth resistance shall not be more than 5 ohms. Earthing system must be interconnected through GI strip to arrive equipotential bonding. The size of the GI earth strip must be minimum 25 mm x 6 mm.

The equipment grounding wire shall be connected to earth strip by proper fixing arrangement. Each strip shall be continued up to at least 500 mm from the equipment.

Necessary provisions shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

For each earth pit, a necessary test point shall be provided.

Total number of Earth pits for PV system: 2

6.5.8 Interconnection PV System to Control Panel

6.5.8.1 Cables

Reference Standards

Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards.

Technical Requirements

Cables of appropriate size to be used in the system shall have the following characteristics:

- For the DC cabling, Solar cables with multi stranded copper conductors XLPE or XLPO insulated and sheathed with the voltage rating of 660 V DC or higher UV stabilised single core flexible copper cables shall be used. Multi-core cables shall not be used. Temp. Range: –10°C to +80°C.
- The total voltage drop on the cable segments from the solar PV modules to the solar grid charge controller shall not exceed 1.0%.
- The total voltage drop on the cable segments from the solar grid charge controller to the OMU's electrical panel shall not exceed 2.0%
- The DC cables from the SPV module array shall run through a UV-stabilised PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5 mm or through a High-Density Polyethylene (HDPE) conduit. Flexible corrugated PVC conduits shall not be used.
- Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.
- All cables and conduit pipes shall be clamped to the structure with thermo-plastic clamps at intervals not exceeding 50 cm. The minimum DC cable size shall be 6.0 mm² copper.
- The following colour coding shall be used for cable wires:
- DC positive: red (the outer PVC sheath can be black with a red line marking)
- DC negative: black
- Earth wires: green
- Cables and conduits passing through walls shall be taken through a PVC pipe sleeve.
- Cable conductors shall be terminated with tinned copper end-ferrules to prevent fraying and breaking of individual wire strands. The termination of the DC cables at the Solar Grid charge controller shall be done as per instructions of the manufacturer, which in most cases will include the use of special connectors.
- Cable lugs and end –ferrules for all cable conductor and wire terminations shall be crimped with crimping pliers and end-ferrule pliers
- All cable ties shall be UV resistant.
- The Cable should be so selected that it should be compatible up to the life of the solar PV panels i.e., 25 years.
- The ratings given are approximate. Contractor to indicate size and length as per system design requirement. All the cables required for the plant provided by the Contractor. Any change in cabling sizes if desired by the Contractor shall be pre-approved after citing appropriate reasons. All cable schedules/layout drawings approved prior to installation.

6.5.8.2 Conduits

PVC conduits shall generally be allowed in cast-in-situ. Exterior installed conduits shall be rigid steel (GI). Where heavy protection against mechanical damage is required only rigid steel (GI) conduit shall be used.

- All conduits and conduit fittings shall comply with concerned local authorities Specifications
- In precast concrete slabs etc. GI conduit shall be used
- All conduits are fire retardant for all systems even if used in concrete slabs.

Conduit System

Conduit system shall be provided including all necessary fittings, supports, Accessories, all other hardware complete as required. For underground installation PVC conduit shall be used

All materials for caulking and sealing conduits, pipes, sleeves etc through fire rated walls or floors, shall be approved by the concerned local authorities as similarly applicable to cable trays and trunking.

Steel Conduits (GI Conduits)

Steel conduits shall be heavy gauge steel conduit hot dip galvanized inside and outside. The steel conduits, all junction boxes and other accessories shall be accordance with standard IEC 61386. The internal diameter of conduits shall be not less than 20 mm.

All conduit boxes shall be constructed in malleable iron and in accordance with locals Standards. All conduit work shall be so arranged to permit wiring to be drawn in after completion of conduit work. Where conduits are terminated in a box without a screwed spout the junction shall be made by means of a coupling and an external thread brass bush with hexagon head.

All external work shall be carried out using galvanized steel conduit and accessories. The installation shall be electrically and mechanically continuous throughout and where polyvinyl chloride conduit is utilized this shall be achieved using a separate polyvinyl chloride insulated earth wire installed throughout the conduit run with terminations being made in conduit boxes or metal enclosures of apparatus. All conduit ends shall be reamed to remove sharp edges and threads shall be of sufficient length to enable conduits to butt within couplings or to the stop end in box spouts. Draw-in boxes on straight runs shall be provided at no more than 9000 mm centres. Where right angle bends are formed in the circuit, draw-in boxes shall be provided at no more than 7500 mm centres and not more than two right angled bends shall be employed in any one run. Conduits shall be fixed by means of spacing saddles on rough concrete or brickwork. On fair faced brickwork or plaster spacer-bar saddles may be used. Saddles shall be spaced at internals of not more than 1300 mm on straight runs and not more than 200 mm on either side of a bend or junction box. Fixings shall be made by means of galvanized steel wood screws of not less than 3 mm diameter and 40 mm in length, screwed into plastic or fibre insert plugs.

PVC Conduits

All rigid PVC conduit and conduit fittings shall conform to Standard IEC 61386 are to be certified as suitable for use at ambient temperatures up to 55 ºC. Additionally, the material shall not soften or suffer any structural degradation at a temperature of 85 ºC and shall be non-hygroscopic and self-extinguishing type.

All boxes and extension rings shall be fitted with brass inserts for the securing screws and with an earth terminal. Conduit fittings and accessories shall be of the same manufacture and shall be of the unthreaded type.

The internal and external surfaces of conduits shall be smooth and free from burrs and similar defects. The interior and ends of conduit fittings shall be free of sharp edges and corners and shall be smooth and well-rounded to permit easy drawing in of cable and to prevent any damage to cable insulation.

A vinyl solvent shall be used for permanent joints and a cement of the type that shall remain in a sticky condition shall be used for expansion couplers.

A separate insulated earth wire shall be drawn into all PVC conduits.

6.5.8.3 Civil Works

Scope

The following civil works should be carried out:

- Site grading, levelling, drilling, and foundation of the area pertaining to the installation of structure of the PV modules.
- Embedment of structures suitable for mounting PV modules.
- Lying of earthing equipment /structures and connecting to the main ground as per the statutory requirements.
- Construction of chamber for cables and electrical enclosure.
- Excavation of cable trenches.

Excavations

The trench shall be excavated in reasonably straight line. Where there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual.

Adequate precautions shall be taken during excavation not to damage any existing cables, pipes, or similar installations in the proposed route. Where bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Engineer.

The bottom of the trench shall be level across the width and free from stone, brick bats, etc. The trench shall be then provided with a cushion of fine sand, the thickness of the cushion being not less than 75 mm.

Cables Laid Through Pipe Sleeves

Entry of cable from underground trenches to the walls shall be through pipe sleeves. Necessary precaution shall be taken to make entry point fully watertight by properly sealing the pipe sleeves in a manner approved by the Engineer.

6.5.8.4 Grounding System

This specification covers the requirements of supply, installation, testing and commissioning of earthing systems. The work shall be carried out in accordance with relevant layout drawings, typical drawings and installation notes etc. All metal conduits, cable sheathes, switchgear, distribution boards, light fixtures, fan and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes.

Grounding System including, but not limited to the following:

- Grounding rods.
- Grounding conductors.
- Grounding connection bar,
- Grounding of various systems.

6.5.8.5 Earthing Electrodes

Earthing electrodes shall be designed as per the requirements of IS 3043. The resistance of earth electrodes shall be as low as possible, the maximum allowable value being one Ohm.

Earth electrodes shall be as far as possible embedded below permanent moisture level. Earth pits shall be further treated with salt and charcoal to improve the soil resistant. In rocky areas, where the required earth resistance cannot be attained using the standard earth electrode, deep well earth pits should be examined.

6.5.8.6 Earthing System

General

Each installation shall have one common earth grid connected to at least two groups of earth electrodes.

The earth grid shall extend throughout the installation in the form of a ring circuit with branch connections to the equipment and structures to be earthed.

Earthing Cables and Connections

Earth systems shall be of solid copper/galvanized flats type, of cross-section specified on the relevant design earth layout drawing.

Connections between earth electrodes and main ring earth conductors shall be executed in accordance with Electrical Drawings and in such a way as to facilitate the inspection and testing the earth resistance of each individual earth electrode group without disconnection of the earth system main ring.

All uninsulated parts of earth conductors shall be suitably protected against direct contact with the soil to prevent electrolytic corrosion. This may be achieved by lap wrapping bared sections with green PVC adhesive tape.

All earthing terminations shall be made with compression type cable lugs. Interconnections shall be directly clamped with compression type branch connectors as detailed in Electrical Drawings.

Execution of earth cable branch connection by means of exothermic welding shall require the approval of The Company Site Representative, who will consider the suitability of the welding equipment and the previous experience of the Contractor's personnel.

The resistance between each earth electrode configuration and the general mass of earth shall not exceed 5 ohms when isolated from the main earth grid.

Location of earth electrodes, earth conductors' connections and earth cable routes shown on the installation earth layout drawing shall be considered as diagrammatic only, and site inspection shall be necessary to determine earth connection onto equipment's locations and conductor routes prior to installation.

Electrical Equipment

Metallic enclosures of all electrical equipment shall be earthed at two ends by connection to the common earth grid.

Cross-sectional area of the equipment earth connections shall be in accordance with the earth layout design drawing.

6.5.9 Electrical Enclosure

The Contractor shall ensure that electrical enclosure is complete with hinged lid and is so constructed that the elements are concealed when the lid is closed. The Contractor shall also ensure that circuit breaker and electrical enclosure used throughout the installation are of the same pattern, range and manufacture and all have short circuit capacity not less than 10 kA.

The level fixing and mounting of board and other associated switchgear shall be agreed on site to suit the plant, chamber, trunking, and services.

6.5.9.1 Reference Standards

- UL 508A: 2018 – Industrial Control Equipment.
- IEC 62208:2011 – Empty enclosures for low-voltage switchgear and control gear assemblies - General requirements.
- IEC 60529:1989/AMD2:2013/COR1:2019 - Corrigendum 1 - Amendment 2 - Degrees of protection provided by enclosures (IP Code).
- IEC 62262:2002 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).

6.5.9.2 Technical requirements

Degree of protection: IP66

Impact resistance: IK10

Material: Polyester reinforced with fiberglass

Color: RAL7035 (Grey)

Locking system: Key 405 (Other key or lock can be provided, see below the drawings)

Dimension: (dimension of board may change with the size of the equipment)

6.5.9.3 Equipment

The electrical enclosure should contain:

- Radio modem, bridge, 42kbps, 400-432MHz, ETH1, COM1, COM2, 10W, router, backup route.
- Transmitter.
- Solar MPPT charge controller 12VDC, 20A
- Waterproof solar battery (1 unit) 12VDC, 200 Ah, C 10.
- Remote terminal unit (RTU), TBOX LT2-530-4W equivalent or better, 8-30VDC, 3G/4G, 1xETHERNET, 1xRS232/485, 1xUSB, 16DI/DO, 8AI 4-20mA ou 0-10V

CONTROL SYSTEM

6.5.10 Scope

Outlet Management Units (OMUs) shall be installed with adequate SCADA appurtenances to relay instrumentation (upstream pressure, downstream pressure, flow rate) and remotely manoeuvre control valve. All elements must be compatible with existing TOPKAPI SCADA software.

6.5.11 Warranty

All the equipment supplied, installed and erection and automation work shall be guaranteed for full replacement for 12 months from the date of commissioning and repair, maintenance and if unavoidable replacement warranty for next 60 months. For any accidental incident or malfunctioning of components the contractor/bidder will be sole responsible in the guarantee/extended warranty period for new replacement of the spare, components, software or connecting cables etc. so as to smooth and hassle-free automation operation of the valves.

6.5.12 REMOTE TERMINAL UNIT (RTU)

Designation	Industrial-grade remote terminal unit (RTU)
Processor	32-bit ARM9, 400MHz
Clock	Real-time clock with lithium battery backup
Memory	32MB NOR Flash 64MB DDR2 SDRAM 1MB SRAM with lithium battery backup Industrial grade µSD card to 32GB (see our price list)
Toggle switch	Run – Stop – Reset
Communication	Ethernet (10/100), USB, Serial (RS-232/RS-485) and LTE/4G modem
Power supply	DC powered, 9 to 30VDC, solar panel can be used Card consumption is typically 1.2W @24VDC
Power backup	Embedded battery charger, 13.8VDC temperature compensated For sealed lead acid batteries only; recommended model: 12V, 7Ah
Inputs/Outputs LT2-530	16 digital inputs or outputs (The first 3 DI can be counter inputs) 8 analog inputs (4-20mA or 0-10 VDC)
Connectors	Spring-cage terminal blocks for power, I/O, RS-232 and RS-485
Operating System	Linux Kernel with TBox Telecontrol 1 analog output (4-20 mA)

Programming	Via TWinSoft Suite (including WebForm Studio 2.0 and Report Studiofor creating local webpages, reports and format of exporting text/csv files))
Languages	Ladder logic, BASIC (IEC 61131-3)
Alarm handling	Smart alarm management with embedded calendar
Data logging	Smart data logging: Sampling tables (periodic) + digital & analogue chronologies (event)
SCADA compatible	Topkapi from AREAL
Remote upload	Up to firmware level
IT features	HTTP(S), FTP(S), SMTP(S) & POP3(S), SNMP, IP forwarding, DynDNS, NTP, SSH/SCP/SFTP
Protocol support	Support for over 40 protocols, including Modbus (master/slave, RTU/TCP/ASCII), DNP 3.0, IEC 60870-5-101/104, OPC UA, MQTT(S), Siemens ISO-on-TCP, Allen Bradley DF1 & EtherNET/IP, IEC-61850 (MMS) and many more
Security	Firewall, 4 levels of authority, HTTP Session Authentication, SSL/TLS & X.509 Certificates, IEEE802.1X
Size	150mm (H) x 83mm (D) x 29mm (W) / 5.91” x 3.27” x 1.14”
Weight	515gr/18.17oz
Mounting	DIN rail fixing
Temperature	Working: -40°C to +70°C / -40°F to +158°F Storage -40°C to +85°C / -40°F to 176°F
Humidity	0 - 95% non-condensing
Altitude	Max. 4000m
Material	Proprietary aluminium enclosure, Alodine coating against corrosion
Approvals	CE, UL/CSA, FCC, RCM, Class I Div.2, IEC 60068-2-6/27/31/64
MTBF	>1,000,000 hours, statement available upon request

6.5.13 SCADA

The SCADA software has been installed by a separate SCADA Contractor; it is not included in the works package Contractor. The equipment supplied by the works package Contractor shall match the SCADA system software, which characteristics are given below.

All associated costs containing all spares, fitting, wirings, connectivity of equipment provided by the works package Contractor shall be part of the bidding price and Bidder will submit year wise cost for operation & maintenance, if necessary replacements, charges of Satellite rent, licenses, NB-IOT, LTE-M, GPRS, 4G. The Contractor would also guard the equipment, machineries & installation of the SCADA Automation including BCR equipment & monitors against theft, damage and pilferages.

The Contractor shall coordinate and collaborate with the SCADA operator for effective integration into the existing system.

6.5.13.1 Objectives of the SCADA System

- Provide a graphical overview of the operational state of the entire OMUs Automation System on real time basis and with historical perspective.
- Real time control of valves for executing desired decisions at site from remote operation.
- Collection and transmission of data.
- Monitoring of operations to minimize errors and identify the malfunctioning sensors and other equipment.
- Database archive for retrieval and analysis of historical and/or current data for entire operational activities of system.

6.5.14 Radio Modem Communications

The radio modem communications equipment is used as primary communication system.

6.5.15 Network Communications

The data can be transmitted based on the cellular phone technology NB-IOT, LTE-M, GPRS, 4G, as backup communication system, regardless of distance, but dependent on cellular signal coverage. When a failure is detected in the radio link used in the RTU, transmission of stored data is started via NB-IOT, LTE-M, GPRS, 4G.

6.5.15.1 Scada Protocol

- Modbus, IEC101, DNP3, PR2000, Comli, DF1, Profibus, Async Link, C24, Cactus, RP570, Slip, Siemens 3964(R), IEC104, DNP3/TCP, Modbus TCP and others.
- SCADA serial protocol addresses are mapped to RipEX addresses
- TCP(UDP) protocols can be handled transparently or using Terminal server or TCP proxy
- Embedded Modbus RTU / Modbus TCP converter
- Each packet is transferred as an acknowledged unicast

6.5.15.2 Technical requirements

- Frequency brands: 400-432 MHz
- Channel spacing: up to 50 kHz
- RF output power max: 10W
- COM2: RS485
- Operating mode: router
- Radio protocol: Flexible
- User protocols on COM Modbus, IEC101, DNP3, PR2000, Comli, DF1, Profibus, Async Link, C24, Cactus, RP570, Slip, Siemens 3964®.
- User protocols on Ethernet Modbus TCP, IEC104, DNP3 TCP, Comli TCP.

6.5.15.3 NB-IOT, LTE-M, GPRS, 4G Communication

The NB-IOT, LTE-M, GPRS, 4G data radio communications equipment shall meet the requirements of regulating agencies in Nepal. Evidence of meeting these requirements of certification will be required as part of the bid. The communication technology will allow for on-demand data collection and reprogramming of the data collection platform. The communication antenna shall also meet the requirements of the communication provider and regulatory agencies of Nepal. The Contractor will make all arrangements for communication access. No usage fees are to be included in Bid unless otherwise stated in the Price Schedule.

7 RESERVOIR MANAGEMENT UNIT (RMU)

It includes the hydraulically actuated control valves (e.g. globe valves or similar equipped with several 'pilots' such as motorized PSV (Pressure Sustaining Valves) to sustain the pressure in BDS network upstream of reservoir) and altimetric pilots to avoid reservoir overflows, electro-magnetic flow meters (incl. a communication system between the flow meter transmitters and the Remote Terminal Units), sensors (reservoir level, inflow discharge, pressure, chlorine and turbidity), actuators and all types of civil works and appurtenances (such as strainers) needed to manage the inflows at a particular reservoir. All the RMUs are connected to the SCADA system.

7.1 AUTOMATIC CONTROL VALVES

The basic element of the RMU is the On/Off Altitude Level Control Valve with Flow Control.

On/Off Altitude Level Control Valve controls the high water level in a reservoir or closed tank without the need for floats or other devices. It is a non-throttling valve that remains fully open until the shut-off point is reached.

The desired water level is set by adjusting the spring force. The pilot control operates on the differential in forces between a spring load and the water level in the reservoir. This valve is typically installed when feeding must be limited to a maximum flow rate.

The recommended On/Off Altitude Level Control with Flow Control Valve brand and model is ClaVal 210-21 (already installed by SCADA Contractor) or similar quality with the same functionalities.

7.1.1 ALTITUDE VALVE FEATURE

Altitude control is a spring loaded, 3-way, diaphragm actuated control that senses pressure in the reservoir. When the reservoir pressure (liquid level) is lower than the set point of control, ports "I" and "D" are interconnected. This relieves main valve cover pressure to atmosphere and the main valve opens to fill the reservoir. Reservoir sensing pressure increases as the liquid level rises in the reservoir. When reservoir pressure increases to the set point of control, control shifts, interconnecting ports "S" and "I". This pressurizes the main valve cover and the main valve closes.

The pilot body and spring casing shall be constructed of ASTM B62 bronze. The pilot trim, consisting of a seat ring, stem, and inner valve, shall be constructed of AISI 316 stainless steel. The pilot elastomer: diaphragm, inner valve, and seals, shall be of EPDM or NRB. The adjustable pilot spring range shall be supplied with a spring range of 3 to 35 mWC or 7 to 56 mWC according with the need of the specific site.

The pilot tubing shall be supplied as ASTM B280 seamless copper or PTFE lined flexible braided stainless steel. The pilot fittings shall be supplied as ASTM B16 brass. According with the design of the pilot, the Contractor shall supply an adjustable ASTM B16 brass needle valve closing speed control, B16 brass pilot isolation ball valves with stainless steel handle operator, and a pilot strainer ASTM A351 CF8M stainless steel with a 40-mesh or 80-mesh 316 stainless steel screen.

7.1.2 RATE OF FLOW FEATURE

Pressure differential control is "normally open" and responds to differential pressure changes sensed across orifice plate assembly. An increase in differential pressure tends to close control and a decrease in differential pressure tends to open control. This causes the main valve cover pressure to vary and the main valve to modulate (opens and closes) maintaining a relatively constant rate of flow.

7.1.3 ACTUATOR

The pressure differential control shall be operated by an actuator. Actuator shall be suitable for use on a nominal 10 to 32VDC power supply. The actuator shall include the electric motor, reduction gearing, torque overload measurement, travel limiting devices, communication ports, and control circuitry within a self-contained, sealed enclosure.

The actuator shall respond to a 4-20mA current signal or Modbus RTU 485 to position the regulator/pilot adjustment screw and change the regulator setpoint. A 4-20mA feedback signal shall be available to indicate actuator response to the control signal. Both analog input and output of the actuator shall be optically isolated to prevent noise and distortion due to ground loops.

The actuator shall have built-in Electrostatic Discharge Protection (ESD) rated at 1 kV at 5 milliseconds to protect the control circuitry from damage due to voltage transients and surges. The actuator shall have reverse polarity protection to prevent damage to the control board in the event the input power polarity is reversed.

The actuator shall be programmable via USB or any other data connector, and it shall be equipped with an IP68 rated port. The software shall have a save and load function to allow the programming parameters to be saved, and then to be either loaded to other actuators or kept as a programming/maintenance record for the installation site of the actuator.

Each actuator must be performance tested with the regulator/pilot. The test certificate shall include the calibrated range, sample data from the test outlining the accuracy at each test point, and overall accuracy of the actuator with the supplied regulator. The test points shall be at 4mA, 8mA, 16mA, and 20mA control signals.

The actuator shall be suitable for indoor and outdoor use. It shall have an operating temperature from -3°C to 36°C, up to 100% relative humidity.

The actuator shall be O-ring sealed and watertight to IP68. The motor and all other electrical internal components shall be protected from ingress of moisture and dust with the use of an IP68 rated plug/receptacle assembly. All wiring shall be done without removing the housing. Removing the housing for internal wiring shall not be permitted.

7.1.4 CLOSING / OPENING SPEED CONTROL

Needle valve controls the reaction speed and particularly the closing speed of the main valve.

7.1.5 STANDARD EQUIPMENT

Isolation ball valve:

The isolation ball valves are used to isolate the pilot system from main line pressure. These isolation ball valves

must be open during normal operation.

Y-Strainer:

The strainer is installed in the pilot supply line to protect the pilot system from foreign particles. The strainer screen must be cleaned periodically.

7.2 CONTROL SYSTEM

Reservoir Management Units shall be installed with adequate SCADA appurtenances to relay instrumentation and remotely manoeuvre the control valve. All elements must be compatible with existing TOPKAPI SCADA software.

7.2.1 REMOTE TERMINAL UNIT (RTU)

Designation	Industrial-grade remote terminal unit (RTU)
Processor	32-bit ARM9, 400MHz
Clock	Real-time clock with lithium battery backup

Memory	32MB NOR Flash 64MB DDR2 SDRAM 1MB SRAM with lithium battery backup Industrial grade µSD card to 32GB (see our price list)
Toggle switch	Run – Stop – Reset
Communication	Ethernet (10/100), USB, Serial (RS-232/RS-485) and optional LTE/4G modem
Power supply	DC powered, 9 to 30VDC, solar panel can be used Card consumption is typically 1.2W @24VDC
Power backup	Embedded battery charger, 13.8VDC temperature compensated For sealed lead acid batteries only; recommended model: 12V, 7Ah
Inputs/Outputs LT2-530	16 digital inputs or outputs (The first 3 DI can be counter inputs) 8 analog inputs (4-20mA or 0-10 VDC)
Connectors	Spring-cage terminal blocks for power, I/O, RS-232 and RS-485
Operating System	Linux Kernel with TBox Telecontrol 1 analog output (4-20 mA)
Programming	Via TWinSoft Suite (including WebForm Studio 2.0 and Report Studiofor creating local webpages, reports and format of exporting text/csv files)
Languages	Ladder logic, BASIC (IEC 61131-3)
Alarm handling	Smart alarm management with embedded calendar
Data logging	Smart data logging: Sampling tables (periodic) + digital & analogue chronologies (event)
SCADA compatible	Topkapi from AREAL
Remote upload	Up to firmware level
IT features	HTTP(S), FTP(S), SMTP(S) & POP3(S), SNMP, IP forwarding, DynDNS, NTP, SSH/SCP/SFTP
Protocol support	Support for over 40 protocols, including Modbus (master/slave, RTU/TCP/ASCII), DNP 3.0, IEC 60870-5-101/104, OPC UA, MQTT(S), Siemens ISO-on-TCP, Allen Bradley DF1 &EtherNET/IP, IEC-61850 (MMS) and many more
Security	Firewall, 4 levels of authority, HTTP Session Authentication, SSL/TLS & X.509 Certificates, IEEE802.1X
Size	150mm (H) x 83mm (D) x 29mm (W) / 5.91” x 3.27” x 1.14”
Weight	515gr/18.17oz
Mounting	DIN rail fixing

Temperature	Working: -40°C to +70°C / -40°F to +158°F Storage -40°C to +85°C / -40°F to 176°F
Humidity	0 - 95% non-condensing
Altitude	Max. 4000m
Material	Proprietary aluminium enclosure, Alodine coating against corrosion
Approvals	CE, UL/CSA, FCC, RCM, Class I Div.2, IEC 60068-2-6/27/31/64
MTBF	>1,000,000 hours, statement available upon request

7.2.2 RADIO MODEM COMMUNICATIONS

The radio modem communications equipment is used as primary communication system.

7.2.3 NETWORK COMMUNICATIONS

The data can be transmitted based on the cellular phone technology NB-IOT, LTE-M, GPRS, 4G, as backup communication system, regardless of distance, but dependent on cellular signal coverage. When a failure is detected in the radio link used in the RTU, transmission of stored data is started via NB-IOT, LTE-M, GPRS, 4G.

7.2.4 SCADA PROTOCOL

- Modbus, IEC101, DNP3, PR2000, Comli, DF1, Profibus, Async Link, C24, Cactus, RP570, Slip, Siemens 3964(R), IEC104, DNP3/TCP, Modbus TCP and others.
- SCADA serial protocol addresses are mapped to RipEX addresses
- TCP(UDP) protocols can be handled transparently or using Terminal server or TCP proxy
- Embedded Modbus RTU / Modbus TCP converter
- Each packet is transferred as an acknowledged unicast

TECHNICAL REQUIREMENTS

- Frequency brands: 400-432 MHz
- Channel spacing: up to 50 kHz
- RF output power max: 10W
- COM2: RS485
- Operating mode: router
- Radio protocol: Flexible
- User protocols on COM Modbus, IEC101, DNP3, PR2000, Comli, DF1, Profibus, Async Link, C24, Cactus, RP570, Slip, Siemens 3964®.
- User protocols on Ethernet Modbus TCP, IEC104, DNP3 TCP, Comli TCP.

7.2.5 NB-IOT, LTE-M, GPRS, 4G COMMUNICATION

The NB-IOT, LTE-M, GPRS, 4G data radio communications equipment shall meet the requirements of regulating agencies in Nepal. Evidence of meeting these requirements of certification will be required as part of the bid. The NB-IOT, LTE-M, GPRS, 4G technology will allow for on-demand data collection and reprogramming of the data collection platform. The NB-IOT, LTE-M, GPRS, 4G antenna shall also meet the requirements of the NB-IOT, LTE-M, GPRS, 4G provider and regulatory agencies of Nepal. The Contractor will make all arrangements for NB-IOT, LTE-M, GPRS, 4G access. No usage fees are to be included in Bid unless otherwise stated in the Price Schedule.

7.3 INSTRUMENTATION

The instrumentation of the RMU includes:

Each SRT common inlet is slated to be equipped with the following:

- One (1) flanged electromagnetic flowmeter to continuously monitor the SRT inflow.
- One (1) pressure sensor to continuously monitor operating pressure in the SRT inlet pipeline.
- One (1) control valve, remotely controlled, to control the SRT inflow and upstream pressure.
- One (1) control panel, including PLC and RTU capabilities.
- Batteries for power supply (rechargeable battery with invertor and automatic switch between grid and battery power supply. Capacity of set of batteries will be of minimum12 - 24 hours back up in case failure of power supply)

Each SRT compartment is slated to be equipped with the following:

- One (1) piezometric level sensor.
- Four (4) level switches.

Each SRT common outlet is slated to be equipped with the following:

- One (1) residual chlorine analyzer.
- One (1) turbidity analyzer.
- One (1) sample pump will supply water to both analyzers. (Doc end)

7.4 DATA TRANSMITTING AND INTEGRATION WITH SCADA SYSTEM

The specifications about the integration and display of the data generated by the RTU at the new RMUs and OMUs, the loggers at pressure sensors in the DMAs and the loggers at the DMA flow meters into the SCADA has been designed to be easy and with a very low risk of failure to implement.

Hence, the specifications are only defining the **exact formats of data to respect when transmitting the data**.

On top of that, a **lump sum must be required for testing and file format corrections** when the implementation phase will be done by the contractors.

Hence, the contractors will not have to enter the SCADA software to add integration processes and displays.

7.5 SPECIFICATIONS FOR THE KIRTIPUR CONTRACTOR

This equipment that will be integrated will have to generate their data exactly as specified below.

The addresses and credentials of the MQTT server will be provided after award of the contract.

A lump sum will have to be defined by the Contractor for doing the testing of communication for each equipment that will be implemented and for corrections that may have to be done on the file generation.

7.5.1 OMU – RTU:

Uplink channel (from RTU to SCADA):

Type of communication: Radio (see specifications) or GSM 3G/4G,

Protocol of communication: MQTT (text files),

Frequency of communication: 2 minutes,

The design of the message will be provided after award of the contract.

Data to communicate for OMU:

7.5.1.1 MEASUREMENTS:

. RTU main voltage (V)

. RTU battery voltage (V)

. RTU internal temperature (°C)

. Flow (m3/h)

. Upstream pressure (bar)

. Downstream pressure (bar)

. Valve position (%)

. Requested valve position (%)

. Totalizer inlet flowmeter (m3)

. Flowmeter totalizer per day (m3)

. Control valve number of starts

. Control valve number of starts per day

. Control valve running time (hour)

. Control valve running time per day (hour)

7.5.1.2 ALARMS:

. Control valve Modbus comm fault

. Fault power outage

. Discrepancy 5% between valve position and setpoint valve position

. Fault low pressure downstream

. Fault measurement flowmeter

. Fault measurement upstream pressure

. Fault low pressure upstream

. Fault measurement downstream pressure

. Fault sudden drop upstream pressure

. Fault sudden drop downstream pressure

7.5.1.3 Downlink channel (From SCADA to RTU):

Type of communication: Radio (see specifications) or GSM 3G/4G,

Protocol of communication: MODBUS IP,

Frequency of communication: on demand,

Data to communicate with MODBUS address to associate:

SETPOINT

. Low pressure alarm setpoint downstream (Modbus Address: 322)

. Low pressure alarm setpoint upstream (Modbus Address: 326)

. Valve position setpoint (Modbus Address: 364)

. Mini analog upstream pressure (Modbus Address: 336)

. Maxi analog upstream pressure (Modbus Address: 338)

. Mini analog inlet flowmeter (Modbus Address: 340)

. Maxi analog inlet flowmeter (Modbus Address: 342)

. Mini analog downstream pressure (Modbus Address: 344)

. Maxi analog downstream pressure (Modbus Address: 346)

. Pilot scale Valve (setting A) (Modbus Address: 232)

. Pilot scale Valve (setting B) (Modbus Address: 234)

. Value pulse flowmeter (Modbus Address: 360)

7.5.2 DMA - Pressure loggers:

7.5.2.1 Uplink channel (from Logger to SCADA):

Type of communication: GSM 3G/4G, NB-IOT or LTE-M,

Protocol of communication: FTP (text files) or MQTT,

Frequency of communication: 6 hours (data recorded each 15 minutes in the loggers),

7.5.2.2 Data to communicate:

. Pressure (bar),

. Alarm on low battery level,

. Low pressure alarm,

Downlink channel (From SCADA to Logger):

None.

a) For FTP protocol:

Structure of the text file:

- Can be at the format IJINUS (as the protocol is already in the Scada software)

- Can be at the format XILOG + from OVARRO (as the protocol is already in the Scada software)

- If it is not following the currently implemented formats as described above, then the text file must follow:

> Extension: .txt

> Name of the file: must be unique for each transmitted file

>Template of the name of the file:

[Name of the station on 3 characters] _YYYYMMDDHHMMSS

(The name of the station on 3 characters will be provided)

Example: ADW_20240910113000

> Content of the file: multiline, with the data in series

> Order of the lines: Ascendant order of dates.

> Separator: space

> End of line: Windows (CRLF)

> Header: No

> Format of the date time in the file: JJ/MM/AAAA HH:MM: SS

> Order of the data in the file must be:

. Date Time (separated with a space),

. Pressure,

. Alarm on low battery level,

. Low pressure alarm,

b) For MQTT protocol:

The design of the message will be provided after award of the contract.

7.5.3 DMA – Flow meter:

7.5.3.1 Uplink channel (from Logger to SCADA):

Type of communication: GSM 3G/4G, NB-IOT or LTE-M,

Protocol of communication: FTP (text files) or MQTT,

Frequency of communication: 2 hours (data recorded each 15 minutes in the loggers),

7.5.3.2 Data to communicate:

. Flow (m3/h),

. Alarm on low battery level,

. Low flow alarm,

. High flow alarm.

7.5.3.3 Downlink channel (From SCADA to Logger):

None.

a) For FTP protocol:

> Structure of the text file:

- Can be at the format XILOG + OVARRO (as the protocol is already in the Scada software)

- If it is not following the currently implemented format as described above, then the text file must follow:

. Extension: .txt,

. Name of the file: must be unique for each transmitted file,

. Template of the name of the file:

[Name of the station on 3 characters] _YYYYMMDDHHMMSS

(The name of the station on 3 characters will be provided)

Example: ADW_20240910113000

Content of the file: multiline, with the data in series,

Order of the lines: Ascendant order of dates,

Separator: space,

End of line: Windows (CRLF),

Header: No,

Format of the date time in the file: JJ/MM/AAAA HH:MM: SS,

Order of the data in the file must be:

. Date Time (separated with a space),

. Flow,

. Alarm on low battery level,

. Low flow alarm,

. High flow alarm.

b) For MQTT protocol:

The design of the message will be provided after award of the contract.

8 CHLORINATION UNIT

8.1 Scope of Work

Design, Supply, Installation, Testing and Commissioning Electro chlorinator at Kirtipur Service Reservoir Tank. The system should be automated for chlorine dosing based on residual chlorine level at supply inlet. Online residual chlorine analyzer shall be included with RTU and necessary accessories for online monitoring (through PID-KUKL Server). Dosing pump shall be having provision of flow sensor and also incorporate microprocessor based PLC for automatic control of dosing operations (with manual by-pass arrangement). Electrolytic cell shall consist of dimensionally stable electrodes made from Gr I Titanium sheet with multi metal oxide coating. Control Panel shall consist of DC voltage and current display incoming phase status unit on-off switches fuses etc. The Chlorine dosing rate must be automatically controlled in proportion to the water supplied to the reservoir and should be incorporated into the existing KUKL SCADA system.

Quality Assurance Plan for the Electro-chlorinator shall be submitted for approval. The manufacturer shall provide guarantee of various components of the Electro Chlorination System. List of mandatory spares shall be included within the supply and costed within the rate.

The unit must include but not be limited to following bill of materials plus any appurtenances:

1. Inlet Valve: 1 No.

2. Inlet Motorized valve: 1 No.
3. Manual Valve for Brine Tank: 1 No.
4. Motorized Valve for Brine Tank: 1 No.
5. Brine Tank: 1 No.
6. Level Switch on Brine Tank: 1 No.
7. Agitator: 1 No.
8. Brine Tank Valves: 2 Nos.
9. Brine Pump: 1 No.
10. Valve before Rotameter: 1 No.
11. Rotameter at water line: 1 No.
12. Electrolyzer Inlet /Outlet Valve: 2 Nos.
13. Electrolyzer Cell: 1 No.
14. Electrolyzer Drain Valve: 1 No.
15. Valve on Sample Line: 1 No.
16. Temperature Sensor: 1 No.
17. Hypo Storage Tank: 1 No.
18. Hypo Tank Valves: 3 Nos.
19. Level Switch on Hypo Tank: 1 No.
20. Dosing Pump Inlet/ Outlet Valves: 2 Nos.
21. Dosing Pump (Diaphragm Type): 1 No.
22. Control Panel (Relay Based): 1 No.
23. Power Supply: 1 No.
24. Blower: 1 No.
25. Acid Tank: 1 No.
26. Acid Tank Valves: 3 Nos.
27. Acid Recirculating Pump: 1 No.
28. Acid Pump Inlet/Outlet Valves: 2 Nos.
29. Piping and Fittings: As Required
30. Power and Control Cables: As Required
31. Chlorine Test Kit: 1 No

The contractor is responsible for executing all necessary civil works for the installation of the Chlorination Unit, subject to the approval of the Employer or Engineer. Additionally, the contractor must handle all required ICT, electrical and mechanical installations as necessary for a complete and workable installation and as the Engineer's instructions. Trial run and commissioning shall be for a period of 15 days. The manufacturer shall depute personnel / staff during installation and commissioning period and impart adequate training during the trial run and commissioning period.

8.2 Automatic Control of Chlorination Dosing

The Contractor is responsible for d**esign review** and to s**upply,** i**nstall,** t**est and** c**ommission an** automatic control system that will vary the chlorine dosing rate in proportion to the water supplied to Kirtipur SRT, as measured by the existing electro-magnetic flowmeter at the SRT inlet.

The Contractor shall be responsible for configuring the existing Remote Terminal Unit (RTU) to transmit flowmeter readings to the chlorination controls by a cable or by radio signal (using Modbus or approved equivalent) and for supplying, installing and configuring the necessary equipment and systems.

The Contractor is also responsible to coordinate with the SCADA operators to ensure that:

- signals for control of the dosing rate are received and displayed on SCADA
- appropriate alarm signals are sent to SCADA
- the dosing pumps can be switched on and off by SCADA, overriding the automatic control from the flowmeter RTU.

8.3 Construction of Prefab Building for Chlorination Unit

For the installation of chlorination Unit and storage of required chemicals, the storage building should be constructed with the Steel Structure and Prefab partition building. The Design and the material should be design and proposed by contractor for the approval of Employer/ Engineer.

8.4 Measurement and Payment

The Works shall be measured and paid on a lump sum basis. Payment shall be made in accordance with Sub-Clause 14.5(c)(i) and (ii) of the Particular Conditions of Contract. The lump sum rate must encompass all costs for:

- Design review, supply, installation, testing and commissioning of the equipment.
- Necessary civil works, including excavation, foundation preparation and construction, pipes and fittings for dosing the chlorine into the Service Reservoir Tank, drainage system, shade construction, material supply and any other associated tasks, all subject to the Engineer's approval.
- The costs of power supply arrangements, lighting, and all applicable taxes and duties.
- All ICT works and equipment for automatic control of the chlorination equipment, including coordination with the SCADA operator and ensuring that the chlorination system is incorporated into SCADA.

9 PILING FOR STRUCTURES

9.1 SCOPE

This Section covers the works connected with various types of piles required for structures.

9.2 GENERAL

The requirements contained in this specification and in the Drawing are the minimum requirements. Strict compliance with these minimum requirements shall not relieve the Contractor of the responsibility of adopting whatever additional measures which may be necessary to ensure the completion of the work to the satisfaction of the Engineer. Unless contracted hereunder, the provision of IRC: 78-1983 shall be strictly followed.

In addition to submitting the records required under Sub-clause 1607 (3) the Contractor shall report immediately to the Engineer any circumstances which indicate that the ground conditions differ from those expected by the Contractor from his interpretation of the soil survey so as to materially affect the bearing capacity of the piles.

9.3 TYPE OF PILES

Based on materials piles may be

(1) Timber piles

(2) Steel piles

(3) Concrete piles of normal or pre-stressed concrete

Based on method of construction piles may be

(1) Driven piles

(2) Bored/Drilled and cast-in-situ piles.

Timber, steel and pre- cast concrete piles are of driven type. Piles may be of solid or hollow section or steel cased piles filled with concrete. They may be of circular, square, hexagonal, H, I, or Z section as applicable.

Timber and steel/steel sheet piles shall comply with their Specifications as provided in the

9.4 PENETRATION AND BEARING VALUE

The bearing values of the piles shown on the Drawing or indicated in the contract are the minimum bearing values to which must be driven or installed. The driving or installation of the piles shall continue until the estimated penetration and set is reached or until the pile has been driven to substantial refusal or to a penetration and set satisfactory to the Engineer.

When water jets are used the bearing capacity of a pile shall be determined from the results of driving with the hammer after the water jets have been withdrawn. The bearing value and set for the purpose of this Clause shall be calculated from the appropriate formula as given in IS 2911 or such other criteria as shall be indicated or described in the contract.

9.5 EXCAVATION IN CUTTING

Specification for pre-cast pre-stressed concrete piles shall conform to those contained in Clause 8 of IS: 2911 (part 1 Section 3), if not covered by Sections 1800, 2000 and 2100. Every pile shall be marked with the date of casting and an identification number. Pre- stressed piles shall also be marked with the pre-stressing force applied.

Pre-cast concrete piles shall be of the size and shape as shown on the Drawing. If a square section is employed, the corners shall be chambered at least 25 mm unless otherwise specified on the Drawing. The length of pile shall not normally exceed 25 meters. However, where special equipment's for handling and installation are available to the satisfaction of the Engineer, longer length shall be permitted.

Piles shall be cast with a driving point for hard driving and shall be cat with a metal shoe approved by the Engineer

9.6 DELIVERY, HANDLING AND STORAGE OF PILES

9.6.1 Number and Length of Piles

When testing of piles are specified in the contract, the pile lengths as shown on the Drawing or described in the contract shall be used for tendering purpose only. The number, section and length of piles as specified shall be subject to change. No piles except test piles, shall be ordered, delivered to site or manufactured on site for any units of a structure until the Engineer has determined from the results of the driving of the test pile. When the test piles are not specified, the number and lengths of piles to be ordered, delivered to site or manufactured on site shall be as specified in the contract.

9.6.2 Handling and Storage

All piles shall be handled, transported and stored in such a way that they shall not be damaged. The use of can hooks, lifting tongs or other pointer tools shall not be permitted. Precast concrete piles shall be supported at the indicated pickup points and shall only be lifted with bridles or slings attached at such pickup points. If no pickup points are indicated they shall be assumed to be at a distance of 0.207 times the length of pile

from each end for two point's lifts. For three points lift it shall be at a distance of 0.145 times length of pile from each end with the middle point being at the centre.

The Contractor shall be responsible for any damage caused by handling or storage.

9.7 DRIVING EQUIPMENT

9.7.1 Pile Driving Frames on leads

Leads shall be required for all types of hammers. Leads shall be so constructed as to allow free movement of the hammer and shall be rigid enough to hold the pile in correct alignment during the driving operation. The leads should be of such length, where practicable, that the use of followers shall not be necessary. The use of hanging leads, guyed leads or other leads shall be subject to the approved of the Engineer, whose approval, if given, shall not relieve the Contractor of the responsibility of driving the piles to the placing and vertically tolerances allowed in the contract.

9.7.2 Pilling Hammers

Pile Hammers, other than drop hammers shall be of approved steam, air or diesel hammers that develop sufficient energy per blow to drive the piles at a penetration rate of not less than 5 mm per blow at the required bearing value. Steam or air hammers shall be with boiler or air capacity at least equal to that specified by the manufacturers of the hammers to be used. The boiler or compressor shall be equipped with an accurate pressure gauge. The value, mechanism and other parts of the hammers shall be maintained in good condition and working order so that the length of stroke and number of blows per minute for which the hammer is designed shall be obtained. Inefficient steam, air, or diesel hammers shall be removed from the site. As a general guide the size of the hammer normally required for steel piles shall be one which develops approximately 1100 kg meters energy per blow. Pre-cast concrete piles and steel shell for cast-in-situ piles longer than 15 meters shall normally require a hammer which develops 1725 kg meters energy per blow. Drop hammers shall in no case weigh less than the combined weight of the pile, dolly and helmet. The Contractor shall, upon request, furnish the Engineer with evidence of the weight of the drop hammer as he requires.

9.7.3 Pile Driving Helmets and Dolly's

(a) For Steel Piles

Whether driving is done with a gravity or a mechanical hammer, a special driving helmet shall be used. It shall be recessed to fit closely around and have a full bearing on the pile head. For Gravity Hammers it shall have a dolly of suitable material on the upper side.

(b) For Pre-Cast Concrete Piles

A driving helmet shall be used which fits closely over the head of the pile. A cushion block of coir or wood shall be used between the pile head and the helmet and the helmet shall have a dolly of suitable material on the upper side.

(c) Shells for cast in-situ piles, if not driven with an internal mandrel shall be driven with a helmet as for steel piles. Shells driven with an internal mandrel shall have a cushion of low water cement ratio green concrete placed in the bottom of the shell. Fresh green concrete shall be added to the cushion after every 30 minutes of driving or after any break in driving of longer than 30 minutes.

9.7.4 Water Tests

The jet or jets shall be freely eroding the material under the pile. The nozzle of each jet shall have a minimum diameter of 19 mm and shall generally be circular. The pump supplying the water shall be of such size & type that it shall maintain a water pressure of at least 9 kg/cm_ at the orifice of each nozzle.

9.8 PILE DRIVING

9.8.1 General

The Contractor shall notify the Engineer at least 24 hours before beginning any pile driving operations and no piles shall be driven unless the Engineer or his Inspector is present. Before any foundation piles are driven in any unit including test piles, the excavation shall be made, approximately, to the planned footing level. Piles to be driven through embankments over 1.5 m in depth constructed by the Contractor shall be driven in holes excavated through the embankment of dimensions not less than the pile dimensions plus 15 mm. After driving, the space around the pile shall be filled with dry sand or single size gravel. During pile driving operations the water level in the excavation shall be kept below the top of the pile. Under water pile driving shall only be permitted when the contract calls for a concrete seal foundation. In such cases, the piles shall be driven by a mechanical hammer equipped to drive when submerged. When the top of the hammer is submerged during driving, it shall be equipped with accurate measuring detachable measuring rods, for the purpose of recording pile penetration. Care shall be taken to obtain accurate location and spacing of the pilling. In all cases of underwater driving, the equipment and method to be used shall be approved by the Engineer in writing. When satisfactory penetration of piles cannot be obtained without damage to the pile from driving, and the character of the soil is considered suitable, the Contractor may with the Engineer's approval use water jets in sufficient numbers to obtain the desired penetration. Before the desired penetration is reached the jets shall be withdrawn and the pile shall be allowed the jetting or the provision of jetting equipment. Water jets shall not be used as an aid for driving steel piling. The driving of piles by means of followers shall be avoided if practicable and shall only be done with the written permission of the Engineer, who may require that one pile from any group of 10 or less shall be a long pile driven without a follower to determine the average bearing power of the group. Sawing or cutting the body of a pile to assist in springing it to proper location shall not be permitted. If a pile vibrates excessively or shows signs of buckling during it shall be braced or guyed as directed by the Engineer. Broken, spilt or wrongly treated piles shall not be measured for payment and if required by the Engineer they shall be completely withdrawn and replaced by satisfactory piles.

9.8.2 Installation

Installation of piles shall be carried out in accordance with the pile layout Drawing or as directed by the Engineer.

The Engineer shall decide the sequence of the group of piles that the Contractor should undertake for installation and shall follow this sequence. In a group the installation shall proceed from those on the center of the group towards those on the periphery.

9.8.3 Temporary

The Contractor shall ensure that free standing piles are temporarily braced on stayed immediately after driving to prevent loosening of the piles in the ground and to ensure that no damage resulting from oscillation, vibration or movement of any free-standing pile length can occur.

9.8.4 Tolerance in Driving

During driving, the piles shall not deviate from the vertical or the specified rake (in the case of racer piles) by more than 40 mm per meter of pile length, and after driving the Centre of the pile at cut-off level, shall be not more than 150 mm from its planned location.

9.9 CUTTING AND LENGTHENING OF PILES

9.9.1 Pre-Cast Concrete Piles

Concrete piles shall be cut off at such level that they shall extend into the cap or footing as indicated in the Drawing. If piles are to be lengthened the main or splicing reinforcement shall be stripped of concrete for the distance necessary to effect a lapped reinforcement splice in accordance with Clause 2013. Alternatively, subject to the Engineer's approval, the reinforcement shall be exposed for a minimum of 250 mm and the extension reinforcement butt welded to the original reinforcement is at least equal to the 28 days' cube strength of the concrete in the original pile and approval of the Engineer to resume driving has been obtained. In cases, where a substantial number of pile extensions are expected, the Contractor may propose special extension methods and procedures. In such cases, the Contractor shall submit full details of the method

and procedure proposed and carry out such tests as the Engineer may require to substantiate the soundness, strength and durability of the extended piles and their suitability to fulfil their function adequately

9.9.2 Steel Piles and Steel Cast-in-situ Shells

Piles shall be cut off at the appropriate level for incorporation of the footing or cap as shown in the Drawing. When driven to cut-off level without damage to the head a tolerance of 25 mm from the true cut off level shall be allowed.

9.10 PILE HEAVE

The Contractor shall take and maintain records of the levels of every pile immediately after driving in accordance with the requirements of the Engineer. After all piles in the group have been completed, the levels shall be checked to determine whether any of the piles has heaved. Such heaved pile shall be re-driven and pile shall not be considered complete until all heaved piles have been re-driven as directed by the Engineer.

9.11 CAST-IN-SITU PILES

Cast in situ concrete piles may be either installed by marking a bore into the ground by removal of material or by driving a metal casing with a shoe at the tip and displacing the material laterally. The two types of piles are termed as bored and cast-in-situ piles and driven shell and cast-in-situ piles respectively.

9.12 BORED AND CAST IN-SITU PILES

9.12.1 Steel Casing

When permanent steel casing is shown on the Drawing, the minimum thickness shall be 10 mm. The minimum length shall be from 100 mm above the bottom of the pile cap to 5 meter under the river bed or into the firm strata. Joints between casings shall be approved by the Engineer. The casing shall be handled and stored in a manner that shall prevent bucking and other deformation as well as accumulation of dirt, oil and paint.

9.12.2 Concrete (Self Compacting Concrete)

The concrete shall conform to the requirements specified in Section VI-C 1.3.

Concrete placed under water or drilling mud by termite shall have a cement content of not less than 380 kg/m3. The density and consistency of the concrete shall conform to the termite casting method. Sufficient workability (slump) of all the concrete during the casting and handling of casing including reasonably calculated delays, shall be secured by a design mix. Necessary retarders and plasticizers shall be tested by trial mixes prior to the pile construction.

All relevant concrete properties such as slump, time of setting, temperature and strength shall be measured on the trial mixes.

a) Characteristics of Self Compacting Concrete and Tests

Characteristics	Preferred Test Method(s)	Limit of Test Value
Flowability	Slump-flow test	550-850 mm
Flowability	T_{500} slump flow Test	2 secs
	V- Funnel Test	8-25 sec
Passing Ability	L-Box Test	0.8
Segregation	Segregation resistance (sieve) test	15 -20 percent

Note: For details of the test methods and limiting test values, as appropriate to placing conditions, amount and congestion of reinforcement, dimensions of the members, size of aggregate etc., EFNARC Guidelines for Self-Compacting Concrete, May 2005 may be referred.

b) Mix-Design

Mix proportions are to be selected by trials and tests, till a satisfactory mix is arrived at. EFNARC Guidelines 2005 suggestions:

- Coarse aggregate content - 1000 – 750 kg per m3 of concrete,
- Total powder content – 380 to 600 kg per m3 of concrete,
- Water/powder ratio by solid volume – 0.85 to 1.10,
- Water content –210 – 150 litres/ m3,
- Paste volume – 380 – 300 litres/ m3,
- Water/cement ratio selected for strength and durability requirements,
- Sand content to balance the remaining volume, usually 48-55% of total aggregate by weight.
- Appropriate anti-washout' admixtures

9.12.3 Reinforcement

The reinforcement shall conform to Section VI-6 1.3.3.6.

9.12.4 Drilling Fluid

The following requirements shall be complied with, if bentonite mud is used to stabilize the boreholes:

(a) Supply

A certificate shall be obtained by the Contractor showing the properties of the consignment delivered to the site. This certificate shall be made available to the Engineer for his approval.

The Contractor shall get approval of the Engineer for any other material proposed by him for the drilling fluid.

(b) Mixing

Bentonite and any other material shall be mixed thoroughly with clean water to make a suspension which shall maintain the stability of the pile excavation for the period necessary to place concrete and complete the construction.

(c) Tests

The frequency of testing drilling fluid along with method and procedure of sampling shall be proposed by the Contractor for approved by the Engineer prior to the commencement of the work. The frequency may subsequently be varied as required, depending on the consistency of the result obtained.

The Contractor shall supply all equipment's and experienced operators required to carry out tests on the drilling mud. No additional payment shall be made for these tests which shall be considered as an essential part of the drilling operations.

9.12.5 Construction Methods

The Contractors shall demonstrate to the satisfaction of the Engineer that his proposed construction method for the pile do not weaken the pile shaft by contamination of the concrete by sectional reduction, by washing out of cement, by breaking during pulling of temporary casing or in any other way including the construction of neighboring piles.

(a) Procedure

The following construction procedure shall be followed:

(i) If permanent steel casings is not specified, a sufficient length of temporary steel casing shall be used to stabilize the upper part of the borehole.

(ii) Boring and excavation inside the steel casing shall be carried down to the casing toe level or to a level approved by the Engineer. The excavation shall be continue to final pile tip level using either temporary casing under water or using drilling mud. The fluid level inside casing shall at all times be at least 2 meters higher than outside the casings.

(iii) All mud or sedimentation from the bottom of borehole shall be cleaned up.

(iv) Reinforcement cage, inspection pipes etc. shall be placed shown on the drawing or instructed by the Engineer.

(v) Concreting underwater or drilling fluid shall be carried out continuously using termite method.

(vi) Withdrawing of the temporary boring casing to the instructed level shall be carried out concurrently with concreting.

(vii) After hardening, the top section of the concrete pile shall be broken to reach sound concrete in the pile.

(b) Approval of Construction Method

The Contractor shall describe the construction method he proposes, including name of proposed Sub-contractor (if any), information on boring equipment, materials, method of boring and quality control. After the contract has been awarded the Contractor shall prepare a detailed programme and establish for the pile construction. The detailed programme shall contain all required information on materials, equipment, methods of work etc., and be approved in writing by the Engineer. Such approval shall not however relieve the Contractor of his responsibilities for pile construction. The import of any boring equipment or materials by the Contractor, before he has receive the Engineer's approval of proposed construction methods, shall be at the Contractor's risk.

The Contractor shall check the casing position for each pile during and immediately after placing the casing, and agree it with the Engineer.

(c) Tolerances

The Centre of the complete pile at cut off level shall not deviate more than 100 mm from the theoretically correct position shown on the drawing. The inclination of the pile shall not deviate more than 1:100 from vertical. The Contractor shall provide suitable equipment such as inverted pendulum, to check the vertically of the boreholes at intervals during drilling and prior to concreting.

9.12.6 Boring

(a) Methods

Methods of excavation shall be proposed by the Contractor for approval of the Engineer. Water or air jetting for boring of the piles shall not be allowed.

(b) Boring near recently cast Piles

Piles shall not be bored so close to other piles which are cast and contain workable or unset concrete likely to flow.

Boring and excavation for a pile shall not commence until 24 hours after completion of any pile within a radius of 6 meters centre to centre.

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9.12.7 Temporary Casing

Temporary casing of approved quality or an approved alternative method shall be used to maintain stability of pile excavation which might otherwise collapse.

9.12.8 Stability of Pile Excavation using Drilling Fluid

Pile through water and/or soft upper soil layers shall be provided with permanent steel casing if shown in the Drawing. The pile boring shall be carried out using temporary steel casing bored in pile toe, to the level of side fall or to a level approved by the Engineer. Before concreting the temporary casing shall be gradually withdrawn. Under certain circumstances the Contractor may permitted to bore all part or the pile without casing under water or using drilling fluid to stabilize the borehole.

Where borehole is formed without casing under water or using drilling fluid for maintaining the stability of a boring, the level of the water or fluid in the excavation shall be maintained so that the water or fluid pressure always exceeds the pressure exerted by the soils and external ground water. The water or fluid level shall be

maintained at a level not less than 2 meters above the level of the river water level or, any artesian pressure level.

In the event of a rapid loss of water or bentonite suspension from the pile excavation, the excavation shall be backfilled without delay and the instruction of the Engineer shall be obtained before excavation at that location is resumed

9.12.9 Pumping

Pumping from the borehole shall not be permitted unless a casing has been placed into a stable stratum hich prevents the flow of water from other strata in significant quantities into the boring, or unless it can be shown that pumping shall not have a detrimental effect on the surrounding soil or property.

9.12.10 Removal of Obstruction

Where boulder or other obstruction render it impossible to bore the pile, excavation operation inside pile casing as directed by Engineer shall be carried out to remove obstructions. The Contractor shall be reimbursed from such operation only when the largest dimension of the obstruction exceeds 200 mm and the obstruction is found more than 2 meters below river bed.

Disturbed and/or undisturbed samples of the soils from boreholes shall be submitted to the Engineer. The contractor shall allow for carrying out sampling and tests to check soil strength including field tests like SPT tests as required by the Engineer.

9.12.11 Final Toe Level of Piles

The final toe level shall be as indicated on the drawing or as instructed by Engineer after due consideration of the Contractor’s proposals, boring logs and test results.

The final toe level of other piles may subsequently be altered according to the results of the tests loading detail in the section.

9.12.12 Inspection and Cleaning bottom of Excavation

The time between final excavation including bottom cleaning and the start of concreting shall be reduced as much as possible and in any case shall not exceed 6 hours.

The cleaning shall be done by an approved method. Before cleaning bottom of every excavation, notice shall be given to the Engineer. The Contractor shall show, to the satisfaction of the Engineer, that the bottom of the excavation is clean.

If boring without casing, the diameter of the borehole for a representative number of piles shall be measured by caliper to the placing of concrete.

These measurements shall be done by the Contractor using approved equipment and no reimbursement shall be made for this.

9.12.13 Placing Reinforcement

The reinforcement shall be placed as indicated on the Drawing. Reinforcement in the form of a cage shall be assembled with additional support, such as spreaders forks and lacings necessary to form a rigid cage. Hoops, links or helical reinforcement shall fit closely around the main longitudinal bars and be bound to them by approved wire, the ends of which shall be turned into the interior of the pile or pour. Reinforcement shall

be placed and maintained in position. The cover to all reinforcement shall be not less than 75 mm.

Joints in longitudinal bars in piles with tension (for instance for test loading) shall be carried out by welding unless another method has been approved by the Engineer.

9.12.14 Placing Concrete

(a) Approval from the Engineer

No concreting shall take place before the bottom of excavation has been cleaned. The Contractor shall get borehole inspected and obtain approval in writing from the Engineer.

(b) General Requirements

While placing concrete, these requirements shall be complied with

(i) The method of placing and workability of the concrete shall be such that a continuous monolithic concrete shaft of the full cross section is formed.

(ii) The concrete shall be placed continuously and without such interruption as would allow the previously placed batch to have hardened. In this respect the Contractor shall submit details of his contingency plans, standby plants etc. to be utilized in the event of an equipment failure.

(iii) The use of pumped concrete and the methods in its use shall be approved.

(iv) The Contractor shall take precautions in the design of the mix and placing of the concrete to avoid arching of the concrete in a casing. No spoil, liquid or other foreign matter shall be allowed to contaminate the concrete.

(v) Concrete to be placed under water or chilly fluid shall be placed by termite and shall not be discharged freely into the water or drilling fluid.

(vi) Before concrete, measures shall be taken to ensure that there is no accumulation of silt or other material at the base of the boring. The Contractor shall ensure that heavily contaminated bentonite suspension, which could impair the free flow of concrete from the pipe of the termite, has not accumulated in the bottom of the hole.

(vii) A sample of the bentonite suspension shall be taken from the base of the boring using an approved sampling device. If the specific gravity of the suspension exceeds 1.25, the placing of concrete shall not proceed. In this event the Contractor shall modify the mud quality. The concrete shall be a rich and coherent mix of high workability in accordance with the requirement of Section- VI C, 1.3.

(viii) The concrete shall be placed in such a manner that segregation does not occur.

(ix) During and after concreting damage to the concrete from pumping and dewatering operations shall be avoided.

(x) The hopper and pipe of the termite shall be clean and watering throughout. The pipe shall extend to the base of the boring. A sliding plug or barrier shall be placed in the pipe to prevent direct contact between the first charge of concrete in the pipe of the termite and the water of drilling fluid. At all times the pipe shall penetrate the concrete placed and shall not be withdrawn from the concrete until completion of concreting. The bottom of the termite pipe shall be kept at least 1.5 meters under the surface of concrete. At all times a sufficient quantity of concrete shall be maintained within the pipe to ensure that the pressure from it exceeds that from the water or drilling fluid. The internal diameter of the pipe termite shall not be less than 150 mm for concrete made with 20 mm aggregate and not less than 200 mm for concrete made with 40 mm aggregate. It shall be so designed that external projection are minimized, allowing the termite to pass through reinforcing cages without causing damage. The internal face to the pipe of the termite shall be free from projections.

(xi) The Contractor shall maintain a continuous record of the volume of concrete used and the level of the concrete in the pipe. Any deviations from the theoretical, or expected, volume/level relationship shall be immediately reported to the Engineer.

(xii) Anti-washout admixture shall be used.

(c) Workability of Concrete

Slump measured at the time of discharge into the pile shall be in accordance with that given in the Table 44.

Table 43: Slump of Concrete for Pile Boring

Pilling mix Workability	Slump		Typical Conditions of Use
	Minimum mm	Range Mm	
A	75	75-150	Placed into water free unlined or permanently lined bore of 600 mm diameter or over where casting level lies below temporary casting: reinforcement widely spaced bearing ample room for free movement of concrete between bars
B	100	100-200	Where reinforcement is not spaced widely where cut off level of concrete is within temporary casing where pile bore is water free and the diameter is less than 600 mm.
C	200	200	Where concrete is to be placed by termite under water or chilly Mud or by pumping.

9.12.15 Extraction of Temporary Casing

(a) Workability of Concrete

Temporary casing shall be extracted while the concrete within remains sufficient workable to ensure that the concrete is no lifted.

(b) Concrete Level

When the casing is being extracted a sufficient quantity of concrete shall be maintained in it to ensure that pressure from external water, drilling fluid or soil is exceeded and that the pile is neither reduced in section

nor contaminated. The toe of the temporary casing shall be kept at a minimum of 2 meters under the outlet of the termite.

Adequate precautions shall be taken in all cases where excess head of water or drilling fluid exists.

The pile shall be concreted with certain over height to allow for chiselling off the top concrete down to sound hard concrete.

(c) Vibrating Extractors

The use of vibrating casing extractors shall be permitted for the extraction of the casing.

(d) Reinforcement Cage

During concreting and puling casing, the reinforcement cage shall be secured against uplift the top shall be kept under close monitoring.

(e) Supervision

The execution of the pile concreting shall be supervised by a qualified and experienced person of the Contractor, who shall keep records on the relation between quantity of concrete used, level of concrete and withdrawal of casing.

9.12.16 Measures In case of Rejected Piles.

If any pile is found unsatisfactory in the opinion of the Engineer for utilization in the structure, it shall be cut off below the pile cap, if so ordered by the Engineer. The piles shall be replaced as directed by the Engineer. All extra expenses shall be borne by the Contractor and the payment shall be made for original piles only considering that no replacement piles are bored.

When by test, the safe allowable bearing value of any pile is found to be less than the design load, longer piles or additional piles shall be installed as ordered in writing by the Engineer.

9.13 DRIVEN SHELL CAST IN-SITU PILES

9.13.1 Shells for Cast In-Situ Piles

Steel shell may be of any type which has a tip diameter of not less than 300 mm, a thickness of not less than 3 mm, and a top diameter not less than that required in the contract, which shall satisfactorily withstand the required driving without distortion or damage to the pile, and which can be filled with concrete for its entire length without placing concrete in or under water. The capacity of the pile frame shall be selected after considering the size and weight of the casing tube to be handled, the location of the work and the hardness of driving. Detachable shoes used with the temporary steel casing shall be cast iron, double rimmed and of requisite strength, standard and sizes to be used with the respective steel casing. The shoe shall be coaxial with the steel casing. However, mild steel pile shoes also shall be accepted. They should have been fabricated out of mild steel plates conforming to IS 2062. Casings distorted from the true and uniform shape, whether caused by driving or earth and water pressure resulting in a reduction of the cross sectional area of the pile in excess of 10 percent shall not be used in the work.

Steel shells for concrete in-situ piles which protruded above ground or bed level shall be as shown on the Drawing, specified in the contract or ordered by the Engineer.

9.13.2 Construction

Before commencement of work the Contractor shall submit to the Engineer construction method and details of driving equipment for his approval.

(a) Driving of steel Casing:

Steel casings shall be driven as per layout plan shown on the drawing or as directed by the Engineer. Sequence of driving steel casing in pile group shall be as agreed by the Engineer.

After commencement of driving all time, prior to the placing of concrete in the driven shells or casings, the Contractor shall provide a suitable light for the inspection of the shell or casing throughout its length. Any improperly driven, broken or defective shell shall be replaced, or an additional pile shall be driven at the expense of the Contractor.

Any reduction in the cross-sectional area in casings or shells in excess of 15% shall be cause for rejection. The insertion of internal casing to remedy defects shall not be permitted. No concrete shall be placed in cast-in-situ piles until all driving within a radius of 6.0 m has been completed, nor until the shells, for any area sub-structure unit or bent, have been completely driven. If this cannot be done, all driving within a 6.0 m distance shall be discontinued until the concrete in the last pile cast is at least 7 days old.

(b) Cleaning and Inspection

Before placing reinforcement accumulation of water or debris in the shells shall be removed and thoroughly inspected throughout its length. It shall be ensure that reduction of the section, if any, shall not be excess of 15% of the specified section and the toe level shall be the same as shown on the drawing or directed by the Engineer.

(c) Placing of Reinforcement

The reinforcement shall conform to the requirements of Section-VI- C 1.3. The reinforcement shall be prepared and placed as described in Clause 9.12.

(d) Placing of Concrete

The piles shall be cast with the concrete using design mix as specified in the contract. Care shall be taken to preserve correct cover and alignment of reinforcement throughout the whole operations of placing the concrete.

Before placement of concrete care shall be taken to ensure that the inside of the casing is free from sludge or any foreign mater. Water inside the casing, if any, shall be removed by bailing or pumping. Where this is not possible, the underwater correcting shall be done with necessary precautions after receiving the specific approval of the Engineer.

The concrete shall be placed to fill the entire volume of the casing without the formation of voids caused by entrapped air. Proper compaction shall be employed to obtain a dense and high-quality concrete. The concrete shall be vibrated immediately after placing each lift and lifts shall not exceed 1.25 m in height. The filling of piles in conjunction with the placing of concrete in the footing shall not be permitted. The volume of concrete placed shall be observed in the case of few piles initially cast and the average figure obtained shall be used to check, whether there is any deviations in the volume of concrete placed for the subsequent piles.

Consistency of concrete to be used for cast-in-situ piles shall be suitable to the method of installation of piles. Concrete shall be so designed or chosen as to have a homogeneous mix having a slump/workability consistent with the method of concreting under the given condition of pile driving. The minimum slump shall be 100 mm when the concrete in the pile is not compacted. The slump shall not exceed 180 mm. in any case. The Contractor shall submit mix design report including calculations and carry out adequate number of tests to ensure the minimum strength in accordance with the Specifications.

The top of the pile shall be brought above the required finished level and any defective concrete removed to ensure satisfactory bonding of the pile head to the substructure.

Withdrawal of casing shall be carried out in stages and utmost care shall be exercised in maintaining an adequate head of concrete above the bottom of casing at each stage of withdrawal so as to prevent the inflow of soil and water into the casing.

9.13.3 Miscellaneous

The requirements for placing reinforcements and concrete, workability of concrete extraction of temporary casing, tolerance, etc. as described in Clause 1612 shall be met with, as applicable.

9.14 PILE TESTS

9.14.1 Test Piles

The Contractor shall furnish test piles of the type, number and length specified in the contract. Generally, the test piles shall be located so as to permit their use in the finished structure and they shall be installed at the positions shown on the Drawing or specified in the contract.

In order to obtain the best possible data from the test pilling the Engineer shall have the right to change test piles from their planned location to any other location in that group or any other group of the structure without any adjustment in the Contract Prices.

The installation shall be done using the same equipment as is to be used for installing the other piles in the works. The Contractor shall co-operate with and assist the Engineer in obtaining data for bearing for the full length of the installation. When using driven piles in soft or plastic soils, the Engineer may require test piles to be re-driven. In such cases the driving shall be stopped at a point when the top of the pile is 600 mm to 1500 mm above cut off level and driving shall be resumed after a minimum of 24 hours.

9.14.2 Loading Tests

Loading tests shall be made on those piles shown in the Drawing or ordered by the Engineer. All labour, material, equipment and attendance required to complete the tests shall be furnished by the Contractor.The piles shall be tested as follows:

(a) The test load shall be 150% of safe load bearing capacity of that pile for no scour case and be applied by a method approved by the Engineer. At least one pile load test shall be performed for each bridge foundations of abutments/piers. It shall be measured within an accuracy of plus or minus 2%. Settlements shall be measured within an accuracy of plus or minus 0.25 mm.

(b) The test load shall be applied in the increments as specified or approved by the Engineer. These shall generally be those recommended in IS 2911.

(c) The load after each increment shall be kept constant until the rate of settlement does not exceed 0.25 mm per hour.

(d) The value of settlement shall be recoded before the next increase of load.

(e) The full test load shall be maintained for 48 hours and the total settlement shall be recorded.

(f) The load shall be reduced in decrements equal to the increments with which it was applied.

(g) The load after each reduction shall be kept constant until the rate of recovery does not exceed 0.25 mm per hour.

(h) The amount of recovery shall be recorded before the next decrease of the load.

(i) The Contractor shall, with 24 hours of the completion of the test, submit to the Engineer for each pile tested, graphs showing;

(a) Load plotted against settlement and time

(b) Settlement and recovery plotted against load.

(j) The settlement of the pile under the test load and recovery of the pile after the removal of the load shall be within the limits required in the contract or ordered by the Engineer.

9.14.3 Other Requirements of Loading Tests

(a) A load test shall consist of the application of a load equal to twice the specified bearing capacity or as otherwise provided for herein or as directed by the Engineer. Unless otherwise permitted by the Engineer the load tests shall be completed before the remaining piles in the same structure are driven or cast.

(b) Load tests shall be performed on the day indicated by the Engineer. The Engineer may order load tests to be performed on piles other than test piles and may also specify different increments of load, more frequent loadings of gauges and different period of loadings than specified herein or in Sub-clause 1614 (2). Such changes shall not continue any claim by the Contractor for any additional payment or compensation other payment for test pile and load test in accordance with the contract unit price quoted by the Contractor in the Bill of Quantities.

(c) Load tests shall be made by method approved by the Engineer. The Contractor shall submit to the Engineer detailed plans of loading system and apparatus he intends to use at least 3 weeks in advance. The apparatus shall be so constructed so as to allow the various increments of the load to be placed gradually without causing vibration to the test piles. Tension anchor piles, if used, shall be of a design and driven to a depth satisfactory to the Engineer. Steel shells or piles whose walls are not of adequate strength to withstand the test loading when empty, shall have the required reinforcement and concrete placed before loading.

9.14.4 Pile Integrity Test

Pile integrity test shall be performed for each pile of each foundation. Low Strain Pile Integrity Testing Apparatus shall comply the requirements of requirement of ASTM D5882-16. The tests shall be conducted at 5-6 places (in no case less than 3 hammer blows) and maximum distance between hammer and sensor should not exceed 300mm to cover the entire section of the pile. Piles shall be trimmed to cut off level or sound concrete level before the test with all laitance removed.

No pile cap construction work should be undertaken prior to the test.

The area surrounding the pile should be free from standing water and kept dewatered during the tests. The pile head should be accessible. Testing should he free of work likely to cause disturbance. The cast-in-.situ piles should not be tested normally before 14 days of casting.

Site Soil information should be uploaded to the PIT Software. Another input data are Pulse width, Magnification, Magnification Delay, Filter, Wave velocity, Length of pile, Cross section area.

The test piles, if available at site, can be used to determine the pulse velocity and characteristic or reference signal generated Where no test pile is available information can be obtained from cast piles whose length is accurately recorded.

Profile and Beta analysis shall be done.

Specific Input for the Test

- Wavelet = 1-2 m
- Magnification Delay (MD) = 20% of Pile Length
- Magnification (MA) = Pile Length, m
- Hi Pass Filter = 0 Use of
- LO Pass filters is discouraged
- Soil Data

Table 44: Selection of Wave velocity for test

Pile Concrete Design Strength, Mpa	20	25	30	35
Adopted Wave Velocity, C m/s	3400	3500	3600	3700

The integrity test report should clearly specify piles that are acceptable, piles that show major defects and are not acceptable, piles that show minor defects and maybe acceptable after review of loads, additional tests etc. and/or piles that are inconclusive due to bulges, high soil resistances etc.

These acceptance criteria shall be followed:

Criteria 1:

- If difference in Construct Area and Minimum Profile (X-Section Area) % <10%: OK
- If difference in Construct Area and Minimum Profile (X-Section Area) % >10 - 25%: Serious Defect, details to be verified
- If difference in Construct Area and Minimum Profile (X-Section Area) % >25%: Rejection of Pile

Criteria 2:

- If Impendence change % <10 : OK
- If Impendence change % >10 - 25% : Serious Defect, details to be verified
- If Impendence change % >25% : Rejection of Pile

9.15 RECORDS

The Contractor shall keep records as indicated below for the installation of each pile and shall submit two signed copies of these records to the Engineer not later than noon of the next working day after the pile was installed. The signed records shall from a record of the work. The following data shall be recorded.

(a) Pile reference number.

(b) Pile location.

(c) Pile type.

(d) Nominal cross sectional dimensions or diameter.

(e) Date and time of boring.

(f) Date and time of concreting.

(g) River bed level at commencement of installation of pile.

(h) Working level.

(i) Pile toe level.

(j) River water levels.

(k) Pile head level.

(l) Length of temporary casing with top level.

(m) Length of permanent casing with top level.

(n) Soil samples taken and in situ tests carried out.

(o) Standing water level.

(p) Length and details of reinforcement.

(q) Concrete mix.

(r) Volume of concrete supplied to pile and corresponding levels of concrete and

casings.

(s) All information regarding obstruction delays and other interruptions to the sequence

of work.

(t) Sequence of driving/boring shown in plan of pile group.

(u) Final set of last ten blows.

(v) Type and weight of hammer.

(w) Type and condition of helmet and dolly.

(x) Details of any interruption in driving, boring and/or concreting.

(y) Other information as required by the Engineer.

That information which are not applicable for the given type of pilling work may be omitted.

9.16 TOLERANCES

9.16.1 Permissible Tolerances for Pile

(i) Precast Concrete Piles:

(a) Variation in cross-sectional dimensions : ±5 mm

(b) Variation in length : ±25 mm

(c) Surface irregularities measured with 3 m straight edge: 5mm

(d) Bow for total length of pile in mm : 1 mm /m length of pile limited to 20 mm

(ii) Driven Piles

(a) Variation in cross-sectional dimensions : +50 mm, -10 mm

(b) Variation from vertical for vertical piles : 1 in 150

(c) For vertical piles deviation at piling platform level : 75 mm

(d) Variation of level of top of piles : ±25 mm

(iii) Bored Piles

(a) Variation in cross-sectional dimensions : + 50 mm, -10 mm

(b) Variation from vertical for vertical piles : 1 in 150

(c) For vertical piles deviation at piling platform level : 75 mm

(d) Variation of level of top of piles : ±25 mm

9.16.2 Permissible Tolerances for Pile Caps

(a) Variation in dimensions : +50 mm, -10 mm

(b) Misplacement from specified position in plan : 15mm

(c) Surface irregularities measured : 5 mm with 3 straight edge

(d) Variation of levels of top of piles : ±25 mm

9.17 MEASUREMENT

For supply of precast concrete, timber or steel piles of specified cross-section, the measurement shall be in metres of the length of piles ordered in writing by the Engineer measured from the head to the butt of the shoe or the tapered point. Reinforcement in precast concrete piles shall not be measured for payment.

For cast-in-situ driven and bored concrete piles of specified cross-section, the measurement shall be the length in metres of the accepted pile that remains in the finished structure complete in place. Reinforcement in cast-in-situ driven and bored concrete piles shall be measured for payment as per Section-VI-C-1.3.

Test piles shall be measured per number of load test carried out including the complete installation of the pile. Piles driven by the Contractor for his own information or for calibrating diesel hammers shall not be measured as test piles.

For installation of the pile, i.e. by driving in the case of precast concrete, timber, steel and cast-in-situ driven piles, and by boring in the case of cast-in-situ bored piles the measurement shall be the length in metres that remains in the finished structure complete in place, limited to that shown on drawings or ordered by the Engineer. No distinction shall be made for penetration through hard strata or rock and socketing into rock.

For steel liners/casing shown on the drawings to be permanently left in place, the measurement shall be by weight in tones that remains in the finished structure complete in place, limited to that shown on drawings or ordered by the Engineer.

For the pile cap, the quantity of concrete shall be measured in cubic metres as per Section VI-C 1.3. While reinforcement in pile cap shall be measured in tones as per Section VI-C 1.3.

9.18 PAYMENT

The contract unit rate shall be the full and the final compensation to the Contractor for Installation of precast concrete, timber or steel piles which shall include cost of making or fabricating the pile complete as shown on the drawing, and where required its loading, transport, delivery to site unloading and stacking it at the place and driving indicated by the Engineer. The cost of reinforcement in precast concrete piles shall be deemed to be included in the quoted rate for piles.

The quantities of pilling left in place in the accepted structure, measured as provided above, shall be paid at the contract unit rate. The contract unit rate shall be the full and the final compensation to the Contractor for all expenditures incurred by the Contractor for incidentals and for doing all the works involved in driving, placing filling materials for cast in-situ or driven piles, cutting off piles as specified in this specification in addition to those specified in Clause 112 of DOR Specification.

Reinforcement in cast-in-situ driven and bored piles shall be paid at the contract unit rate as specified in Section 2000.

Permanent steel liners shall be paid at the contract unit rate. The contract unit rate shall be the full and the final compensation to the Contractor for, fabrication and placing the steel liner to the required depth as shown on the drawings and as ordered by the Engineer in addition to those specified in Clause 112 of DOR Specification.

Concrete and reinforcement in pile cap shall be paid separately at the contract unit rate as specified in Section VI-C, 1.3.

Pile shoes when called for on the Drawing or by the Engineer shall not be paid for separately, but full compensation for all the work involved in supplying and fitting pile shoes shall be considered as included in the unit rate for pre cast concrete piles and no additional compensation shall be allowed.

Splicing of piles, when allowed, shall not be paid for separately but full compensation for all the work involved shall be considered as included in the unit rate from pre cast concrete piles.

Additional quantities of concrete, reinforcement and form work, caused by incorrect location of piles or additional piles necessary to replace defective piles shall be at the Contractor's expense.

Test piles shall be paid at contract unit rate which shall be full and final compensation for the cost of all operations and incidental costs associated with supply of piles in place and testing thereof in addition to those specified in Clause 112 of DOR Specification.

10 MECHANICAL

10.1 General

The Present Project is a portion of the clear water supply pumping station construction, consisting of supply, installation and commissioning of the mechanical, electrical equipment of the plant.

The pump, hoist, piping, valves and other equipment required for the construction shall be easy to procure from Nepal, India, China and other adjacent countries, if possible.

The equipment applied in pumping station can change the specification under the approval of the Employer and supervisor, if the performance and efficiency of equipment is equal or above the specification.

10.1.1 Field Conditions

The project area is located at 1300m above mean sea level in Kathmandu District, Bagmati Zone of the Central Development Region of Nepal.

Weather conditions

The following general climatic parameters will be referred and recent 10 years weather data will be analyzed for application.

The following general climatic parameters shall be referred and the recent 10 years of weather data shall be analyzed for application.

- Temperature : Max. : 32℃, Min : 6℃
- Relative humidity : Max. : 95%, Min : 66%
- Yearly average rainfall : 4046mm
- Altitude above sea-level : 1,300m

10.1.2 Plant design standard

Performance and Warranty

- The contractor is solely responsible for the performance of the equipment.
- The warranty period for equipment shall be 3 years from the completion of work.

10.1.3 Access and Transportation

Contractor shall investigate the availability of transportation facilities and shall make all arrangement for the delivery of materials to be used on the work. The Contractor shall make his own investigations on the condition of available public roads access, bridge load limits, and restrictions and limitations affecting transportation and ingress.

Access from Kolkata to the site is available by road or by combination of railway and road. The Indian Railway is available from Kolkata to Raxual at the Nepal-India border. The International Airport is in Kathmandu city. One of the possible transportation routes by road from Kolkatta is as follows:

In India: Kolkatta (port of Import) – Burdwan – Asansol – Tilaiya Junction – Jharkhand – Bihar-Mokameh Bridge – Muzaffarpur – Motihari – Raxaul, approximately 800 km.

In Nepal: Birgunj (continued from Raxaul) – Hetauda – Narayanghat – Muglin – Thankot – Kathmandu; approx. 360 km.

The Contractor shall use every reasonable means to ensure that all loading limits and other limitations on loads, bridge etc. are observed, and in the event of it being necessary to move any extraordinary load of equipment or pre-construction unit or part of the Work, the Contractor shall, before moving such, comply with all other lawful requirements.

The Contractor shall abide by all limitations, laws and regulations relating to the use of public transportation routes. The Contractor shall make any necessary repair or replacements as the case may be to any structure on the route which is damaged by the Contractor as a result of own negligence. Such repair or replacement shall be satisfactory to the Employer or the appropriate government authorities.

The limitations on national road shipments vary according to the conditions of the road, bridges. It shall be the Contractor's responsibility to get informed of the limitations on all road shipments.

10.1.4 Utility Conditions

Power supply

- IncomingT/L : 11kV, 3ph, 50Hz
- Low voltage : 400V, 3ph, 50Hz (Less than 160kW)
- Lighting& Small Socket Outlet (S.S.O) : 230V(1ph)
- Control Power :AC 230V, 1ph, 50Hz

10.1.5 General Specification

The section covers the supply, design, manufacture, inspection and testing, packing, on-site delivery, storage, installation, acceptance testing, O&M, finishing, painting and the work/repair settings during the contract period of the mechanical/electrical plant and equipment included in the contract.

Prior to, or together with, the submission of Design Documentation for a particular activity or part of the Works, the Contractor shall submit to the Employer for approval such as a list of proposed suppliers and sources of materials, technical specifications, certified dimensional drawings, weights and loadings, and power requirements for all principal items of equipment required for the execution of the activity or part of the works. The samples shall also be submitted for acceptance under the request of the Employer.

The materials, which are supplied afterwards, shall conform to the material specifications and the quality of any samples approved from the Employer.

The lists of names for additional suppliers and sources can be submitted by the Contractor during the execution of the Contract, but no source of supply shall be changed without the Employer's acceptance.

The plant is required to be complete in all respects as specified herein and shall include all items of plant, machinery, fittings, equipment, etc. necessary whether such items are specifically referred to in the Contract or not.

The plant and materials shall be suitable for the operation under the climate conditions of the site as stated in the previous chapter. The plant on the outside shall be compatible with the operation within the temperature intervals ranging from 5ºC below the minimum temperature to 5ºC above the maximum temperature, which are recorded in the area. The plant shall be designed to operate correctly in periods of high wind speed.

The Contractor shall co-ordinate the activities of all the sub-contractors to ensure that the sufficient drawings, diagrams and schedules for co-ordination shall be provided to all the sub-contractors related to the mechanical and electrical works before placing the orders for plant and equipment.

The Contractor shall provide all the facilities to the Employer for the inspection and testing, during the manufacturing and installation stage of mechanical/electrical plant and equipment. The Contractor shall also carry out all obligations and requirements regarding the inspection and testing of mechanical/electrical plant and equipment at all stages, which are manufacture, installation and post-installation.

10.1.6 Regulations, Standards, Materials and Workmanship

All the works to be carried out and all the equipment and materials to be provided, and all the parts to be manufactured and the workmanship to be executed under the Contract shall comply with the latest editions of American or ISO Standards and have ISO 9001 quality certificates unless otherwise required by the Employer.

All the materials shall comply with the appropriate ASTM Standards, International Organization for Standardization (ISO), common International Standards (ex) KS, JIS, ANSI, BS and DIN), the recommendations of the International Electro-technical Commission and other standards specified herein.

All the materials and workmanship shall be within the satisfaction of the Employer. The particular attention shall be paid to the well-arranged installation, which is carried out in a methodical competent manner.

All the works related to the trades shall be carried out by the tradesmen in fully competent and qualified manner, and the entire installation shall be performed in a workmanlike manner. The tradesmen may be required to demonstrate the proficiency to satisfy the needs from the Employer.

All the equipment shall be of the best modern design, the high class durable finishing and compatible for installation inside the modern complex requiring the excessive heavy duties.

The Contractor shall be responsible for ensuring that the components of each system are initially compatible and integrated to form fully efficient systems, which are complying with the drawings and Specification.

The design philosophy shall have the simplicity and the reliability so that the equipment provides the long trouble-free service with the low maintenance costs. The particular attention shall be taken care of with the ease of access to facilitate the inspection, cleaning, maintenance and repair.

All the supplied equipment shall be designed to meet the requirements for the satisfactory operation for all variations regarding the operating loads, pressures and temperatures as well as the ambient temperature.

The components inside the Plant shall be selected to minimize the maintenance costs. As a minimum requirement, the items of Plant shall include the features, which are normally associated with the Plant, as detailed in specifications and literature, unless specifically excluded.

The Contractor is responsible for checking if the electrical equipment is completely compatible with the mechanical equipment, which is offered.

The Employer shall have the right to request the Contractor to justify the background of equipment selection. If the materials or plants are below the necessary standards to satisfy the Specification, the Contractor shall modify or replace the concerned equipment with no additional cost.

The choice of materials and finishes shall be taken into account the atmospheric conditions of site.

The outdoor equipment shall be weatherproof and designed to prevent the water stuck at any points. The metal-to-metal joints shall not be allowed and all the external bolts or screws shall be provided with the blind tapped holes in order to prevent the ingress of moisture through the hole.

The machines shall be made of materials, which do not jam due to the rust, corrosion, brine or dust. The bearings of exposed operating shafts shall be designed to prevent the moisture seeping along the shaft into the interior of equipment.

The equipment and instruments shall not be located in positions where the equipment and instruments are vulnerable to the falling objects or water dripping. The weather shields shall be provided to protect equipment and instruments, if necessary.

All the materials and components shall be of good quality, new and unused, suitable for the purpose specified, and to the acceptance of the Employer. Equipment shall be of the most recent or current design and specification, and shall incorporate all recent improvements in design and materials unless otherwise specified in the Contract. No second-hand materials whatsoever will be acceptable. The Contractor may be required to produce certified invoices.

In the case of Standard Specifications and Codes of Practice, the latest edition, which is current at the time of tendering, shall be used.

All the parts of the works shall, unless otherwise specified, comply with the provisions of the part or be subject to the acceptance of the Employer.

The names of the manufacturers regarding the materials and equipment, which are proposed for the incorporation in the Works including the performance, capacities, certified test reports and other significant information pertaining to the same, shall be furnished if requested by the Employer for the consideration. The Employer shall have a right to reject any parts which do not comply with the opinion or the Specification. Such parts shall be replaced by the Contractor with no additional cost.

All the materials associated with the Works shall be the most suitable for the duty concerned, and of the brand new with first class commercial quality. All the materials associated with the works shall be free from defects, and have the long-life cycle and the minimum maintenance. All the components of the Works shall be manufactured from the materials, which are specifically chosen for the corrosion resistance.

Where the stainless steel is specified or used, the stainless steel shall be resistant to the atmospheric corrosion with not less than the standards provided by ASTM. The particular attention shall be paid to the prevention of seizure by fretting where two corrosion resistant metals are in contact, by the selection of materials with suitable relative hardness and surface finish, and the application of lubricants. The zinc shall not be applied where the bronze is specified or used.

The particular attention shall be paid in order to prevent the corrosion due to the close proximity of dissimilar metals. The dissimilar metals with low bimetallic corrosion shall be applied where the metals are in contact.

The equipment shall be installed with high quality workmanship at the required places and levels from the Drawings, which are provided by the Contractor, and approved by the Employer. Any digression from the Drawings shall not be acceptable unless otherwise specified by the Employer. All the plant shall be in the right line, level and location for the satisfactory operation, and allow easy access for making the necessary connections between equipment.

The workmanship and general finish shall be of first class commercial quality in accordance with the best workshop practice.

All the similar items of plant and components shall be completely interchangeable. The spare parts shall be manufactured from the same materials with the originals, and fit into all the similar items from plant. The machining fits on renewable parts shall be accurate and have a specified tolerance so that the replacements made to the manufacturer's drawings can be readily installed.

The use, installation, application or fixing of materials and components shall be in accordance with all the applicable recommendations from the manufacturer, unless otherwise described in the Contract. Where appropriate, the Contractor shall make use of any technical advisory services, which are offered by manufacturers.

10.2 Reference Standards

The contractor shall furnish all equipment, materials and labor required to complete the works, in all respects, and install the equipment as shown on the plans and/or as hereinafter specified. The numbering system employed in as-per specifications is used throughout the contract documents.

The specifications, standards, or methods of the respective national or international associations shall be referred when the references to the following capitalized abbreviations are mentioned in as-per specifications. Other national standards or internationally accepted standards ensuring an equal or higher quality than as-mentioned standards are acceptable. The contractor shall submit any explanatory material upon the request of the engineer, concerning the standards in conformity of manufacturing goods.

KS : Korean Industrial Standard

JIS : Japanese Industrial Standard

BS : British Industrial Standard

DIN : German Industry Standard

ISO : International Standard Organization
JEC : Standard of Japan Electrical Committee
JEM : Standard of Japan Electrical Manufacturer Association
NEMA : National Electrical Manufacturer Association U.S.A
IEC : International Electric technical Commission
JWWA : Japan Water Works Association
AWWA : American Water Works Association
JEAC : Japan Electrical Association Code
KEMC : Korean Electrical Manufacturer Committee
KECO'S : Korean Electrical Company Standards
JCS : Japanese Cable Maker's Association Standards
AWS : American Welding Society
SSPC : Steel Structures Painting Council
NS : Nepalese Standard
IS : Indian Standards

10.3 Description of Works

The pumping stations are designed to transmit the water from RVT (Reservoir Tank) to Clear Water Supply Area through the pumping.

The design details of Clear Water Pumping Station are listed as follows.

- Gate valves are installed on both suction and discharge pipes of pump respectively, in order to shut down the water from either the suction or discharge side during the maintenance.
- Centrifugal pumps with economic feasibility are applied due to the high efficiency and compatibility for the clear water transmission.
- Manual hoists or Hoists with trolley are installed for the maintenance of pump.
- Water hammer control devices and Dashpot-type check valves are applied to some of pumping stations to relief the water hammer, which is occurred from the start and stop sequence of pump.

Clear water pumping stations are as follows:

	DSC-05 DESIGN							
PUMPING	Pump power (kW)	No. of running	Stand by	Number on PS	Flow	Head	Type	Water Hammer Control System
Kwacho	22	1	1	2+1	15.17 lps	84 m	Vertical	Blader tank 0.5 m3
Lyaku	15	1	1	2+1	14 lps	68 m	Vertical	Blader tank 0.5 m3
OHT	15	2	1	2+1	24.17 lps	30 m	Horizontal	-

10.4 Temporary Works

Temporary works which is necessary for installation of the equipment shall be executed as follows

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10.4.1 Temporary office and space for storage at the jobsite.

The space for temporary office and storage at the jobsite shall be provided by the Employer. And the location thereof shall be directed by the engineer at the time of pre-bid meeting. However, the costs for erection of office and the costs for all the equipment, parts, operation, and maintenance in the office shall be borne by the contractor.

10.4.2 Temporary water, sewerage system and electric power

The Contractor shall make his own arrangements for the water supply to the construction work site.

The Contractor shall also maintain the site, and working areas in good sanitary conditions. And the criteria for health and sanitation shall comply with the requirements of the local medical office of Health or other competent authorities.

The electric power required for the work shall be provided by the Contractor at the work site.

The costs for temporary water, sewage system and electric power shall be borne by the contractor. The arrangement of piping and wiring for temporary water, sewage system and electric power shall be made by the Contractor. And the cost thereof shall be borne by the Contractor.

The facilities for emergency power supply shall be applied on the site so that there would be no issues on the power supply.

10.5 Equipment Maintenance

All the equipment and part installed shall be provided with the proper oil and lubricants by the Contractor before being placed in operation. All new equipment shall be maintained and operated by the Contractor until the Work is completed with certificate from the Engineer.

10.6 Storage of Materials

The materials shall be stored to ensure the preservation of quality and the fitness for the Work. The materials shall be placed on the wooden platforms or other hard, clean surfaces, and not on the ground. And the materials shall be stored with the cover. The stored materials shall be located so as to facilitate the prompt inspection.

10.7 Operation and Maintenance Manual

The written operation and maintenance manuals, including both comprehensive and unit operation manuals as the requirement, shall be prepared and submitted by the Contractor in English as directed by the Engineer.

The Operation & Maintenance manual shall include the followings as the minimum:

Recommendation for the consumable supplies (e.g. packing, lubricants)

- Brief outline of plant operation including the sequence of events, which are required for the operation of each plant item. The information shall have the sufficient details that allow uninstructed personnel to be instructed in the operation of the Works.
- Instructions on the stop and start sequences of the Plant, noting any safety and operating sequence requirements.
- Details of the required preventive maintenance with recommended frequencies of action

including the testing, adjustment, and calibration of Plant maintenance during the normal operation.

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- Details of each item for Plant including the name and the address of the manufacturer and the local agent, type and model, serial number, duty, rating, clearances and tolerances where applicable.
- Detailed assembly drawings and instructions in terms of dismantling, component replacement and reassembly.
- Fault finding charts and procedures.
- List of spare parts including all necessary information for placing the order.
- Lists of packing seals and gasket materials.
- List of special tools required for maintenance

10.8 Supervision & training

On the installation and test run of facilities, the schedule and personnel of supervision shall be discussed with the Employer and the dispatched supervisor shall submit the daily report to the Employer.

If the Employer requires the instruction for operation and maintenance of facilities, the cost for training shall be borne by the supplier. The agency, place and other issues regarding the training shall be compromised between both parties.

On the installation and test run of facilities, the manufacturer shall bear for any increase of supervision M/D(Man Day) and cost, which are caused due to the delay of working term from the manufacturer.

10.9 Materials

Regarding the manufacture and installation of the equipment herein specified, the best appropriate materials shall be applied in terms of strength, ductility, durability, and the basis of the best current engineering practice. The materials shall meet the requirements, which are listed as follows.

- Brand new, unused and first quality
- Free from defects
- Suitable for the application with mechanical/electrical overstress
- Steel Casting : High Tensile strength Carbon steel Castings for Structural Purposes and Carbon Steel Castings
- Gray Iron
- Spheroid Graphite Iron Casting
- Rolled Steel and Structural Steel
- Carbon Steel :Carbon Steel for Machine structural use
- Stainless Steel :Stainless steel Bars, Hot Rolled stainless steel Sheet and Plate, Cold Rolled Stainless Steel Sheet and Plate, Hot rolled stainless Steel Strip, Cold Rolled Stainless Steel Strip, Stainless steel Wire and Stainless Steel Wire.

10.10 Finish

The surface requiring the painting or coating for corrosion protection shall be smooth without having any sharp edges, burrs and projections. And all the welds shall be grounded smoothly, and all the edges and corners of structural members shall be rounded. The members with finishing treatment shall be true to line without the twists and open joints.

10.11 Nameplates

The nameplates, which are attached on the facilities, shall be made of stainless steel or copper, and attached firmly at the easily recognizable location.

The nameplates shall include with the following information as minimum.

Name of manufacture and contact address

Type and Model No.

Series No.

Performance, specification capacity, voltage and other appropriate information.

10.12 Performance guarantee

Performance guarantee

Design data, which is proposed by Inquiry Specification, shall be fulfilled.

Term of mechanical warranty

Term of warranty shall be 3 years from the completion of work.

During the warranty period, the supplier shall bear the expense for repair and replacement against any defects due to the wrong design, material or technology.

10.13 Packing and transport

The packing of all facilities shall use the materials, which are suitable for packing, and be able to protect the facilities from the impact and humidity from carriage. The packing for test-run delivery shall also be packed in order to withstand the rain and humidity, since the outdoor piled up is inevitable due to the field conditions. The fragile parts, such as electrical equipment, shall be packed separately.

The contractor shall deliver facilities after he completed separate performance test for each facility during production process.

The Contractor shall deliver the facilities after completing the performance test for respective facility during the production process.

The processed external surface shall be coated properly with the anti-corrosive agents.

The processed hole shall be sealed with the caps or plugs, which are made of casing material or equivalent.

The flange holes shall be sealed not to admit the foreign objects.

Technically, all the products shall be delivered in a complete assembly. For the large facilities or products which are impossible to transport and install in the completely assembled condition, or exceed the limit of transportation, the disassembled transportation shall be specified in the approved drawings. The re-assembly of such facilities or products shall be governed by the Contractor.

Conditions of packing

Freight type: (□ Domestic, ■ Export, □ Others)

Packing type: (□ airtight, □ half airtight , □ pallet bundle, □ skid bundle)

Others: prepare water proof, rust proof and dust proof type

10.14 Installation

10.14.1 Installation of Equipment

The contractor shall construct the foundation for all the equipment specified in as-per specifications, unless otherwise specified.

The contractor shall install all the equipment specified herein on the foundation.

All the parts to be installed shall be cleaned thoroughly. All the packing compounds, rust, dirt, grit and other foreign matters shall be removed. All the holes and grooves for lubrication shall be cleaned.

All the enclosed chambers or passages shall be examined in order to check the injurious materials.

The bolts and screws shall be tightened firmly and uniformly without overstressing the threads.

10.14.2 Settling

The extensive care for handling the equipment is necessary to avoid the dropping, bumping or dragging. In hoisting, special lifting eyes shall be applied where provided whereas the equipment shall be lifted by hooks, slings, wire attached to proper.

10.14.3 Foundation Finish

The contractor shall finish concrete foundation for equipment. The Contractor shall submit shop drawings of foundation finish including finishing materials to the Engineer for approval.

The foundation constructed including any core holes shall be completed to lines and levels required with concrete and reinforcement if necessary. After alignment, level and plumb are checked, the said foundation shall be given mortar finished.

10.14.4 Noise, Vibration and Seismic Forces

General

The Contractor shall provide a quiet installation. All items of plant and equipment shown on the drawings shall be carefully chosen with a view to minimizing sound levels.

The noise levels outside plant rooms shall not exceed over 65 dB measuring at 3 meters from the external wall. The noise levels within the plant rooms and buildings shall not exceed over 85dB measuring at 1 meter from the equipment. The Contractor shall take all necessary measures to meet as-per criteria, including the provision of acoustic panels or enclosures.

Anti-Vibration Mountings and Sound Absorption

The Contractor shall provide and fix all the materials to prevent the transmission of noise and vibration through the structure.

Where appropriate, all the fans, A/C package units, compressors, and other motive plant shall be applied on the resilient mountings so that the plant foundations are isolated from the floor or structure. In addition, all the rotating plants shall be statically and dynamically balanced.

The vibration isolator shall be installed for the motor that can damage other equipment or buildings due to the severe vibrations.

The mechanical vibration shall be eliminated by the use of anti-vibration mountings and flexible connections to ensure an isolation efficiency of 95 % from the building structure.

The machinery vibration shall not exceed the limits defined in the relevant section of ISO.

10.14.5 Checking

After installation, all the equipment shall be checked by the Contractor for correct positioning, alignment, fixing and all items which may affect the normal operation thereof. Before start-up, the following items of work shall be carried out.

Removing all packing materials tape, wood spacers and so on.

Checking lubricant levels, and topping up if necessary

Checking clearance and free turning for rotation shafts and other moving parts.

All other necessary preparation for start-up.

10.14.6 Fixings

Nuts, bolts, studs and washers used in the construction of plant and equipment shall conform to the requirements of the appropriate International, German, British or other approved standard, and shall be of the best quality bright steel, machined on the shank and under the head and nut.

All thread forms shall be to ASME and ISO standards, and bolts shall protrude by 2 to 3 threads from the end of nut (including any locking device to be inserted). Washers shall be used under all bolt heads and nuts.

Black bolts, nuts and washers shall be used for pipework and structural steel erection. Precision bolts, nuts and washers shall be used for the assembly of machines and electrical plant. Stainless steel shall be used for those subjected to the continuous or occasional immersion, for those in corrosive atmospheres, and for those which require removal or adjustment during the maintenance or repair of plant.

In general, bolts, nuts and washers (other than those of stainless steel), pipe hangers and small fixings shall be hot dipped galvanized to ASTM. Screw threads shall be undercut prior to galvanizing to prevent stripping. All nuts, bolts, studs and washers used for the assembly of pipe flanges, structural steelwork or fixings in the damp or humid conditions, shall also be galvanized. Insulating washers and sleeves shall be fitted if necessary to safeguard against galvanic corrosion.

Where screws, bolts, nuts or other similar fixings are used, the back face of flange shall be smooth and flat so that the fixing is perpendicular to the flange. Where the back face of flange in contact with fixings is not flat or true over the full face of fixing, it shall be machined or spot faced. It shall be possible to rotate all screws, bolts and nuts through 180° without interference from adjacent parts.

Fitted bolts shall be a light driving fit in the reamed holes, shall have the screwed portion of a diameter such that it will not be damaged in driving, and shall be marked in a conspicuous position to ensure the correct assembly at Site.

Washers, locking devices and anti-vibration arrangements shall be provided where necessary and shall be subject to the acceptance of Employer.

In the case that bolts pass through the structural members, taper washers shall be fitted where necessary to prevent the bending stress caused in the bolts.

Bolts and studs under the risk of corrosion shall be designed so that the maximum stress in the bolt and stud does not exceed the half of the yield stress of material under all conditions.

The Contractor shall provide all the necessary items such as nuts, bolts, studs, washers, other specified fixings, line, leveling nuts, spacers, bearing plates and frames for setting the equipment as well as all the necessary works for transferring the equipment loads to the ground uniformly.

In order to weld to the adjacent pipework, all the nuts, bolts, studs, screws, washers and seals etc., together with all adjoining flanges or dismantling joints connecting to pumps or valves etc., shall be supplied loose by the pump or valve manufacturer.

All the nuts, bolts, screws and washers used for fixing or adjusting the plant shall be made of brass or stainless steel depending on their location.

All bolts, nuts and screws which are submerged or partially submerged in water shall be made of nickel-bearing stainless steel having a corrosion resistance not less than that of 18% chromium 8% nickel composition.

10.14.7 Fixing of Machinery

Except in special cases (e.g. the plant is mounted on anti-vibration mounts or the special arrangements need to be made to ensure water tightness), the items of plant shall be securely fixed and aligned on a common baseplate or frame.

The common baseplate or frame shall be leveled, aligned and secured before grouting.

10.14.8 Accessories

All the equipment shall have the necessary accessories for operation and maintenance. When the additional or special accessories are indicated in the specification, they shall be mounted or supplied as specified.

10.14.9 Protective Coating

All equipment shall be finished up by a protective coating.

Coating shall conform to the coating schedule defined by the service conditions of the equipment specified below.

The coating thickness shall be more than 200µm unless otherwise specified.

The nonferrous and corrosion-resistant steel surfaces need not be coated by any material other than grease or lubricating oil.

a) Service conditions

- Service Condition A shall apply to all ferrous metals that are submerged or intermittently immersed in sewage, sludge, effluent water or similar corrosive liquids.
- Service condition B shall apply to all ferrous metals in normal indoor or outdoor exposure without exposure to corrosive atmospheres.
- Service condition C shall apply to all ferrous metals subject to corrosive atmospheres.

b) Coating Schedule

Unless otherwise specified, the following list shall apply as a guideline for the application of various coating systems.

Conditions		**Paint Type**
A	Surface Preparation	Blast
	Primer	Tar Epoxy Resin
	Recoating	Tar Epoxy Resin
	Finishing	Tar Epoxy Resin
B	Surface Preparation	Blast
	Primer	Alkyd Resin

	Recoating	Alkyd Resin
	Finishing	Alkyd Resin
C	Surface Preparation	Blast
	Primer	Inorganic Epoxy Resin
	Recoating	Inorganic Epoxy Resin
	Finishing	Inorganic Epoxy Resin

c) Surface Preparation

Surface preparation of ferrous metal surfaces shall be as follows:

Removing the dirt, dust, chalk, oil and rust.

Washing with the detergent or applicable solvent.

Filling and smoothing the imperfections

10.14.10 Motors

a) Materials, Workmanship and Test

Materials, workmanship and test shall conform to the current standards and specifications recommended by KS, JIS, BS, DIN, ISO, JEC, JEM, NEMA and IEC.

b) Low Tension Motor

Low tension motors from 0.1 kW to 150 kW shall comply with the following specifications unless otherwise specified:

- Type : The motor shall be of the squirrel cage, induction, direct starting or reduced voltage starting type.
- Power source : The motor shall be rated for 400 V 3 Phase, 50 Hz operation.
- Insulation : The motor shall be provided with the class E of the said standards or equal insulation.
- Enclosing and protective : The motor shall be of the drip-proof type for indoor service and of the totally enclosed fan-cooled type for outdoor service unless otherwise specified.

High Tension Motor

high tension motor shall comply with the following specifications for motors from 160 kW and bigger except where specified otherwise:

- Type : The Motor shall be squirrel cage, induction, reduced voltage starting type.
- Power source : The motor shall be rated for 11 kV 3 phase, 50 Hz operation.
- Insulation : The motor shall be provided with class B of the said standards or equal insulation.
- Enclosing and Protective : The motor shall be given drip-proof unless otherwise specified.

Single-Phase Motor

The single-phase motor shall comply with the following specifications except where specified otherwise:

- Type : The motor shall be of split-phase induction type or capacitor-start induction type.
- Power source : The motor shall be rated for 230V,50Hz operation.

- Insulation : The motor shall be provided with the class E or equal insulation.
- enclosing and Protective : The motor shall be given drip-proof for indoor service and totally enclosed fan-cooled for outdoor service unless otherwise specified.

10.14.11 Pumps

a) General

Each pump shall be designed and constructed so as to be suitable for the particular liquid to be pumped.

All pumps shall comply with the requirements of ISO, Technical Specification for Centrifugal Pumps - Class I.

Pumps shall be designed to give the specified output against all losses including those relating to the pump.

The Contractor shall match his pump characteristics to the pipe system networks to achieve the highest pump efficiency and reliability.

The pumps shall have a non-overloading characteristic over the complete range of head and flow rate delivered and the drive shall be capable of starting centrifugal pumps against maximum run out conditions.

Each set must be capable of running satisfactorily in parallel with other sets in the system without throttling and by itself, without cavitation or overload under all operating conditions within the system characteristics given, and shall have a sufficient stand-by pump.

Centrifugal pumps shall have head/quantity characteristics which fall continuously from the maximum pressure at closed valve conditions and which are steep in order that variation in head shall have a minimum effect on the flow rate discharged.

The whole pumping unit shall be capable of withstanding without detriment, reverse rotation to a speed that would occur if the pump were to stop when the differential head was at a maximum and the delivery and/or non-return valve failed to close.

Pumps shall be arranged for priming by gravity, via normal suction flow path.

Waterways through pumps shall be smooth and free from recesses and obstructions. Pumps for wastewater and raw water services shall be capable of passing solids:

The head/flow characteristic of any pump shall be stable under all possible operating conditions including parallel operation and with maximum sump surcharge.

The design of the influent path to the sump and the configuration of the sump shall avoid risk of ingesting entrapped air or other condition likely to result in cavitation.

Velocities in the suction and delivery branches shall be sufficiently low to prevent hydraulic turbulence and cavitation within the pump and the pipework and sufficiently high to prevent settlement of any suspended solids.

The pump and its drive motor shall be suitably rated and the characteristic curve selected as appropriate to allow for any increased head, due to sliming, etc., of the rising main, without unacceptable loss of delivery during the lifetime of the pump.

b) Miscellaneous

Cooling and lubrication water pipework shall be fitted with flow indicators where specified.

On horizontal pumpsets fitted with hydraulic balance devices, the couplings shall permit free axial movements of pump shafts under load.

On vertical pump sets where the shaft couplings are of the screwed type, the couplings shall be positively locked.

Automatic float type air valves with cocks shall be fitted in the highest part of the casing or head bend to assist priming. Automatic air valves shall be fitted with pipes to convey leakage back to drains.

The Contractor shall ensure that adequate Net Positive Suction Head (NPSH.) is available to ensure that pumps operate without cavitation under the worst operating conditions.

Indicating pressure gauges each with an isolating cock and snubbers shall be provided on the suction and delivery side of each pump.

c) Performance

Any guarantees given in respect of the output, overall efficiency and NPSH shall be verified with tests in accordance with ISO or ASME at the manufacturer's works in the presence of the Employer. No negative tolerance shall be applicable to the guaranteed values for Flow rate, Head or Efficiency.

For the purpose of this Specification, the following definitions of parameters shall apply:

- Static Head

The difference in level between the free water surface levels on the suction side of the pump and the discharge side of the pump.

- Delivery Main Friction Head

The head required to overcome the friction in the delivery main from the connection with the main external to the pump house to the discharge point.

- Station Losses

The head loss through the suction pipework and valve, delivery pipework and valves, up to the connection with the delivery main external to the Pump Station.

- Overall Efficiency

The work done by the pump (that is, water power) in kilowatts divided by the total power input to the motor in kilowatts. The power shall be based on the total head.

10.14.12 Reduction Gears

Reduction gear under these specifications shall be of cycle type reduction gear of equipment.

The cycle type reduction gear shall be fully enclosed in an oil-tight casing. Mechanism of this reduction gear shall be of a combination of a planet gear and a fixed-internal sun gear. Wear resistance parts shall be in rolling contact. The reduction gear shall consist of casing, ring gear housing, low speed and high speed shafts, low speed shaft roller and shaft pin, and cycloid discs. The cycloid disc namely planet gear shall have cycloid shaped teeth, and the sun gear circular pin teeth. The torque transmitting components of the gear shall be made of high carbon chromium bearing steel. The lubrication shall be in accordance With current practice of manufacturer.

10.14.13 Structural Steel

All structural steel shapes, plates, bars and their products, unless otherwise indicated, shall be in accordance with Rolled Steel for General Structure.

10.14.14 Lubricating oil

The Contractor shall provide lubrications of types recommended by equipment manufacturers, in quantities sufficient for consumption prior to completion, testing and final acceptance. A three-year supply of each lubricant shall also be provided. Equipment lubrication systems shall be such that require attention no oftener then weekly during continuous operation, do not require attention during start-up or shut down, and do not waste lubricants.

10.14.15 Base bolt and nut

The Contractor shall provide base bolts, nuts and washers of necessary and sufficient design to fix mount and base plate at the location appropriate for concrete foundation. Contact part of effective thread shall be 1.5 times of base bolt's diameter. Especially, as long as there are certain notifications or appointments, base bolt for each device of equipment that will be attached to base plates shall be grouted by 40mm thickness at the low part of base plate and have sufficient length to be fixed within structural concrete. All the base bolts, nuts and washer, unless special material requirement were given to them, shall be galvanized steel. Among static devices, Base bolts, that will be applied to wall and ceiling shall be set anchor, and floor base bolts for rotating devices and static devices shall be hook anchor. And base bolt and nut are used, unless otherwise mentioned the stainless steel.

10.14.16 Protective devices

Driving parts, such as coupling, power transmission devices (chain and V-belt), exposed shaft, fan, etc., shall be equipped with proper safety devices including safety cover that comply with safety rules and regulations, in order to secure safety of human, operation and maintenance. Also, they shall be designed to be easy for assembly and disassembly.

10.14.17 Tools

The Contractor shall provide all special tools or sets of tools necessary for installing and dismantling plant and for the maintenance during the Warranty and O&M Period of the machinery and equipment. Such special tools shall be defined as any tool which would not be included within a standard mechanics tool kit. These tools shall be of an adequate number and quality for the training of the operating staff. A list of all special tools proposed shall be included in the relevant schedules.

10.14.18 Spare parts and expendable other material

The contractor shall provide spare parts and expendable other material, which are necessary for the installation, operation and maintenance of equipment specified in the specification for purchase order.

If the list is not indicated in the specification for purchase order, spare parts list shall be submitted with based on the estimated life of abrasive parts. Such list shall indicate the applied location, quantity and unit price of parts.

Spare parts shall be marked with product name and number so to identify their items. Some measures to prevent corrosion and rust shall be taken. Spare parts shall be packed in separate box then be marked as "Spare Part Mark".

The contractor shall supply the necessary spare parts set and expendable other material for 3 years before the completion of construction management.

The list of spare parts refers to the specifications described in the special specifications, and the manufacturer shall separately recommend the spare parts list for optimum operation and maintenance.

10.15 Testing and Inspection

10.15.1 Factory Testing and Inspection Costs

The Contractor shall offer all equipment for inspection examination and factory witness testing and shall give the Engineer seven days' notice that the equipment is ready for operation and of his intention to carry out tests.

Where tests and inspection have been completed to the Engineer's satisfaction and when the test certificates, performance curves, etc. have been checked, the Engineer shall confirm acceptance in writing and the equipment shall not be incorporated in the Works or delivered until this acceptance has been received.

Where witness tests are not required, the test certificate and performance curves shall be forwarded to the Engineer within two weeks after instructions to waive witness tests have been received. On each test certificate, sufficient information to enable the Engineer to issue a release certificate, including the Contract number and pumping station details, shall be given for ready identification of the material or equipment to which the certificate refers. No inspection or acceptance by the Engineer of the equipment or materials covered by the Contract, whether carried out or supplied by the Contractor, shall release the Contractor from any of his obligations under the Contract.

The Engineer reserves the right to require the Contractor to meet any extra costs which are occasioned by failure of the Contractor to comply with the above testing and inspection requirements including the provision of test certificates, curves, sub-orders etc., or which in the opinion of the Engineer are due to insufficient care having been taken by the Contractor or his Subcontractor before presenting the plant for inspection or test. If unauthorized delivery has taken place, the Contractor may be required to arrange for the plant to be returned to the manufacturer for inspection and/or witness testing at the Contractor's expense.

Any equipment used in the testing of the plant shall in all respects comply with the appropriate safety regulations and/or requirements regarding electrical apparatus for the safety of the plant and the men working thereon.

The Contractor shall ensure that all subcontractors are given copies of the Specification.

Full details of the method of testing proposed for each item shall be submitted to the Engineer.

The Contract Prices shall include for the costs of all works tests, including temporary erection, labour, materials, instrumentation, stores, fuel and power used, as may be required during all inspections and tests and for the provision of certified records and curves.

The Contract Prices shall also cover all the costs during works testing including accommodation, travelling expenses and all reasonable expenses, incurred by the Engineer, allowing for individual inspection visits each of a duration of three days.

The above periods are deemed to exclude any necessary re-inspection visits arising from any abortive inspection visits, resulting from the Contractor's failure to comply with the requirements of this Section.

Where needed equipment shall be tested and a certificate obtained by the appropriate government office, such as lifting devices, electricity authority etc.

10.15.2 Test Instruments

The manufacturer shall satisfy the Engineer as to the accuracy of all the instruments used for the tests and if required shall produce recent calibration tests, or otherwise have them calibrated at his own expense by an independent authority.

Kilowatt- and Kilovar hour meters shall be checked for correct rotation and creep tests shall be carried out to ensure that the meter is inoperative with voltage alone if the secondary of the current transformers is left connected with the primary current interrupted.

10.15.3 Factory Test Certificates

Test certificates shall be provided by the Contractor, giving a detailed record of all electrical and mechanical factory tests carried out on the equipment and material.

Copies of certificates of all works hydraulics tests shall also be provided.

The Contractor shall obtain and submit to the Engineer and to other parties as may be directed, within two weeks of completion of any witnessed tests, test certificates and curves of all items certifying that they have been satisfactorily tested and describing and giving full particulars of such tests.

Copies of test certificates of major items shall be included in the Operating and Maintenance Manuals.

10.15.4 Factory Hydraulic Tests

All equipment subject to clear water pressure including pressure vessels, pumps, pipes, fittings and valves, shall be hydraulically factory tested to the pressure where specified or to at least 1,5 times the maximum working pressure.

Certificates of tests for all items shall be submitted.

Any of the hydraulically tested items shall be subject to the Engineer's random item proof re–test and notice of testing dates shall be submitted to the Engineer.

10.15.5 Facilities Inspection, Test and Guarantees

All equipment subject to clean water pressure including pressure vessels, pumps, pipes, fittings and valves, shall be hydraulically factory tested to the pressure where specified or to at least 1,5 times the maximum working pressure.

Full witness testing to the relevant standards and to prove guarantees given may be required for all equipment.

All items of equipment not subject to witness testing shall be temporarily erected at the manufacturer's works, tested for satisfactory operation and offered for inspection.

Certified copies of the manufacturer's test readings shall be submitted to the Engineer prior to packing for shipment. (Pre-shipment inspection)

Such inspection, examination, or testing, shall not release the Contractor, manufacturer or supplier of any item from any obligation.

Whilst the Engineer shall be provided with facilities for witness testing and/or inspection of all items of equipment at the manufacturer's works, he may at his discretion advice that the tests shall proceed in his absence, the tests shall be made as if in his presence, and duly certified copies of test readings shall be submitted.

Where items of equipment are of identical size and duty it may be required, at the Engineer's discretion that a reduced number of the items be subject to witness tests, however, this shall not relieve the manufacturers from the requirement of carrying out the performance tests on all items prior to offering for witness testing.

If after inspecting, examining, or testing any material or equipment, the Engineer shall decide that such items or any part thereof is defective, or not in accordance with the specification or performance requirements, he may reject the said items or part thereof, giving to the manufacturer within a reasonable time, notice in writing of such rejection, stating therein the ground upon which the said decision is based. All retesting shall be at the manufacturer's expense.

As and when the Engineer is satisfied that the equipment shall have passed the required tests he shall notify the Contractor in writing to that effect.

Each pump shall be witness tested as an integral unit for a capacity of 50%, 100% and 110% of the rated capacities (duty points). The factory tests shall include efficiency curves for the above capacities - both for the motors and for the pumps.

Curves for motors may be based on the supplier's efficiency ratings. Factory tests shall be witnessed by the Engineer and Employer.

10.15.6 Co-Ordination of Site Testing Program

The Contractor shall be responsible for coordinating the program of site testing of all items and to ensure that all parties concerned are present during any tests to obligate their responsibilities.

10.15.7 Tests on Completion

After erection is completed and the equipment is running satisfactorily after primarily setting to work the Contractor shall notify the Engineer that he is ready to demonstrate the performance of the facilities. Such demonstration is referred to herein as Site Testing, which shall be witnessed by the Engineer. The Contractor shall then test fully all items of equipment and shall include provision and arrangement of:

- All skilled and qualified operating and test staff for the testing of all equipment.
- Provisions and disposal of all services, lubricants, and fuels and electricity.
- All measuring and testing instruments to demonstrate equipment operates to the fulfilment of the works tests.

All tests shall be carried out by the Contractor under the supervision of and to the satisfaction of the Engineer.

10.15.8 Approved certificates from authorities

The Contractor shall be responsible for providing all skilled personnel for the pre-commissioning and contractual maintenance of the Installations as specified.

Before take-over, the approved certificates must be obtained including the following:

- Nepal Electricity Authority: Approval of installations
- Fire Safety: Fire Brigade
- Any other authority necessary

It is the responsibility of the Contractor to obtain these certificates.

10.16 Pipe work

10.16.1 Protection and Care of Conduits, pipe work, etc.

Before dispatch from the works, equipment shall be thoroughly cleaned and packed to provide protection against damage, deterioration, corrosion and ingress of dirt and be suitable for prolonged storage in a humid atmosphere.

All apparatus shall be stored in a waterproof housing and be examined and cleaned before installation. All open pipe ends whether installed or in store, shall be fitted with plastic caps or suitable protective covering.

Every precaution must be taken by the Contractor to prevent damage or the entry of foreign matter into the plant by other trades.

No claim can be met for damage to plant, pipework or any item of electrical equipment due to the Contractor neglecting these precautions, and all damaged items shall be replaced with new items by the Contractor without any additional payment.

All piping under these specifications shall be installed to the required lines and grades and as closely as possible to walls, ceilings, columns, and other structural parts to occupy the minimum of space. The Contractor shall conform to the following requirements.

All pipes shall be sound and clean before installation.

Piping shall run at right angle to walls, unless noted otherwise.

All piping shall have a sufficient number of joints to allow convenient removal of piping.

Pipe installed shall not cause stress or strain in the line.

All piping shall be rigidly supported from the structures by approved hangers, inserts or supports with adequate provisions for expansion and contraction.

10.16.2 Pipe work General Requirements

The Contractor shall include for the supply, delivery and erection of all pipework and fittings within the buildings, sumps and valve chambers and between all sections of the plant as defined and detailed in this Specification and where indicated in the Employer's Requirements, to form a complete and fully functional installation.

In arranging pipework systems, provision must be made for the convenient removal of Plant from the pipework by the use of flange adapters, unions or conveniently placed bends. Flange adapters shall not be used simply to accommodate misalignment in the fixing or building-in of pipework systems. Flange adapters shall be anchored or tied to withstand maximum possible system pressure.

Where more than one item of Plant is served by a common pipework system, the pipework shall be arranged so that when a single item of Plant has been removed the remaining items can be operated safely without the need to provide any special fixings and supports for the pipework system.

Pipework shall be adequately supported and fastened so that strain is not placed on any pump casing or other associated Plant due to the weight of fixing of the pipework.

Rodding and flushing points shall be provided on pipelines containing sludge or slurry to enable the complete line to be cleaned.

The Contractor shall ensure that the design, fabrication and installation of the pipework shall allow for the misalignment of fixed terminal points by 25mm in any direction.

Adequate provision shall be included to cater for settlement of rigid structures/pipework systems.

Joint pipes, puddle pipes, tees, elbows, flanges, reducers, crosses, etc. to be used in the plant of different diameters, classes and structures shall be supplied, manufactured and erected in accordance with the erection plans, technical specifications and directives of the Employer.

Puddle pipes to be used in water retaining structures shall be placed in the formwork of the walls and cast in with the first stage concrete. Puddle pipes placed in box-outs and cast in with second stage concrete shall not be allowed.

The collar size of puddle pipes, where they pass through water retaining structures or chamber walls shall be the same diameter as the pipe flange and the collars shall be continuously welded to the pipes on both sides of the collar.

Pipes, puddle pipes, elbows, big tee pieces, etc. used in the Works at different diameters, pressures and structures shall be coated with epoxy against corrosion, and buried parts and parts in channels shall be painted with epoxy in accordance with AWWA. Internal linings of pipes shall be as specified in the particular requirements. Coating damage due to welding or during delivery or handling shall be made good, both inside and outside, by using the same coating materials to the satisfaction of the Employer.

All pipework, valves and fittings shall be rated in excess of the maximum pressure they will attain in service including any surge pressure.

The pipework installation shall be so arranged to offer ease of dismantling and removal of pumps or other major items of equipment. Flange adapters shall be supplied and fitted in pipework runs, wherever necessary, to permit the easy removal of valves and other equipment without the need to disturb any adjacent valves or equipment which are fixed in place. A flange adapter shall be included in the suction and delivery pipework of all pumps and adjacent to every valve for easy dismantling unless alternative provisions (such as an adjacent flanged bend) are available. Provision shall be made for a flexible joint arrangement adjacent to all structures.

The ends of pipes for use with flange adapters and couplings shall be faced, squared and sized to the tolerances required by the manufacturer of the coupling.

All loose flanges shall be secured to fixed flanges by suitable tie-bolts.

All pipework shall be adequately supported with purpose made fixings. When passing through walls, pipework shall incorporate a puddle flange or other suitable sealing device.

The final outlet connection of the pipework shall match the connecting point of any external rising main.

Flanged joints shall be made with 3 mm thick full face, fabric reinforced rubber gaskets, pierced to take the bolts, and the face of all flanges shall be machined to give a true angle of90° to the center line of the pipe or fittings.

The whole of the jointing work and materials necessary to fix and connect the pipes, including adequate and efficient pipe supports, shall be included in the Contract.

The hydraulic test pressure applied at the manufacturer's works shall be 2.0 times the design working head, or 1.5 times the maximum working head or pipe rated pressure, whichever is the greater.

All pipework shall be adequately sized to limit the velocity to acceptable levels. Pump suction and delivery pipe velocities shall not exceed 1.5 m/s and 3.0 m/s respectively.

The Contractor shall be responsible for ensuring that the internal surface of all pipework is thoroughly clean before and during erection and before commissioning. Cleaning shall include removal of all dirt, rust, scale and welding slag due to site welding. Before dispatch from the Contractor's works the ends of the pipes, branch pipes, etc. shall be suitably capped and covered to prevent any accumulation of dirt or damage. This protection shall not be removed until immediately prior to connecting adjacent pipes or valves.

After completion of any fabrication, all pipes will be hydraulically tested.

If any alterations involving additional fabrication are made after dispatch, a further hydraulic test will be required on the pipe or piping assembly concerned.

All testing of pressure pipelines related to pipe laying, welding, hydraulics and pressure shall be carried out by the Contractor in accordance with ASTM.

The Contractor shall have the full responsibility for supplying all types of testing equipment for the tests and also for supplying the water for hydraulic and pressure testing the pipelines.

All small-bore pipes shall be blown through with compressed air before connection is made to instruments and other equipment.

The Contractor shall note the necessity for providing flexibility in the pipework at joints in the main structures to allow for differential settlement and thermal stresses which shall not be transferred to the anchor blocks. Flexible joints, collars and cut pipes shall be allowed on all pipework where necessary to allow for some margin of error in the building work. The pipework system shall be so designed to ensure that anchorages at blank ends, bends, tees and valves may be kept to a minimum. The Contractor shall indicate on his detailed drawings any thrust blocks that are required to anchor pipework supplied by him.

During installation, all pipes shall be hung on their respective supports and lined up so that their joint faces are parallel before flanges are bolted together. In making joints, no springing of pipes into position shall be allowed.

Small bore pipes and hoses shall be of non-flame propagating materials. They shall be arranged for easy dismantling for cleaning where appropriate, and if screwed joints or joints formed by solvent welding are proposed for any chemical line, a sufficient number of flanged or flexible joints shall be provided to enable the pipework to be removed in sections without working from one end to the other

of a particular run. Tees and cocks shall also be provided at convenient points for the connection of a pressure water supply to flush pipework through as required.

All pipes and hoses shall be labeled to enable individual lines to be identified throughout their run. Identification markings consisting of single or multiple colored rings painted around the pipe or proprietary self-adhesive colored pipe marking tapes shall conform with the recommendations of ASME where appropriate. Wherever possible, racks or trays shall be fixed to duct walls or walls of tanks and buildings and the pipes shall be fixed to these racks or trays with clips which can easily be removed without dismantling adjacent pipes. The Contract includes for the supply and fixing of all such racks or trays. Full details of the type of hoses, pipes, and racks or trays proposed, shall be provided at the time of tendering.

All necessary supports, saddles, slings, fixing bolts and foundation bolts shall be supplied to support the pipework and its associated equipment in an approved manner. Valves, meters, strainers and other devices mounted in the pipework shall be supported independently of the pipes to which they connect.

All brackets or other forms of supports, which can conveniently be so designed, shall be rigidly built up of steel by riveting or welding in preference to the use of castings.

No point of passage of pipes through floors or walls shall be used as a point of support, except with the acceptance of the Employer.

After the collars and boxes or other fittings have been fixed in position, the floors, walls and roof structure will be made good.

General

Welding of circumferential joints in the pipeline shall comply with the requirements of 1.16.3. and as additionally specified here.

Line-up clamps shall be designed to prevent tears, scars, or indentations of the pipe walls and keep misalignment of pipes at a minimum.

All welding shall be carried out in accordance with specific procedures prepared by the Contractor and approved by the Employer.

Adequate precautions shall be taken to protect welding operations from wind, rain, blowing sand, etc.

Welder Qualifications:

All welders employed on the Works shall be fully qualified and shall have successfully passed all tests required by relevant codes for type of work each individual welder does.

Welder qualification tests shall be carried out in the presence of the Employer or his authorized representative in accordance with Clause 1.16.3.

The Contractor shall provide necessary labor, pipe welding materials, and equipment for performing welder qualification tests on site.

The Contractor shall maintain the list of approved welders agreed upon with the Employer. And no other employees shall perform the welding operations on the permanent Works.

Procedure:

In order to remove dirt, loose mill scale, rust, oil, grease and other matter which may be injurious to the weld, the pipe ends shall be swabbed with the leather or canvas belt disc.

The cleaning of pipe ends shall be performed by the power wire brushing and/or grinding. The damaged pipe ends which no longer meet the joint specifications, shall be re-beveled by a suitable machine.

The pipe ends shall be aligned with the line-up clamps so that the longitudinal weld seams of adjacent pipe are staggered at least 20 degrees.

The stringer bead on pipeline shall be applied by at least two welders welding in the opposite quadrants.

The number of filler and finish beads shall be in accordance with the approved and qualified procedures.

The cross-section of completed weld around the entire circumference of the pipe shall be substantially uniform. The crown surface shall not be below the outside surface of pipe and shall not be raised above the parent metal by more than 1.5 mm.

No welding shall be performed when the shade temperature is below 5°C and unless approved by the Employer who may require the preheating of pipe.

All the joints on which welding is started shall be completed before the end of each day's work. During the night time or when the work is not in progress, the pipe ends of pipeline shall be securely capped with a suitable cover to prevent the entrance of dirt, small animals, water and foreign matter into the pipeline.

Tie-ins shall be carefully aligned to limit the residual and/or reaction stresses after the welding is completed. Tie-ins shall be carried out within the temperature range of 10 to 30°C.

Quality Control:

All the production welds shall be subject to the visual inspection from the Employer. The visual inspections may be carried out at any stage of the welding of a joint.

For each weld, the identification of the welder shall be clearly marked adjacent to the weld. The steel die stamping will not be permitted.

The non-destructive testing will be carried out during the course of the work as required by the Employer. The field welds shall be examined ultrasonically or by the dye penetrant testing in accordance with Clause 1.16.3. The Contractor shall pay for the testing.

The Employer reserves the right to cut out and remove welds using the welder no cost.

The welds, which are rejected by the Employer, shall be cut out and replaced by the Contractor. If the cut out weld does not meet the Specifications on test, the cost for cutting out and rejoining shall be borne by the Contractor. If the weld is in the satisfaction, the cost shall be borne by the Employer.

The welds rejected by the Employer may, at his discretion, be repaired subject to the following:

The filler weld which would penetrate the stringer bead will not be permitted to repair.

The arc burns shall not be repaired by the welding, but shall be removed by the grinding if no reduction in wall thickness is made in excess of 12.5% of the nominal wall thickness.

The Contractor shall maintain all repair records of pipelines with the descriptions and locations of the repair.

The welding together of pipes that have been cut shall be carried out with a single weld if it is practical to pull the pipes into position, otherwise two welds shall be made by setting in a piece of pipe with length of 2.0 m or more

10.16.3 Welding

The welded parts consisting of steel to ASTM or similar materials shall comply with not less than AWS or equivalent standards. The circumferential welds, etc. shall be fabricated and tested in accordance with ASME, AWS or equivalent applicable standards. All joints shall have the plate edges accurately prepared to the appropriate profile for welding. Then the parts shall be assembled and accurately checked before welding. The welding and fabricating procedures shall be such that residual stress is

minimalized and distortion is prevented. Special attention shall be given to ensure that distortion to affect the alignment and operation of the part concerned does not occur after machining.

All the welded parts shall be stress-relieved before machining.

Welding procedures shall be in accordance with AWS.

Each unit shall be fabricated and welded before final machining or other fitting work is carried out. All the fillet welds shall be continuous.

The electrodes of low hydrogen type shall be used, and shall comply with requirements not less than in AWS or equivalent standard for carbon steels and AWS or equivalent standard for stainless steel. The stainless steel electrodes shall be only used for welding stainless steel. Stainless steel to be welded shall be suitably stabilized. The heated storage and ovens shall be provided for the electrodes. The welded stainless steel surfaces shall be cleaned from remaining dirt by a suitable polishing material and shall be polished as other polished stainless steel surfaces.

Only skilled, qualified and tested welders shall be employed. The welders shall be tested in accordance with ASME or other equivalent standard. The detailed records of welding shall be kept, showing the name of each welder against each run in a weld, and any welder produced an unacceptable amount of defects shall be removed until he has passed the test again.

Where the valve bodies, sleeves, etc., are of welded construction, all the longitudinal butt welds in the shell plates shall be completely radio-graphically tested.

For pipelines, at least 10% of the site made circumferential butt welds shall be ultrasonic tested, including the junctions with the longitudinal joints. The remainder of these welds shall be dye penetrant tested and visually inspected.

The ultrasonic testing shall be carried out in accordance with ASME and the Contractor shall propose a standard of acceptance. The site welding shall not proceed more than three days in advance of testing and acceptance.

All the fillet welds shall be tested by ultrasonic, crack detention or other approved means.

The Contractor shall allow for the cost of adequate radiograph examination for the welds of all other items of equipment. The positions to be examined will be indicated by the Employer.

The "International Institute of Welding Collection of Reference Radiographs of Welds" shall be used as a guide for the interpretation of radiographs and as a basis for comparison regarding the nature and extent of weld defects. The minimum grade for acceptance shall be black.

The welded parts or castings, which are subjected to appreciable stress when the plant is in operation, shall receive the appropriate heat treatment where applicable before machining.

Before the manufacturing starts, the Contractor shall provide the Employer the detailed drawings for welding preparations of all parts to be welded and subjected to high stress. No welding shall be settled down until the Employer accepts the proposed details.

The fillet welds shall not have any oxidizing, remains, condensation and cracks. No deterioration shall be seen at the connection points of domes and cylindrical parts due to the size and welding and a perfect welded joint shall be assured.

When the ambient temperature at the welding site is below +5°C, no welding shall be carried out.

10.16.4 Pipe

All the pipe, fittings, bolts, nuts, jointing materials and part for piping under these specifications shall be manufactured in compliance with the standards mentioned below or equivalent.

a) Steel pipes

Applicable Standard

Coating Steel Pipes for Water service

Fitting of Coating Steel pipe for Water Service

Steel Butt-Welding Pipe Fittings for Ordinary Use.

Steel Plate Butt-Welding Pipe Fittings

Joint

The steel pipes shall be jointed with flanges unless otherwise specified.

Coating

The exterior surface of the pipes and fittings shall be coated with the manufacturer's standard coating materials.

b) Small Steel Pipe

(i) Applicable Standard

Galvanized Steel Pipes for Water Service

Carbon Steel Pipes for Ordinary Piping

Screwed Type Malleable Cast Iron Pipe Fittings

Steel Butt-Welding Pipe Fittings for Ordinary Use

(ii) Joint

The small steel pipes shall be Jointed with flanges or screwed couplings.

Coatings

The exterior surface of the pipe, of Carbon Steel Pipes for ordinary Piping, and of the fittings, of Steel Butt-Welding Pipe Fittings for ordinary use, shall be coated with manufacturer's standard coating materials.

c) Poly vinyl Chloride pipes

(i) Applicable Standard

Un-plasticized Poly vinyl Chloride (PVC) pipes

Un-plasticized Poly vinyl Chloride pipe Fittings for Water Works.

Joint

The pipe shall be jointed with flanges or sockets.

d) Polyethylene Pipes

(i) Applicable Standard

Polyethylene pipes for General Purposes

Polyethylene Pipe Fittings for Water Works Service

Joint

The pipe shall be jointed with sleeve joint or other way acceptable to the Engineer.

e) Ductile Iron Pipes

(i) Applicable Standard

Centrifugally Cast Iron pipes for Water Works

Ductile Iron Pressure Fittings for Water Works

f) Stainless Steel Pipework

The stainless steel pipework shall comply with ANSI/ASTM, the operation pressure shall comply with 10kg/cm^2, 20kg/cm^2.

The straight pipes of the minimum wall thickness shall be 2mm and further for a minimum internal working pressure of 10 bar.

The pipe ends shall be calibrated prior to welding in order to maintain a disalignment tolerance between the pipe ends within 20% of the wall thickness at any point of the circumference.

The elbows shall be designed as long, smooth bends with a radius of about 1.5 times the nominal size of the pipe and shall not be made of welded segments.

The tees up to and including an external diameter of 323.9 mm shall be of the pressed type.

Reducers shall, unless otherwise specified, be made with a length L=3×(OD-Od), where "L" is the construction length, "OD" the outer diameter of the large end and "Od" that of the small end. Unless otherwise stated, the wall thickness of a reducer shall be the same as that of the adjacent large straight pipe.

10.16.5 Valves

The sluice valves, butterfly valves and gate valves under the specifications shall be manufactured in compliance with the standards mentioned below or equivalent.

a) Sluice Valves

Sluice Valves for Water works

b) Butterfly Valves

Butterfly Valves for Waterworks

Standards for Rubber-seated Butterfly Valves

Butterfly Valve shall have flange ends. Valve seats shall be mounted in valve bodies unless otherwise specified.

c) Gate Valves

10kg/cm^2,20kg/cm^2Cast Iron Flange Gate Valves

d) Swing type Check Valve

10 kg/cm^2,20kg/cm^2Cast steel Flange Swing Check Valves

e) Diaphragm Valves

Diaphragm valve shall be made of fabricated polyvinyl chloride with diaphragm of neoprene rubber or equivalent suitable materials.

The valves shall be of flanges ends.

10.16.6 Flexible Joints

Flexible joints in steel pipelines will have ANSI/ASTM standards.

Type: It selected in accordance to whether pipelines have the small or large diameter (ex. wire or ribbon type), the large diameter (ex. double suction volute pump) shall be applied with long bolts.

Material: It shall be made of stainless steel.

10.16.7 Flanges

All the flanges on equipment and part under these specifications shall be manufactured in compliance with the following standards of equivalent.

All the flanged connections of pumps, pipe work, valves and other relevant equipment shall have flanges in accordance with ANSI/ASTM standards.

The flanged stainless and steel pipe work shall comply with slip-on type, ASTM.

All the flange shall be applied with AWWA Class D.

20kg/cm^{2}Flange : Basic Dimensions of 20kg/cm^{2}Ferrous Materials Pipe Flanges

10kg/cm2 Flange : Basic Dimensions of 10 kg/cm2 Ferrous Materials Pipe Flanges

7.5 kg/cm2 Flange : Fitting of coating steel pipes for water service

11 MECHANICAL DETAILED REQUIREMENTS

11.1 Kirtipur pumping station

11.1.1 Lyaku Tank (Old)

The Mechanical component of the pumping station shall consist of the following equipments. Details of each equipment shall be designed, manufactured, and installed in accordance with the specificatio ns and drawings set forth hereinafter in this Section.

The equipment mentioned in the following sections shall be equal or above the specification.

The equipment applied in pumping station can change the specification under the approval of the Em ployer and supervisor, if the performance and efficiency of equipment is equal or above the specificat ion.

11.1.2 Equipment of pumping station

MK-101	Clear Water Pump	2 units
MK-102	Check Valve	2 units
MK-103	Discharge Valve (Motorize Butterfly Valve)	2 units
MK-104	Water Hammer Control System	1 units

11.1.3 MK-101 CLEAR WATER PUMP

Functions: Pumping clean water into OHT or TANK

Design factors

Division	Type and specifications	Remarks
TYPE	Vertical multi stage pump	
Capacity	0.84㎥/min	
Head	Minimum 68 mH	
Expected power	Approx. 15 kW	
Power source	400V × 3ϕ × 50Hz	
Efficiency of pump	75% (Shall be proposed by Manufacturers)	
Quantity	2units (Including 1 unit Stand-by)	
Operation type	Water Level interlocking operation & manual operati on	

Design criteria

Pump

The pump shall be a vertical, multistage centrifugal pump, and it shall be direct connection type that t he pump and electric motor are connected directly each other. The inline design enables the pump to be installed in a horizontal pipeline system where suction and discharge ports are on the same horizo ntal plane.

The impeller shall be made of the press forming of stainless steel (SSC13 or above) in order to obtain t he smooth surface with no protrusions, holes and defects.

The shaft is made of STS316. The ring holder can be used to fix the shaft location so that mechanical s eal can be assembled with the shaft easily. The shaft should have a structure that doesn't need adjust ment of tension of M/Seal.

The pump can be maintained without disassembly of connecting pipe as top-pull-out type.

The shaft sealing unit shall be made of FPM O-ring which has the strong resistant to corrosion, oil and heat at the operating temperature above 250℃, and SIC / Carbon with high resistance to temperatur e shock. Also, the shaft sealing unit shall be durable to the fluid with temperature of 120℃ and shall b e completely enclosed to prevent the leakage.

The air vent plug is mounted on the top of the pump casing and shall be able to remove 100% of air g enerated during operation that the dry operation of mechanical seal shall not be accepted.

The casing shall be made of press forming of stainless steel (SSC13 or above) and the round baffle wit h same material shall be applied so that the foreign object inside the casing can be completely discha rged during the operation.

The shaft and impeller shall be able to assemble / disassemble without dismantling the connecting pi pes from the pump.

Motor

The motor is a totally enclosed type model with 400V × 3ϕ × 50Hz
F CLASS (Insulation Grade) andIP55(Ingress Protection Rating) shall be applied.
The electric motor must be manufactured so that it can operate at any point on the performance curv e of the applied pump.
The motor shall have high durability against the frequent operations.

Material

Casing Stainless Steel Cast(A743-CF8, orBS1504 304C15, or SSC13) or Eq.

Impeller Stainless Steel Cast(A743-CF8, orBS1504 304C15, or SSC13) or Eq.

Shaft Stainless Steel (A276-316, or BS1504 316S16, or STS316) or Eq.

Bearing contacting with liquid Tungsten Carbide

Common bed Carbon Steel(A-283C or BS4360-40 or SS400) or Eq

Configurations

Accessories per unit

Common bed	1 set
Pressure gauge & Connection Pipe	1 set
Bolt & nut	1 set
Reducer for Inlet & Outlet	1 set
Standard & Special Tools	1 set
Counter Flange	1 set
Other necessary part	1 set

Spare parts per unit

Impeller Ring	1set
Wear-ring Ring	1set
Shaft Sleeve	1set
Bearing	1set
Mechanical Seal	1set
Other necessary parts	1set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pre ssure of equipment, and provide the equipment after the discussion with the mechanical supervisor i n order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are g uaranteed under the close cooperation with the other fields in terms of the design, manufacturing, o n-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.1.4 MK-102 CHECK VALVE

Functions: To prevent reverse flow when pump suddenly stop.

Design factors

Division	Type and specifications	Remarks
Type	Non-slam, Dashpot with Counter weight loaded type (flange end)	

Size	125mm	
Operating Pressure	10.0kg/㎠	
Quantity	2 Sets	

Design criteria

(i) General

Valve shall be of non-slam, dashpot with counter weight loaded type and shall block the counter flow in order to mitigate the water impact. when counter closed, in case water hammering of max pressure 10kg/cm². The check valve shall consist of a body, disc, stem, seat and dashpot.

(ii) Body

The body shall be made of cast steel or equivalent, and be of streamlined shape in order to reduce the head loss. The cross-sectional area shall be larger than the diameter of flow pipie. The check valve shall be designed for the horizontal piping and the normal pumping operation. The center of gravity for disc stem boss shall be designed to relieve the impact, and the dash-pot shall be installed on the body.

(iii) Disc

Material shall be supplied ductile cast iron or approved equivalent material. Disc shall be supplied steam lined shape to be reduced head loss related to head of fluid when free open.

(iv) Shaft

The shaft shall be made of Stainless Steel (ANSI 410 or above) and whose diameter shall be designed to withstand more than 150% of twist loading placed from the disc.

(v) Seat

The seat shall consist of Body seat and Disc seat. Disc seat shall be made of EPDM, and Body disc shall be made of bronze casting or stainless steel304. Seat shall be able to disassemble and assemble in field. The fixture of seat shall be fitted without any leakages.

(vi) Bearing

The bearing shall be of the sleeve type that fits into the boss of body. The material shall be made of the bronze casting or equivalent.

(vii) Shaft Seal Device

The part of body and shaft shall be applied with V-Packing or O-Ring in order to prevent the leakage. The shaft seal shall be designed to assemble with packing box without disassembly.

(viii) Hydraulic damping system

The hydraulic damping system shall be of the adjustable type, which consists of the cylinders, pistons, piston rods, piston press rams, piston-pulling springs, speed control units and the pressure relief valves. Also, the damping system shall be able to adjust the mounting position for the piston press ram of the piston rod in the desired position within the field.

Materials

Body Cast Steel (A216-WCB, or BS1504 161 Gr480, or SCW410) or Eq.

Disc	Ductile Cast iron (A536-65-45-12, or BS2789 Gr.420/12, orGCD450) or Eq.
Shaft	Stainless Steel(ANSI 410 or STS410) or Eq.
Seat ring	Stainless Steel(A240-304 or BS1501-304S15 or STS304) or Eq.
Cylinder	Cast steel(A27-60 or BS3100 Gr. A1 or SC42) or Eq.
Piston	Forged steel(A105, or BS1503 221-490, or SF45) or Eq.
Piston rod	Forged steel(A105, or BS1503 221-490, or SF45) or Eq.
Counter weight	Cast iron(A48-CL30, or BS1452 260, or GC200) or Eq.

Configurations

(i) Accessories per unit

Floor stands	1 set
Hydraulic damper	1 set
Counter Flange	1 set
Other necessary part	1 set

(ii) Spare parts per unit

Bolt & Nut	1 set
Other necessary part	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pre ssure of equipment, and provide the equipment after the discussion with the mechanical supervisor i n order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are g uaranteed under the close cooperation with the other fields in terms of the design, manufacturing, o n-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.1.5 MK-103 DISCHARGE VALVE

Functions: For pump interlocking and discharge water flow control.

Design factors

Division	Type and specifications	Remarks
Type	Motorized Butterfly Valve (Wafer type)	

Size	125mm	
Operating Pressure	10.0㎏/㎠	
Power source	400V × 3ϕ × 50Hz	
Expected power	Approx. 0.4kW	
Quantity	2 Sets	
Operation type	Pump interlocking operation & manual operation	

Design criteria

(i) General

The butterfly valve shall be of short body type with double flange, which includes the manually operated worm gear, stem cap, gear box and body flange mating. (Or shall be made with the 'tongue and groove joint' method.)

(ii) Body

The body shall be made of cast iron or approved equivalent. The rib shall be provided and installed if the reinforcement of body is necessary. The leg shall be of integral type and be installed at 400mm above. The seat and disc shall be provided in accordance with the conformity criteria. The valve body shall be designed with wafer connection type.

(iii) Disc

The disc shall be made of cast iron or approved equivalent. The disc shall be parallel to the direction of flow when the valve opens. The disc shall be of streamlined shape and provided with the thickness, which is smaller than 2¼ of valve diameter.

(iv) Shaft

The valve shaft shall be made of stainless steel or approved equivalent. The valve shaft shall be configured with either one valve stem that goes through inside or two valve stems inserted from both sides. In case of two valve stem configuration, the size of shaft shall be 1.5 times larger than the disc.

(v) Valve Seat

Seat shall be designed for waterproof under the maximum differential pressure. If the seat material is composed of metal, the disc shall be applied with EPDM. If EPDM is applied on the body, the disc shall be made of metal. The EPDM seat shall be installed with care to avoid any issues. The valve installing at 800mm above shall be able to replace the EPDM parts without disassembly.

(vi) Motorized actuator

The motorized actuator, which is able to remote if necessary, shall be of the integral type as included the strong control with simple system and fast response speed, no out-of-order for long time operation, case, bevel gear, limit switch, torque switch, manual handle, manual & MOV reserve device, field & remote selector switch, open & close switch lamp, digital aperture gauge, and terminal box. The motorized actuator shall have high torque under 3P, 400V, 50Hz and the maximum torque, which is 2.5 times greater than the normal operation. And the actuator shall be able to run for 30 min under the overload. And no other issues shall be occurred from the frequent start and stop sequences. The motorized actuator shall be designed with F class insulation rating without revealing the rotating parts

while the face of casing and flange shall be interconnected each other. The operation shall be shut down if the actuator is overloaded due to the device malfunction occurred by sudden errors. When the motor coil is overloaded, the actuator shall be protected by the temperature sensor. The motor shall be protected even if the problem is occurred from 3P. The actuator shall be able to operate even in the 10 percent of decrease for power supply.

Materials

Body	Cast iron(A-48 CL35 or BS1452 Gr.300 or GC250) or Eq.
Disc	Cast iron(A-48 CL35 or BS1452 Gr.300 or GC250) or Eq.
Shaft	Stainless Steel(A276 403, or BS 420 S29, or STS403) or Eq.
Seat	Bronze casting or Stainless steel304

Configurations

(i) Accessories per unit

Connection spindle	1 set
Limit switch	1 set
Torque switch	1 set
Space heater	1 set
Counter Flange	1 set
Other necessary part	1 set

(ii) Spare parts per unit

Bolt & Nut	1 set
Fuse and lamp	1 set
Other necessary part	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.1.6 MK-104 WATER HAMMER CONTROL SYSTEM

Functions: Water hammer control

Description

The bladder tank protects the pipelines & pump systems against shocks by water hammer that can be caused when the pump accidentally stops due to such as power outage.

Design factors

Division	Type and specifications	Remarks
Type	Vertical cylindrical bladder tank type	
Capacity	500ℓ	
Connection Pipesize	80mm	
Expected power	0.1kW × 230V	
Operating Pressure	10.0㎏/㎠	
Initial air pressure	3.0kg/㎠ (Shall be proposed by Manufacturers)	
Quantity	1 Set	

Design criteria

(i) Bladder tank

The bladder tank is connected with a flange, which is connected to the flanges of main pipe, drain pipe, and all necessary measuring instruments. The tank shall come with all necessary parts to guarantee the performance. Also, an internal pressure shall be easily read with a pressure gauge through the naked eye.

The bladder tank shall be designed, manufactured, and installed according to the standard of ISO or ASME Boiler and Pressure Vessel code. The bladder tank shall be a welded steel plate construction and absolutely leak-proof structure which can withstand the multiple shocks caused by water hammer. The inspection and completion certificate shall be prepared in accordance with the relevant standards.

The bladder tank has a diaphragm inside the tank and a device shall be installed inside the tankto monitor the breakage of diaphragm. If the diaphragm is damaged, the device shall be able to transmit the warning signals to operators

The pressure inside the tank shall be configured at the appropriate design conditions based on the computational analysis considering the site conditions, and able to minimize the water hammer.

(ii) Lop

An electric circuit shall be provided in order to monitor the diaphragm within the pressure vessel, and a terminal capable of transmitting a signal to the outside shall be provided in case of diaphragm breakage.

The primary power is supplied from the electrical work scope to the local operational panel. And the electrical works for the control cable and the secondary power supply to control the units from ancillary devices and local operation panel are included in the contractor's work scope. In addition, the terminals must be provided for manually testing the contacts.

Operating conditions:
Temperature: -10℃~+40℃ (14℉ ~ 104℉)

Test &inspection:
After completing the production, all the required inspections should be implemented at the manufacturer's factory, the test runs &training should also be implemented after the on-site delivery.

(iii) Piping works for valves and accessories

The manufacturer's work scope includes the pipelines and valve works, which are required to connect with the bladder tanks to a companion flange of the branch pipe from main pipeline.

All the required electrical wiring and piping, which are connected to the control panel with the primary power source of 230V, are within the work scope of manufacturer.

The valves shall withstand at the maximum working pressure (equal or above)against the water hammer. Thevalves shall be installed between the connecting pipelines and the pressure vessel. Since the flange is connected to the civil pipeline, it must be selected after consultation.

The opening of the valve is manual and the operation is hand wheel, but the operation force shall be within 20kg.

The finishing coat shall be appropriate for the water supply andshall be applied more than 3 times.

(iv) Pipings

All piping materials shall be ISO standardized products.
The piping shall be installed without bending and durable with the internal and external stress.
The piping except for stainless steel shall be applied with the rust resistant coating for water supply.
The disassembly and assembly of piping shall be convenient for the maintenance.

Material

Tank body Carbon Steel(A-283C or BS4360-40 or SS400) or Eq.

Configurations

(i) Accessories per unit

Pressure Vessel	1 set
Drain Valve	1 set
Diaphragm Monitoring Unit	1 set
Pressure Gauge	1 set
Valve & Piping	1 set
Electrical wiring and piping	1 set
Anchor bolt and nut	1 set
Counter Flange	1 set
Other necessary part	1 set

(iii) Spare parts per unit

Bolt & Nut	1 set
Other necessary part	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are

guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.2 Kwacho Tank (New)

The Mechanical component of the pumping station shall consist of the following equipments. Details of each equipment shall be designed, manufactured, and installed in accordance with the specifications and drawings set forth hereinafter in this Section.

The equipment mentioned in the following sections shall be equal or above the specification.

The equipment applied in pumping station can change the specification under the approval of the Employer and supervisor, if the performance and efficiency of equipment is equal or above the specification.

11.2.1 Equipment of pumping station

MK-201	Clear Water Pump	2 units
MK-202	Check Valve	2 units
MK-203	Discharge Valve	2 units
MK-204	Water Hammer Control System	1 units

11.2.2 MK-201 CLEAR WATER PUMP

Functions: Pumping clean water into OHT or TANK

Design factors

Division	Type and specifications	Remarks
TYPE	Vertical multi stage pump	
Capacity	0.91㎥/min	
Head	Minimum 84mH	
Expected power	Approx. 22 kW	
Power source	400V × 3ϕ × 50Hz	
Efficiency of pump	77% (Shall be proposed by Manufacturers)	
Quantity	2units (Including 1 unit Stand-by)	
Operation type	Water Level interlocking operation & manual operation	

Design criteria

(i) Pump

The pump shall be a vertical, multistage centrifugal pump, and it shall be direct connection type that the pump and electric motor are connected directly each other. The inline design enables the pump to be installed in a horizontal pipeline system where suction and discharge ports are on the same horizontal plane.

The impeller shall be made of the press forming of stainless steel (SSC13 or above) in order to obtain the smooth surface with no protrusions, holes and defects.

The shaft is made of STS316. The ring holder can be used to fix the shaft location so that mechanical seal can be assembled with the shaft easily. The shaft should have a structure that doesn't need adjustment of tension of M/Seal.

The pump can be maintained without disassembly of connecting pipe as top-pull-out type.

The shaft sealing unit shall be made of FPM O-ring which has the strong resistant to corrosion, oil and heat at the operating temperature above 250℃, and SIC / Carbon with high resistance to temperature shock. Also, the shaft sealing unit shall be durable to the fluid with temperature of 120℃ and shall be completely enclosed to prevent the leakage.

The air vent plug is mounted on the top of the pump casing and shall be able to remove 100% of air generated during operation that the dry operation of mechanical seal shall not be accepted.

The casing shall be made of press forming of stainless steel (SSC13 or above) and the round baffle with same material shall be applied so that the foreign object inside the casing can be completely discharged during the operation.

The shaft and impeller shall be able to assemble / disassemble without dismantling the connecting pipes from the pump.

(ii) Motor

The motor is a totally enclosed type model with400V × 3ϕ × 50Hz

F CLASS (Insulation Grade) and IP55(Ingress Protection Rating) shall be applied.

The electric motor must be manufactured so that it can operate at any point on the performance curve of the applied pump.

The motor shall have high durability against the frequent operations.

Material

Casing Stainless Steel Cast(A743-CF8, orBS1504 304C15, or SSC13) or Eq.

Impeller Stainless Steel Cast(A743-CF8, orBS1504 304C15, or SSC13) or Eq.

Shaft Stainless Steel (A276-316, or BS1504 316S16, or STS316) or Eq.

Bearing contacting with liquid Tungsten Carbide

Common bed Carbon Steel(A-283C or BS4360-40 or SS400) or Eq

Configurations

(i) Accessories per unit

Common bed	1 set
Pressure gauge & Connection Pipe	1 set
Bolt & nut	1 set

Reducer for Inlet & Outlet	1 set
Standard & Special Tools	1 set
Counter Flange	1 set
Other necessary part	1 set

(i) Spare parts per unit

Impeller Ring	1set
Wear-ring Ring	1set
Shaft Sleeve	1set
Bearing	1set
Mechanical Seal	1set
Other necessary parts	1set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.2.3 MK-202 CHECK VALVE

Functions: To prevent reverse flow when pump suddenly stop.

Design factors

Division	Type and specifications	Remarks
Type	Non-slam, Dashpot with Counter weight loaded type (flange end)	
Size	125mm	
Operating Pressure	16.0 kg/㎠	
Quantity	2 Sets	

Design criteria

General

Valve shall be of non-slam, dashpot with counter weight loaded type and shall block the counter flow in order to mitigate the water impact. when counter closed, in case water hammering of max pressure 20kg/cm². The check valve shall consist of a body, disc, stem, seat and dashpot.

(i) Body

The body shall be made of cast steel or equivalent, and be of streamlined shape in order to reduce the head loss. The cross-sectional area shall be larger than the diameter of flow pipie. The check valve shall be designed for the horizontal piping and the normal pumping operation. The center of gravity for disc stem boss shall be designed to relieve the impact, and the dash-pot shall be installed on the body.

(ii) Disc

Material shall be supplied ductile cast iron or approved equivalent material. Disc shall be supplied steam lined shape to be reduced head loss related to head of fluid when free open.

(iii) Shaft

The shaft shall be made of Stainless Steel (ANSI 410 or above) and whose diameter shall be designed to with stand more than 150% of twist loading placed from the disc.

(iv) Seat

The seat shall consist of Body seat and Disc seat. Disc seat shall be made of EPDM, and Body disc shall be made of bronze casting or stainless steel304. Seat shall be able to disassemble and assemble in field. The fixture of seat shall be fitted without any leakages.

(v) Bearing

The bearing shall be of the sleeve type that fits into the boss of body. The material shall be made of the bronze casting or equivalent.

(vi) Shaft Seal Device

The part of body and shaft shall be applied with V-Packing or O-Ring in order to prevent the leakage. The shaft seal shall be designed to assemble with packing box without disassembly.

(vii) Hydraulic damping system

The hydraulic damping system shall be of the adjustable type, which consists of the cylinders, pistons, piston rods, piston press rams, piston-pulling springs, speed control units and the pressure relief valves. Also, the damping system shall be able to adjust the mounting position for the piston press ram of the piston rod in the desired position within the field.

Materials

Body	Cast Steel (A216-WCB, or BS1504 161 Gr480, or SCW410) or Eq.
Disc	Ductile Cast iron (A536-65-45-12, or BS2789 Gr.420/12, orGCD450) or Eq.
Shaft	Stainless Steel(ANSI 410 or STS410) or Eq.
Seat ring	Stainless Steel(A240-304 or BS1501-304S15 or STS304) or Eq.
Cylinder	Cast steel(A27-60 or BS3100 Gr. A1 or SC42) or Eq.
Piston	Forged steel(A105, or BS1503 221-490, or SF45) or Eq.
Piston rod	Forged steel(A105, or BS1503 221-490, or SF45) or Eq.
Counter weight	Cast iron(A48-CL30, or BS1452 260, or GC200) or Eq.

Configurations

(iv) Accessories per unit

Floor stands	1 set
Hydraulic damper	1 set
Counter Flange	1 set
Other necessary part	1 set

(v) Spare parts per unit

Bolt & Nut	1 set
Other necessary part	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.2.4 MK-203 DISCHARGE VALVE

Functions: For pump interlocking and discharge water flow control.

Design factors

Division	Type and specifications	Remarks
Type	Motorized Butterfly Valve (Wafer type)	
Size	125mm	
Operating Pressure	20.0kg/㎠	
Power source	400V × 3ϕ × 50Hz	
Expected power	0.4kW	
Quantity	2 Sets	
Operation type	Pump interlocking operation & manual operation	

Design criteria

(i) General

The butterfly valve shall be of short body type with double flange, which includes the manually operated worm gear, stem cap, gear box and body flange mating. (Or shall be made with the 'tongue and groove joint' method.)

(ii) Body

The body shall be made of cast iron or approved equivalent. The rib shall be provided and installed if the reinforcement of body is necessary. The leg shall be of integral type and be installed at 400mm above. The seat and disc shall be provided in accordance with the conformity criteria. The valve body shall be designed with wafer connection type.

(iii) Disc

The disc shall be made of cast iron or approved equivalent. The disc shall be parallel to the direction of flow when the valve opens. The disc shall be of streamlined shape and provided with the thickness, which is smaller than 2¼ of valve diameter.

(iv) Shaft

The valve shaft shall be made of stainless steel or approved equivalent. The valve shaft shall be configured with either one valve stem that goes through inside or two valve stems inserted from both sides. In case of two valve stem configuration, the size of shaft shall be 1.5 times larger than the disc.

(v) Valve Seat

Seat shall be designed for waterproof under the maximum differential pressure. If the seat material is composed of metal, the disc shall be applied with EPDM. If EPDM is applied on the body, the disc shall be made of metal. The EPDM seat shall be installed with care to avoid any issues. The valve installing at 800mm above shall be able to replace the EPDM parts without disassembly.

(vi) Motorized actuator

The motorized actuator, which is able to remote if necessary, shall be of the integral type as included the strong control with simple system and fast response speed, no out-of-order for long time operation, case, bevel gear, limit switch, torque switch, manual handle, manual & MOV reserve device, field & remote selector switch, open & close switch lamp, digital aperture gauge, and terminal box. The motorized actuator shall have high torque under 3P, 400V, 50Hz and the maximum torque, which is 2.5 times greater than the normal operation. And the actuator shall be able to run for 30 min under the overload. And no other issues shall be occurred from the frequent start and stop sequences. The motorized actuator shall be designed with F class insulation rating without revealing the rotating parts while the face of casing and flange shall be interconnected each other. The operation shall be shut down if the actuator is overloaded due to the device malfunction occurred by sudden errors. When the motor coil is overloaded, the actuator shall be protected by the temperature sensor. The motor shall be protected even if the problem is occurred from 3P. The actuator shall be able to operate even in the 10 percent of decrease for power supply.

Materials

Body	Cast iron(A-48 CL35 or BS1452 Gr.300 or GC250) or Eq.
Disc	Cast iron(A-48 CL35 or BS1452 Gr.300 or GC250) or Eq.
Shaft	Stainless Steel(A276 403, or BS 420 S29, or STS403) or Eq.
Seat	Bronze casting or Stainless steel304

Configurations

(iii) Accessories per unit

Connection spindle	1 set
Limit switch	1 set
Torque switch	1 set
Space heater	1 set
Counter Flange	1 set
Other necessary part	1 set

(iv) Spare parts per unit

Bolt & Nut	1 set
Fuse and lamp	1 set
Other necessary part	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.2.5 MK-204 WATER HAMMER CONTROL SYSTEM

Functions: Water hammer control

Description

The bladder tank protects the pipelines & pump systems against shocks by water hammer that can be caused when the pump accidentally stops due to such as power outage.

Design factors

Division	Type and specifications	Remarks
Type	Vertical cylindrical bladder tank type	
Capacity	500ℓ	
Connection Pipesize	80mm	
Expected power	0.1kW × 230V	
Operating Pressure	16.0 ㎏/㎠	
Initial air pressure	5.0kg/㎠ (Shall be proposed by Manufacturers)	
Quantity	1 Set	

Design criteria

(i) Bladder tank

The bladder tank is connected with a flange, which is connected to the flanges of main pipe, drain pipe, and all necessary measuring instruments. The tank shall come with all necessary parts to guarantee the performance. Also, an internal pressure shall be easily read with a pressure gauge through the naked eye.

The bladder tank shall be designed, manufactured, and installed according to the standard of ISO or ASME Boiler and Pressure Vessel code. The bladder tank shall be a welded steel plate construction and

absolutely leak-proof structure which can withstand the multiple shocks caused by water hammer. The inspection and completion certificate shall be prepared in accordance with the relevant standards.

The bladder tank has a diaphragm inside the tank and a device shall be installed inside the tank to monitor the breakage of diaphragm. If the diaphragm is damaged, the device shall be able to transmit the warning signals to operators

The pressure inside the tank shall be configured at the appropriate design conditions based on the computational analysis considering the site conditions, and able to minimize the water hammer.

(v) Lop

An electric circuit shall be provided in order to monitor the diaphragm within the pressure vessel, and a terminal capable of transmitting a signal to the outside shall be provided in case of diaphragm breakage.

The primary power is supplied from the electrical work scope to the local operational panel. And the electrical works for the control cable and the secondary power supply to control the units from ancillary devices and local operation panel are included in the contractor's work scope. In addition, the terminals must be provided for manually testing the contacts.

Operating conditions:
Temperature: -10℃~+40℃ (14℉ ~ 104℉)

Test &inspection:
After completing the production, all the required inspections should be implemented at the manufacturer's factory, the test runs &training should also be implemented after the on-site delivery.

(ii) Piping works for valves and accessories

The manufacturer's work scope includes the pipelines and valve works, which are required to connect with the bladder tanks to a companion flange of the branch pipe from main pipeline.

All the required electrical wiring and piping, which are connected to the control panel with the primary power source of 230V, are within the work scope of manufacturer.

The valves shall withstand at the maximum working pressure (equal or above)against the water hammer. Thevalves shall be installed between the connecting pipelines and the pressure vessel. Since the flange is connected to the civil pipeline, it must be selected after consultation.

The opening of the valve is manual and the operation is hand wheel, but the operation force shall be within 20kg.

The finishing coat shall be appropriate for the water supply andshall be applied more than 3 times.

(iii) Piping's

All piping materials shall be ISO standardized products.
The piping shall be installed without bending and durable with the internal and external stress.
The piping except for stainless steel shall be applied with the rust resistant coating for water supply.
The disassembly and assembly of piping shall be convenient for the maintenance.

Material

Tank body Carbon Steel(A-283C or BS4360-40 or SS400) or Eq.

Configurations

(ii) Accessories per unit

Pressure Vessel	1 set
Drain Valve	1 set
Diaphragm Monitoring Unit	1 set
Pressure Gauge	1 set
Valve & Piping	1 set
Electrical wiring and piping	1 set
Anchor bolt and nut	1 set
Counter Flange	1 set
Other necessary part	1 set

(vi) Spare parts per unit

Bolt & Nu t	1 set
Other necessary part	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.3 Kirtipur OHT (New)

The Mechanical component of the pumping station shall consist of the following equipments. Details of each equipment shall be designed, manufactured, and installed in accordance with the specifications and drawings set forth hereinafter in this Section.

The equipment mentioned in the following sections shall be equal or above the specification.

The equipment applied in pumping station can change the specification under the approval of the Employer and supervisor, if the performance and efficiency of equipment is equal or above the specification.

11.3.1 Equipment of pumping station

MK-301	Clear Water Pump	3 units
MK-302	Check Valve	3 units
MK-303	Discharge Valve	3 units
MK-304	Sump Pump	2 units
MK-305	Maintenance Hoist	1 units

11.3.2 MK-301 CLEAR WATER PUMP

Functions: Pumping clean water with OHT or RVT

Design factors

Division	Type and specifications	Remarks
TYPE	End Suction Single-stage Volute Pump	
Capacity	1.45㎥/min	
Head	Minimum 30 mH	
Expected power	Approx15 kW	
Power source	400V × 3ϕ × 50Hz	
Efficiency of pump	71% (Shall be proposed by Manufacturers)	
Quantity	3units (Including 1 unit Stand-by)	
Operation type	Water Level interlocking operation & manual operation	

Design criteria

The pump and electric motor shall be appropriate for both continuous and intermittent operations. The pump shall be able to operate without experiencing the surge, cavitations and vibration within the pump head.

(i) Casing

The casing shall be made of cast iron (GC 250 or above) without any defect. And the inner &outer surface of casing shall be treated with the smooth surface finish.

The bearing housing shall be made by either split casting or integral type casting, and fastened with the lower casing by using the bolts.

The casing shall be fastened with eyebolts or lifting rings, and the pipe coupler shall be applied for the air extraction.

(ii) Impeller

The impeller is cast steel (SSC13 or above), integral type and shall be statically and dynamically in equilibrium with smooth surface finish.

The external diameter surface, slip surface, boss hole and two boss end surfaces of impeller shall be machined. The impeller shall be firmly fixed to the pump shaft so that the impeller or shaft sleeve do not relatively rotate in the forward or reverse direction to the pump shaft.

(iii) Stuffing box

The mechanical seal must be used for the penetrating part so that complete water tightness is maintained

(iv) Wear ring

The stainless steel (STS 304) wear ring shall be fixed to the casing and impeller respectively and shall be replaceable labyrinth type or L type which the gap flow caused by the difference in pressure between both ends is small. The wear ring shall be fixed with the key to prevent the movement regardless of the rotational direction of impeller.

(v) Main shaft

The main shaft shall be able to transmit the power and shall have the sufficient stiffness against the deflection.

The bolts of main shaft shall be fastened in the direction to avoid the loosening of bolts and shall be fortified with the washers and so on, to prevent the loose nuts.

The waterproof collar kit shall be applied on the main shaft to prevent the water from entering inside the bearings.

(vi) Bearing housing

The bearing housing shall have the sufficient durability against the impacts, which are caused by the operation and shutdown of pump.

The thrust bearing shall be durable to all possible axial thrusts acting on the shaft during the operation.

Bearing shall be lubricated by grease or oil.

The drainage hole and waterproof hole shall be applied so that the water leakage from stuffing box does not enter inside the bearing.

(vii) Coupling

The pump or motor shall be replaceable by removing the coupling without making any changes of other component.

The coupling shall be equipped with spline or other mechanical key for the accurate transmission of power to the shaft.

For the safety, the coupling shall be installed with the coupling guards, which is bolted to the common bed.

(viii) Motor

The motor shall be totally enclosed fan cooled type, and lubrication method shall be totally enclosed type, and shall be installed on the common bed of pump.

(ix) Common bed

The common bed shall be able to support the pump and the electric motor, of which the forces are acting on the structure, and shall be fixed with the anchor bolt on the concrete foundation.

11.3.3 Coating

The coating shall be applied in accordance with the terms of coating and painting from general specification.

Material

Casing	Gray Cast Iron (A48-CL35 or BS1452 Gr260 or GC250) or Eq.
Impeller	Stainless Steel Cast (A743-CF8, orBS1504 304C15, or SSC13) or Eq.
Shaft	Stainless Steel (A240-304 or BS1501-304S15 or STS304) or Eq.
Common base	Carbon Steel (A-283C or BS4360-40 or SS400) or Eq.

Configurations

(ii) Accessories per unit

Coupling (including cover)	1 set
Common bed	1 set
Pressure gauge & Connection Pipe	1 set
Bolt & nut	1 set
Air extraction valve & Drain valve	1 set
Reducer for Inlet & Outlet	1 set
Standard & Special Tools	1 set
Counter Flange	1 set
Other necessary part	1 set

(ii) Spare parts per unit

Mechanical seal	1 set
Pressure gauge	1 set
Other necessary part	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.3.4 MK-302 CHECK VALVE

Functions: To prevent reverse flow when pump suddenly stop.

Design factors

Division	Type and specifications	Remarks
Type	Non-slam, Dashpot with Counter weight loaded type (flange end)	
Size	200mm	
Operating Pressure	10.0㎏/㎠	

Quantity	3 Sets	

Design criteria

(i) General

Valve shall be of non-slam, dashpot with counter weight loaded type and shall block the counter flow in order to mitigate the water impact. when counter closed, in case water hammering of max pressure 10kg/cm². The check valve shall consist of a body, disc, stem, seat and dashpot.

(ii) Body

The body shall be made of cast steel or equivalent, and be of streamlined shape in order to reduce the head loss. The cross-sectional area shall be larger than the diameter of flow pipie. The check valve shall be designed for the horizontal piping and the normal pumping operation. The center of gravity for disc stem boss shall be designed to relieve the impact, and the dash-pot shall be installed on the body.

(iii) Disc

Material shall be supplied ductile cast iron or approved equivalent material. Disc shall be supplied steam lined shape to be reduced head loss related to head of fluid when free open.

(iv) Shaft

The shaft shall be made of Stainless Steel (ANSI 410 or above) and whose diameter shall be designed to withstand more than 150% of twist loading placed from the disc.

(v) Seat

The seat shall consist of Body seat and Disc seat. Disc seat shall be made of EPDM, and Body disc shall be made of bronze casting or stainless steel304. Seat shall be able to disassemble and assemble in field. The fixture of seat shall be fitted without any leakages.

(vi) Bearing

The bearing shall be of the sleeve type that fits into the boss of body. The material shall be made of the bronze casting or equivalent.

(vii) Shaft Seal Device

The part of body and shaft shall be applied with V-Packing or O-Ring in order to prevent the leakage. The shaft seal shall be designed to assemble with packing box without disassembly.

(viii) Hydraulic damping system

The hydraulic damping system shall be of the adjustable type, which consists of the cylinders, pistons, piston rods, piston press rams, piston-pulling springs, speed control units and the pressure relief valves. Also, the damping system shall be able to adjust the mounting position for the piston press ram of the piston rod in the desired position within the field.

Materials

Body Cast Steel (A216-WCB, or BS1504 161 Gr480, or SCW410) or Eq.

Disc	Ductile Cast iron (A536-65-45-12, or BS2789 Gr.420/12, orGCD450) or Eq.
Shaft	Stainless Steel(ANSI 410 or STS410) or Eq.
Seat ring	Stainless Steel(A240-304 or BS1501-304S15 or STS304) or Eq.
Cylinder	Cast steel(A27-60 or BS3100 Gr. A1 or SC42) or Eq.
Piston	Forged steel(A105, or BS1503 221-490, or SF45) or Eq.
Piston rod	Forged steel(A105, or BS1503 221-490, or SF45) or Eq.
Counter weight	Cast iron(A48-CL30, or BS1452 260, or GC200) or Eq.

Configurations

(i) Accessories per unit

Floor stands	1 set
Hydraulic damper	1 set
Counter Flange	1 set
Other necessary part	1 set

(ii) Spare parts per unit

Bolt & Nu t	1 set
Other necessary part	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.3.5 MK-303 DISCHARGE VALVE

Functions: For pump interlocking and discharge water flow control.

Design factors

Division	Type and specifications	Remarks
Type	Motorized Butterfly Valve (flange end)	
Size	200mm	
Operating Pressure	10.0㎏/㎠	
Power source	400V × 3ϕ × 50Hz	
Expected power	Approx 0.4kW	

Quantity	3 Sets	
Operation type	Pump interlocking operation & manual operation	

Design criteria

(i) General

The butterfly valve shall be of short body type with double flange, which includes the manually operated worm gear, stem cap, gear box and body flange mating. (Or shall be made with the 'tongue and groove joint' method.)

(ii) Body

The body shall be made of cast iron or approved equivalent. The rib shall be provided and installed if the reinforcement of body is necessary. The leg shall be of integral type and be installed at 400mm above. The seat and disc shall be provided in accordance with the conformity criteria.

(iii) Disc

The disc shall be made of cast iron or approved equivalent. The disc shall be parallel to the direction of flow when the valve opens. The disc shall be of streamlined shape and provided with the thickness, which is smaller than 2¼ of valve diameter.

(iv) Shaft

The valve shaft shall be made of stainless steel or approved equivalent. The valve shaft shall be configured with either one valve stem that goes through inside or two valve stems inserted from both sides. In case of two valve stem configuration, the size of shaft shall be 1.5 times larger than the disc.

(v) Valve Seat

Seat shall be designed for waterproof under the maximum differential pressure. If the seat material is composed of metal, the disc shall be applied with EPDM. If EPDM is applied on the body, the disc shall be made of metal. The EPDM seat shall be installed with care to avoid any issues. The valve installing at 800mm above shall be able to replace the EPDM parts without disassembly.

(vi) Motorized actuator

The motorized actuator, which is able to remote if necessary, shall be of the integral type as included the strong control with simple system and fast response speed, no out-of-order for long time operation, case, bevel gear, limit switch, torque switch, manual handle, manual & MOV reserve device, field & remote selector switch, open & close switch lamp, digital aperture gauge, and terminal box. The motorized actuator shall have high torque under 3P, 400V, 50Hz and the maximum torque, which is 2.5 times greater than the normal operation. And the actuator shall be able to run for 30 min under the overload. And no other issues shall be occurred from the frequent start and stop sequences. The motorized actuator shall be designed with F class insulation rating without revealing the rotating parts while the face of casing and flange shall be interconnected each other. The operation shall be shut down if the actuator is overloaded due to the device malfunction occurred by sudden errors. When the motor coil is overloaded, the actuator shall be protected by the temperature sensor. The motor shall be protected even if the problem is occurred from 3P. The actuator shall be able to operate even in the 10 percent of decrease for power supply.

Materials

Body	Cast iron(A-48 CL35 or BS1452 Gr.300 or GC250) or Eq.
Disc	Cast iron(A-48 CL35 or BS1452 Gr.300 or GC250) or Eq.
Shaft	Stainless Steel(A276 403, or BS 420 S29, or STS403) or Eq.

Seat Bronze casting or Stainless steel304

Configurations

(v) Accessories per unit

Connection spindle	1 set
Limit switch	1 set
Torque switch	1 set
Space heater	1 set
Counter Flange	1 set
Other necessary part	1 set

(vi) Spare parts per unit

Bolt & Nut	1 set
Fuse and lamp	1 set
Other necessary part	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.3.6 MK-304 SUMP PUMP

Functions: To drain the wastewater in pumps room.

Design factors

Division	Type and specifications	Remarks
TYPE	Submersible Motor Pump	
Capacity	0.1㎥/min	
Head	Minimum 10 mH	
Expected power	Approx 0.75 kW	
Power source	400V × 3ϕ × 50Hz	
Quantity	2 units (Including 1 unit Stand-by)	
Operation type	Water Level interlocking operation & manual operation	

Design criteria

(i) General

The pump and motor shall be capable of pumping within the pre-designated flow range without causing the rapid torrent, cavitation or vibration while maintaining the rating for consistent durability. In order to prevent the turbulence, cavitation and vibration throughout the entire pump operating range, the motor of pump shall not be overloaded on the specific point from the pump characteristic curve at the maximum speed within the stable pump operating range, which is proposed by the manufacturer.
The load correction factor can not be applied for determining the size of motor.
All the rotating parts of pump shall be statically and dynamically balanced in order to prevent the vibr ation during the pump operation. And no resonance shall be occurred at the normal operating speeds during the weight distributing process of equipment.
In any cases, the amplitude of vibration measured at any point of the pump shall not exceed the limits according to the latest edition of Hydraulic Institute or ISO Standards. The excessive vibration can be an appropriate reason for the rejection of equipment.
The whole parts for each pump shall be designed to withstand any stresses that can be possibly imposed during the handling, shipping, erection, and operation.
The end product of equipment shall not have the resonance, the vibration, the noise, and the water leakages beyond operation range, in the middle of the assembly and operation. All the equipment shall be convenient for the disassembly and maintenance.

(ii) Casing

The pump Casing shall be of cast iron or approved equivalent material.

(iii) Impeller

The impeller shall be made of cast iron or approved equivalent material, and be semi-open statically, dynamically, and hydraulically balanced, accurately machined and filed for smoothness.

(iv) Shaft

The shaft shall be made of stainless steel with the ground and polished surface finish. The shaft shall double mechanical sealed, and tungsten-Carbide carbon ring with stainless steel parts, and oil filled chamber to lubricate running faces.

(v) Fasteners

The fastener shall be stainless steel 304 or approved equivalent material.

(vi) Motor

The motor housing shall be cast iron, and hermetically sealed, squirrel cage induction type in oil filled chamber. Power shall be 400V, three phase, 50 Hz.
The motor and pump shaft shall be connected as an integrated model, and provide the waterproof, oil resistant and grounded features as well as the flexible power cord. The motor shall not be overloaded throughout the entire pump characteristic curve.
The motor shall be capable of running dry operation for the extended periods of time without having any damages to the motor or seal.
The design of motor shall be applied with the submersible design and the enclosures at IP 68 or equivalent.

(vii) Motor lead cable

The conductors shall be made of the copper stranded wire and Vinyl or neoprene shall be applied to Jacket. The terminal head grommet shall be of Epoxy sealed Buna - N.

(viii) Others

Except as otherwise indicated, It shall be apply to general specification.

Material

Casing Cast iron(A-48 CL30, or BS 1452 Gr. 260, or GC200) or Eq.
Impeller Cast iron(A-48 CL30, or BS 1452 Gr. 260, or GC200) or Eq.
Shaft Stainless Steel 304(A240-304, or BS1501-304S15, or STS304) or Eq.

Configurations

(i) Accessories per unit

Cab type cable (from equipment to control panel)	1 set
Pressure gauge & Connection Pipe	1 set
Counter Flange	1 set
Lifting chain	1 set
Mechanical seal	1 set
Other necessary parts	1 set

(ii) Spare parts per unit

Mechanical seal	1 set
Other necessary parts	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract shall check the flange specifications in application and the working pressure of equipment, and provide the equipment after the discussion with the mechanical supervisor in order to avoid any issues from the installation.

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

11.3.7 MK-305 MAINTENANCE HOIST

Functions: To maintenance the mechanical equipment.

Design factors

Division	Type and specifications	Remarks
Type	Manual Movable Crane Hoist	
Rated loads	1.0 Ton	
Span	Approx. 3.0 m	
Lift height	Approx. 8.0 m	
Quantity	1 Set	

Design criteria

The manually driven portable monorail gantry crane shall have a chain pulley block, geared trolley, gantry structure with wheel supports at its base. It shall be designed in the way so as to facilitate the installation and maintenance activities.

(i) Gantry Structure with crane legs

The gantry structure shall be the truss type, which is provided with I-beam as a tracking beam at the top, and support the legs with necessary bracing on the either side. The crane legs shall be made of welded structural steel. The connection between the crane leg and the I-beam on upstream side shall be connected with the rigid bolt, and the pivoted pin joint or the semi-rigid bolted joint for the downstream side. The gantry structure legs shall be provided with a pair of wheels and fixing device.

(ii) Girders

The girder (I-beam) shall be provided at the top of gantry crane legs. The allowable deflection for the supporting beam structures under the normal design load shall not exceed more than 1/850 of the span.

(iii) Chain pulley block and geared trolley

The chain pulley block shall be suitable for lifting the loads in the vertical direction by manual operation. The chain pulley block shall be light weight, easily portable for installation, and easy for operation. The chain pulley block consists of top and bottom hook fittings. And the hook on top of chain pulley block shall be hung on the hook of geared trolley equalizer pin. The lifting hook shall be of the swivelling type which rotates freely during the lifting, and the rigging hook shall be placed on the other end.

The length of chain shall be over 2 times greater than the total head and have the sufficient margins when the hook reaches down to the designated point.

The release prevention mechanism shall be applied to prevent the loads from falling off the hoist.

The manual grease lubrication shall be applied to the bearings and the grease sealing shall be applied where the grease refuelling is not available.

The monorail trolley shall be mounted on the end flange of tracking beam (girders) in the appropriate size. The trolley shall consist of gears, wheels and hand chain. The reciprocating motion of geared trolley shall be available when the sufficient power is acting on the hand chain. The geared trolley shall be easily towed with the specially-designed contoured wheels through the I-beam of gantry structure. The trolley shall be adjustable to fit into the flange widths of beam.

Material

The materials shall be suitable for the own purposes, and comply with the latest standards or the approved equivalent standards. The specific materials shall not be designated. And the use of alternative materials with corresponding or higher quality and properties shall be subject to the approval of Engineer.

Frame	Shape and steel plate or Carbon Steel or eq.
Gears	Cr-Mo alloy Steel or eq.
Hook	Forged Steel(A105, or BS1503 221-490, or SF45) or Eq.

Coating

The coating shall be applied in accordance with the terms of coating and painting from general specification.

Test & inspection

Following type of tests shall be performed on the lifting arrangement.

(i) Proof test

The chain pulley block shall be subjected to the proof load of 1.5 times the working load limit through the lifting length with ensuring that the load is acting on every part of the block mechanism and each gear tooth. When the test is carried out through the operation of hand chain wheel by power, the load shall be lifted and lowered by hand through the distance to prove satisfactory working of the mechanism of the block.

(ii) Load test

The load test for chain pulley block shall be carried out between 100% through 125% of the working load limit during the lift and release.

(iii) Type test

Any breakage or distortion of material shall not be occurred from the test during the load release.

(iv) On-site testing and inspection

Main dimension &appearance inspection
Test run
Performance Testing

Configurations

(i) Accessories per unit

Hoist & parts	1set
Portable lifting frame	1set
Hand chain	1set
Load chain	1set
Geared trolley with hand chain	1set
Gantry frame with wheels	1set
Standard & Special Tools	1set
Lubricating tools	1set
Other necessary parts	1 set

(iii) Spare parts per unit

Grease (18 lit.)	1 set
Other necessary parts	1 set

Others

Except as otherwise indicated, It shall be apply to general specification.

Notes

The vendor under the contract regards the completion of work if the fully functional equipment are guaranteed under the close cooperation with the other fields in terms of the design, manufacturing, on-site delivery, installation (On-site engineer provides the technical support in case of the installation by other constructor), test run.

12 ELECTRICAL WORKS

12.1 General

12.1.1 Overview

This document outlines the electrical requirements for the construction of various pumping station at Kathmandu.
This specification covers the requirements for all electrical systems to ensure consistency and compliance with site requirements.

12.1.2 Scope

The scope of the electrical works of Pumping Station is described in the following sections.
The scope of electrical works covers the design, manufacture, testing at manufacturer's works, delivery up to site, complete erection, final checkup, painting, testing, commissioning, and performance guarantee test of various electrical equipment and accessories.

a) Incoming power supply from NEA 11 KV Distribution
b) 11/0.400 kV Distribution Transformer
c) Emergency diesel generator with integrated control panel and diesel tank
d) 400V Motor Control Center
e) Power and control cables
f) Ladder type cable tray and conduits
g) Power and lightings (indoor and outdoor) of pump house
h) Earthing system
i) Lightning protection of pump house

The electrical works consists of:

- Contractor shall be Supply it, it is all necessary for power supply to pumping station from NEA medium voltage network (11kV)
- Supply and installation of Transformer for Pumping Station
- Supply and installation of all necessary power cables from Transformer and LV panel(Motor Control Center) in the electrical room including connection to the emergency Generator.
- Supply and installation of a diesel generator set for Pumping Station including built-in panel, fuel tank.
- Supply and installation of all complete necessary cable systems for all electrical installations, pumps and controls as described in the specifications and the drawings including indoor and outdoor lighting system and sockets.
- Supply and installation of earth connection equipment, lightning protection and equipotential bonding connections.
- Supply and installation of Main Control Panels, distribution panels and LV panel/Main Distribution Boards.
- Supply and installation of complete cable tray/ladder System.
- Supply and installation of conduits, boxes, terminal points for the motors, starters and controls.
- Arrangement of permanent power supply from NEA by submission of necessary documents and acquisition of all necessary approvals.
- Any work which can be reasonably inferred as necessary for the safe and satisfactory operation of each electrical part whether such work is specified or shown on drawings or not.
- The Contractor shall include own temporary power supply for construction until commissioning.

Drawings for electrical works are intended as indicative drawings only. The contractor shall make detailed designs of all electrical works based on the indicative drawings and the specifications and shall submit this design to the Engineer for approval.

The Project shall be connected to the distribution line for power supply. The Contractor will be expected to secure electricity for the operation of the Project from NEA. The Contractor is responsible for constructing the electricity connections from specified connections points to the Pumping Station. Required transformers, main electrical switchboards, substations metering units, etc. are to be provided by the Contractor.

The Contractor shall consider that cost of connection to the power supply network shall be completed by provisional sum after Employer's approval.

Provisional Sum : Incoming power supply from NEA 11 KV Distribution line (HT metering, Double pole, LA, DO Fuses, transformer installation and earthing's).

12.1.3 Existing Condition

The Contractor is advised to visit the sites to be familiarized with the existing conditions. Because the site is currently under construction, Existing facilities can be changed.

12.1.4 Design

Manufacturing drawings and calculations shall be provided as specified in the General Technical Specification Requirements.

12.2 Specific Requirements

The Electrical Installation Contractor, herein referred to as the 'Contractor' within this section and all other sections of this specification shall carry out all electrical works complete in accordance with the requirements of the Contract Documents. Works in all respect shall be completed under the direction of the Engineer.

12.2.1 Ambient conditions

Field installation works shall be based on the following environmental conditions;

- Location : Kathmandu City, Republic of Nepal
- Relative humidity : Max.84%, Min.37%.
- Extreme temperature range : -3.3° C to +36° C
- Ambient temperature : 45° C
- Elevation : 1300-1400 Meters above sea level.

12.2.2 System Design Parameters

The electrical equipment's / items selected for this work shall be suitable for operation of technical parameters specified below:

- Incoming Power Supply : AC, 11kV, 3Ph, 50 Hz
- Low distribution voltage : AC, 400, 3Ph, 4 wire, 50 Hz
- Lighting and Socket : AC, 230V, 1Ph, 2 wire
- Switchgear control circuit : DC, 110 V, 1Ph, 2 wire
- AC control : AC, 230V, 1Ph, 2 wire
- Voltage Variation : + 10%; -10% of rated voltage
- Frequency Variation : ± 5% of rated frequency
- Voltage drop shall be limited as follows : Maximum Allowable System Voltage Drop
  Service/Branch Feeders : 2%
  Branch circuits : 3%

12.2.3 Codes and Standards

All electrical equipment, design, materials, manufacture, testing, inspection and performance shall, unless otherwise specifically mentioned in this Specification, conform to the authorized latest Standards by IEC.

IEC : International Electric technical Commission

Other internationally acceptable national standards equivalent to IEC may be considered.

If the contractor offers, materials or equipment which conforms to standards other than the IEC and those stipulated in this Specification, full details including copies in the English language of such standards, grade and class, shall be submitted for approval. Such standards, if approved, shall be incorporated in the Contract, in all other cases IEC standards and the standards specified in these

documents shall be strictly adhered to.

ANSI : American National Standards Institute
NEMA : National Electrical Manufacturer Association U.S.A
EN : European Standards
NEC : National Electrical Code
IEEE : Institute of Electrical and Electronics Engineers
ISO : International Standard Organization
BS : British Standards

12.2.4 Quality Assurance

All supplies and services offered in response to this specification shall conform to the latest standards. The design, equipment and installation requirements shall comply with the standards and recommendations lay down by the following:

- Regulations for Electrical Installations as issued by the supply authority.
- Standards relating to Electrical Installations and equipment as issued by International Electro-technical Commission.
- Any other related standards approved by owner(supervisor)

12.2.5 Submittals

12.2.5.1 Shop Drawings

a) Provide shop drawings, to a scale not smaller than the corresponding layout drawings, showing the following:

Submit dimensional drawings of all the switchgears, switchboards and motor control centers, including sections and elevations

Single line diagram, three line diagram and sequence diagram of all the switchgears, switchboards and motor control centers.

- Exact runs and sizes of conduits, ducts, cables, cable trays and trunking.
- Layout drawings for each separate electrical installation showing the actual locations of points, suitably identified, the locations of switchgear, switchboards, motor control centers and distribution boards, details and types of fittings.
- Plans showing the equipment assembly, space requirements, clearances and locations for cable entrances and anchor bolts.
- Elevations showing all parts, devices, components and nameplates, positions and arrangements of the equipment. Show as many elevations as necessary to clearly depict component and device arrangements.
- Schedules of points, indicating how the various outlets are connected to the distribution boards, size of circuit wiring, the rating of the protective device and the type and size of appliance of fitting.
- Schematic diagram of connections of distribution boards, and equipment to main switchboards showing sizes of feeders, etc.
- Schematic and elementary wiring diagrams, of each unit of each equipment, showing numbered terminal points, numbered wires and numbered interconnections to other equipment and remote devices.
- Connection wiring diagrams, each unit of each equipment, showing numbered terminal points, numbered wires and numbered interconnections to other equipment and remote devices.
- Complete catalogue information of all parts and components of electrical equipment.
- All cable routings and layouts for the different electrical services, feeders and branch circuits showing routes, sizes and types of cables.

- Any other data necessary for the proper maintenance of the installations.

b) An over current protective device coordination study that shows all protective devices to be properly coordinated shall be submitted with the equipment shop drawings for approval.
c) Final coordination of electrical works with mechanical, structural and architectural work shall be carried out from complete shop drawings and sufficient time shall be allowed for coordination and checking of shop drawings and calculations after shop drawings are submitted.
d) Individual shop drawings shall bear a stamp indicating that the work has been coordinated with other trades.

12.2.5.2 Progress Drawings

a) Provide and keep on the job at all times, one complete and separate set of black line prints of the electrical work on which shall be clearly, neatly and accurately noted, promptly as the work progresses, all architectural and electrical changes, revisions and additions to the work. Whenever work is installed other than as shown on the Contract Drawings, such changes shall be noted.

b) Indicate daily progress on these prints by colouring in the various conduits, ducts, trunking, cable trays, fixtures, apparatus and associated installation works erected.

12.2.6 Job Conditions

a) Lay electrical works in advance of pouring concrete slabs and construction of walls. Obtain Engineer's approval before commencing builder's work in connection with electrical installation; related shop drawing, coordinated drawing and materials should be approved prior to the work commencement.
b) Before the permanent electricity supply is connected the electrical installations must be complete, tested and approved by the Engineer and the supply authority.

12.2.7 Segregation of Services

Electrical services shall be segregated as specified throughout the installation to obviate the following:

- Electrical interference from one circuit to another.
- A fault on one circuit affecting another.
- Difficulties in circuit identification.
- Voltage limits for general safety.

12.2.8 Delivery, Storage and Handling

The Contractor shall include for packing, shipment and delivery to site of all equipment and materials necessary for the completion and satisfactory working of the installation. Each item shall be adequately protected and packed and be clearly marked to ensure the safe conveyance and delivery to site.

12.2.9 Products

12.2.9.1 Materials

a) All equipment and materials used in the electrical installation work shall be new and of the highest quality to the best modern practices. All materials shall be approved types, supplied by approved manufacturers and shall be fully suitable for use in the conditions stated.
b) All electrical materials and equipment shall comply in all respects (design, properties, qualities, testing, etc.) as a minimum with the latest International Electro technical Commission

recommendations. Should there be and difference between the IEC and this Specification, then the most stringent requirements shall apply.

c) Component parts of similar use and rating shall be interchangeable with each other.
d) All manufactured items shall be the product of manufacturers regularly engaged in producing works of the types specified and be constructed and finished by the same manufacturer.
e) All manufactured items shall be free from imperfections and defects which may impair their durability and serviceability or affect their appearance.

12.2.9.2 Labels

a) For substations, switchgear, switchboards, motor control centers and panel boards engraved name plates. The text shall be in Nepali or English.
b) Wiring Identification
   Identify wiring with permanent indelible, wrap-around, identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
   - Maintain phase sequence and colour coding throughout.
   - Use colour coded wires in communication cables, matched throughout system.
c) For Doors
   - Where switchboard rooms, cable chambers, metal screened spaces and the like contain electric power cables, bus bars or equipment operating at voltages exceeding 600 V: enamelled sheet metal, red on white, reading "Danger - High Voltage".

12.2.9.3 Standard Products

Where two or more units of the same class of equipment are required, these units shall be product of a single manufacturer.

12.2.9.4 Mounting Height of Accessories

a) Unless indicated otherwise, the mounting height of accessories shall be as indicated below. Mounting heights shall be measured between the centre line of the item concerned and the finished floor level.
b) The following is the schedule of mounting height:
   - Lighting switches, equipment and pushbuttons, and any other item containing manual controls for the operation or regulation of any system or facility, shall be mounted at 1200 mm above finished floor level, unless indicated otherwise.
   - Socket outlets shall be mounted at 300 mm other than in kitchens and switch rooms. The sockets above any work bench, where socket outlets shall be mounted at 1200 mm above finished floor level.

12.2.9.5 Accessories

a) Accessories installed throughout the Contract Works shall, unless indicated otherwise, match in colour, style and manufacture. Situations where this is impracticable shall be brought to the Engineer's attention prior to work being put in hand.
b) The cover plates of flush-mounted accessories shall be fixed square and flush with the building surface.

12.2.9.6 Fixings

a) Unless indicated elsewhere in the Specification or on the Drawings, the Contractor shall provide and make all fixing to the Facility for all services included in this Contract.
b) All metal fixing devices shall be zinc or cadmium plated, sheradized or hot dipped galvanized including any expansion shields, plugs, nuts, washers, etc., associated with the fixing devices.
c) The Contractor shall carry out any drilling and plugging for screw fixings of pipe work, raceways, cable trunking, ducting, wiring, conduit fittings, accessories and finishing trims

supplied under this Contract.

d) Supports or equipment installed by other trades shall not be used except with the permission of the other trades and approval of the Engineer.
e) Purpose made fixing clips and brackets may be necessary in certain areas and the Contractor shall be deemed to be aware of this at the time of tendering and to have included for the supply and fixing of same in this Tender Bid.
f) Details of proposed clips and/or brackets shall be submitted to the Engineer for approval, prior to the manufacture of same being commenced.
g) Holes shall not be drilled in any structural steelwork or prestressed concrete without first obtaining the approval of the Engineer.

12.2.10 Execution

12.2.10.1 Workmanship

a) Entire work provided in this specification shall be constructed and finished in every respect in a workmanlike and substantial manner. The Contractor shall provide the system in accordance with the best trade practice and to the satisfaction of the Engineer.
b) Keep others fully informed as to the shape, size and position of all openings required for apparatus and give full information sufficiently in advance of the work so that all openings may be built in advance.
c) Obtain detailed information from the manufacturers of apparatus as to the proper method of installing and connecting same. Obtain all information from others which may be necessary to facilitate work and the completion of the whole project.
d) Before installing any work, verify that it does not interfere with clearance required for other work. Notice of adverse conditions shall be forwarded in writing to the Engineer before any work in question is installed. If notification is not made, and work installed causes interference with the contemplated design, make such changes in his work as directed by the Engineer to permit the installation of all work of the project, at no additional cost to the Employer.
e) All equipment and accessories shall operate without objectionable noise or vibration.
f) Wherever possible services shall not cross expansion joints. Where this is unavoidable the services shall accommodate the design movement without damage, by use of approved expansion couplings/flexible conduit arrangement.

12.2.10.2 Protection

a) The Contractor shall be responsible for his work and equipment until finally inspected, tested and accepted, carefully store materials and equipment, which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.
b) Protect exposed live equipment during construction for personnel safety.
Shield and mark live parts "LIVE 230 VOLTS"

12.2.10.3 Layout of the Work

a) The electrical drawings show the general arrangement of the work and the approximate locations of equipment. Refer to all other drawings to verify all spaces and conditions affecting work of this section. The construction of the facility in certain places may disclose the inaccessibility of equipment apparatus if placed in locations shown on the drawings.
b) Where departures from the drawings are deemed necessary, details of such departures and reasons therefore shall be submitted to the Engineer for approval.
c) No such departures shall be made without prior written approval of the Engineer.
d) Conduit and ducts shall be run in wall chase, pipe shafts and ceilings except where indicated otherwise. Arrange work accordingly.
e) All equipment and apparatus such as motors, switchgear, switchboards, motor control centers,

panels, controls etc., shall be installed as to be readily accessible for operation and maintenance.

12.2.10.4 Fireproofing

a) Establish from Drawings where fire and smoke barriers exist, and make adequate provision of fire and smoke barriers in and around trunking, conduits, cables, etc., where they pass through floors and fire rated walls, and where inert gas smothering systems are installed pack space between wiring and sleeve full with suitable material and seal with caulking.
b) The Contractor shall ensure that this work is carried out such that the integrity of any such fire barrier is properly maintained where pierced by electrical services.

12.2.10.5 Testing and Commissioning

a) General
   - The Engineer shall be authorized to inspect, examine and test at any reasonable time and in the premises of the manufacturer the quality of the material used for the equipment to be supplied.
   - Should part of the equipment be subcontracted to another manufacturer, the Contractor shall ensure that the Engineer is authorized to inspect, examine and test the equipment in the premises of the Sub-Contractor.
   - These inspection, examinations and tests shall not relieve the Contractor in any case from this contractual responsibility and commitments.
   - The Contractor shall notify the Engineer in writing at least 15 days beforehand of the date and place at which any equipment shall be available for tests to be made according to the provisions of the Contract. Should the Engineer not have appeared at the place indicated within ten days following the date indicated by the Contractor, the latter shall proceed with the tests and it shall be deemed that they had been witnessed by the Engineer. The Contractor shall send the Engineer duly certified copies of the results of the tests.
   - The Engineer shall notify the Contractor of his intentions to attend the test 24 hours beforehand.
   - Should the Contract provide for tests to be made in the premises of the Contractor or any Sub-Contractors or suppliers. The Contractor shall afford any assistance, labour materials, electricity, fuel supplies, equipment and instrument required and which can be reasonably requested for these tests.

b) Testing
   - On completion of the entire electrical installation work or any separate or distinct part thereof, notify the Engineer, in writing, that the complete part of the electrical work is ready for inspection. Before doing so, perform initial trial tests. Test, correct, adjust, balance, and regulate, etc., the section concerned as necessary until required conditions are obtained.
   - Supply all instruments and tools required for carrying out the tests.

12.3 Power Incoming

11KV Medium Voltage is the rated voltage from NEA D/L to Pumping Station through H-Pole with LA, DoF, ToD Meter.

The location of the 11kV incoming point can be changed by the status of the distribution line of NEA.

12.4 Power Transformers

12.4.1 General

The specification covers the design, engineering, manufacture, testing, supply, installation and

performance requirements of three phase, 11/0.400 KV,50 Hz, copper wound Distribution Transformer for outdoor use in water supply pumping stations.

Transformers shall be oil immersed, hermetically sealed, naturally cooled, core type suitable for outdoor installation.

The transformers shall be mounted on a steel structure fixed on double pole (Hot dip galvanized steel tubular, 11meter pole) structure.

12.4.1.1 Standards

a) Transformers shall be manufactured and tested to comply with IEC 60076.
b) Transformer oil shall be to IEC 60296.

12.4.1.2 Quality Assurance

The manufacturer shall have quality control conforming to the relevant parts of ISO 9000. Proof of compliance verified by an independent inspection agency shall be submitted with the offer.

12.4.2 Products

12.4.2.1 Ratings

a) Transformers shall be rated as described in the Particular Specification.
b) Ventilation pattern shall be oil natural, air natural, ONAN.
c) The impedance voltage of the transformer shall be not less than 4 %.

12.4.2.2 Transformer Duty

The Contractor shall furnish the transformer manufacturer with the single line diagrams indicating the types and sizes of the loads connected to the transformers

12.4.2.3 Winding Connections

a) The windings shall be connected HV delta, LV star in accordance with vector group reference Dyn 11 of IEC 60076.
b) The star point of the secondary windings shall be brought out through the tank and suitably terminated in a separate housing for solid earthing in addition to the neutral connection.

12.4.2.4 Tappings

a) Tapping control shall be by means of a manual, externally operated, off-circuit tapping switch complete with tap mechanical tap position indicator.
b) Locking facilities shall be provided for the switch such that the lock can be inserted only when the switch is in a definite tap position.
c) The tap changing selector shall be located below the oil level inside the tank and the selector operating rod shall be external outside the tank.

12.4.2.5 Construction

a) The core shall be constructed from cold rolled grain oriented (CRGO) silicon steel sheets laminations.
b) The windings design and construction shall provide adequately designed and located coolant flow ducts so that possible hot spots are eliminated. Windings shall be braced to withstand dynamic stress due to short circuit conditions.
c) The core and winding shall be designed so that the iron loss is at a minimum but the ratio of copper loss to iron loss shall be in accordance with an economic design and the manufacturer

shall state the ratio used.

d) The arrangement of internal connections shall be such that the transformer core and windings may be lifted bodily from the tank without disturbing the insulators.
e) The transformer tanks shall be constructed from high grade steel with electrically welded seams.
f) Tank shall be mounted on a steel structure.
g) The tank shall incorporate lifting eyes suitable for the mass of the transformer and oil.
h) The tanks shall be provided with external cooling tubes or fins to provide natural cooling under the climatic conditions.
i) The tank covers shall be of such construction as will prevent the accumulation of moisture and shall be bolted to a flange on the tank top to form a weatherproof seal. All gaskets shall be of synthetic rubber and cork compositions. The tank tubes and all steelworks shall be shot blasted internally and externally before painting and a rust inhibiting paint shall be applied to both external and internal surfaces before applying a final finish. The exterior shall be given an additional coat on site of a durable oil and weather resisting paint.
j) The design and construction of the transformer core winding and tank shall ensure that the noise level at full load is kept to the minimum consistent with economic design. The tank shall be reinforced or braced where necessary to reduce the noise level.
k) The complete transformer arranged for service shall be capable of withstanding the specified impulse voltage on the HV windings.
l) All windings, winding terminals and connections shall be fully immersed in oil under all operating conditions and materials shall be suitable for this duty and not be subject to deterioration from contact with oil.
m) The windings shall be thoroughly dried out under vacuum at the manufacturer's works and shall be delivered to Site filled with oil to the normal level and ready for service.

12.4.2.6 Fittings

In addition to the standard fittings as per IEC, the transformer shall be fitted with the following:

a) Thermometer pocket for oil temperature.
b) 200 mm diameter dial type oil thermometer.
c) Oil level gauge clearly visible from ground levels.
d) Tank filling and drain valves.

12.4.3 HV and LV Terminations

a) The HV insulated ACSR conductor termination suitable for upto 120 mm2 cable or conductor.
b) The bushings shall be replaceable without having open the tank cover.
c) The LV cable terminations shall consist of 3 phase and 1 neutral bushings mounted for receiving upto 300 mm2 single core (two nos.) XLPE / PVC cables

12.4.4 Eatrthing

a) The transformers shall be connected to the earth electrode.
b) All metallic enclosures, tanks, fittings and accessories must be bonded together and connected to the earth electrode.
c) The transformer secondary winding star point/neutral shall be connected to earth electrode.

12.4.5 Transformer Installation

a) HT and LV cables to the transformers shall be supported on galvanized steel conduit or HI-PVC conduit, cable tray.
b) If applicable, outdoor Hit Shrink Cable End Kits shall be used with the H.T cables.
c) Transformer shall be installed as per recommendation of local power supply authority (NEA)

12.4.6 Testing

The purpose of testing is to prove the validity of all technical data and sound performance of the transformer.

a) Type and routine tests shall be carried out in accordance with IEC .
b) All test shall be carried out as per procedures recommended by the local power supplier (NEA)
c) Routine tests shall be carried out in accordance with IEC, including:
   - Measurement of winding resistance (1)
   - Voltage ratio measurement (2)
   - Check of voltage vector relationship (3)
   - Measurement of impedance voltage and load losses (4)
   - Measurement of no-load loss and current (5)
   - Insulation resistance measurement (6)
   - Separate-source voltage with stand test (7)
   - Induced over voltage with stand test (8)
   - External construction inspection (9)
   - Check of oil leakage (10).
d) All the above tests shall be carried out at the transformer manufacturer's factory. Only tests 6, 9 and 10 need to be repeated on site.
e) Type Tests
   - Temperature rise test on the transformer.
   - Impulse withstand test on the transformer shall be applied on the HV winding leg only and shall be in accordance with IEC.
f) Short circuit test need not be performed if already performed on a transformer of the same rating and similar construction. Type test result shall be made available.

12.5 Stand-By Generator (Diesel Generator)

12.5.1 General

This specification describes of generator set together with its accessories which are to be installed in the generator set.

The specification covers the design, supply, installation, testing and commissioning of Three phase 400 V, 50 Hz, Diesel engine operated generator suitable for in house installation with control panel for providing stand-by source of power supply.

The Contractor shall supply, install, commission, test and handover in good operable manner and maintenance, diesel generator as indicated in the Particular Specification and as indicated on the drawings.

12.5.1.1 Standards

All materials and equipment, fabrication and testing shall conform to the latest edition of the following standards.

IEC- International Electro-Technical Commission

ISO- International Standard Organisation

BS – British Standard

Other internationally acceptable national standards equivalent to IEC, ISO, BS may be considered.

(If approved by the supervisor(Owner))

12.5.1.2 Painting

After cleaning dust, foreign element, oxide scale, and contaminations, the surfaces shall be degreased with solvent.

Painting be carried out on the procedure prime coat, under coat and finishing coat.

The color of frame shall be a follows.

a) Generator set main body : Maker standard
b) Generator control panel : Maker standard

12.5.1.3 Quality Assurance

a) The equipment set shall be the product of a single manufacturer regularly engaged as a manufacturer of such equipment.
b) Test the Diesel generator at the factory and submit the certified test copies of all tests to the Engineer for his approval.
c) The manufacturer shall have quality control conforming to the relevant parts of ISO 9000.

12.5.1.4 Ratings

Generators shall be rated as described in the Particular Specification.

12.5.2 Composition

a) Diesel engine
b) AC synchronous generator
c) Generator control panel(Installed on the generator)
d) Others

12.5.3 Diesel Generator Set

12.5.3.1 Diesel engine

The engine should be multi cylinder, vertical type, 4 stroke compression ignition, direct injection, water cooled (radiator cooled), turbo charged cooled.

The engine should be suitable for power generator capacity.

a) Speed : 1500rpm
b) Cooling method : radiator water cooling
c) Starting method : battery starting (DC 24V)
d) Fuel : Diesel oil

12.5.3.2 AC synchronous generator

The Alternator shall be screen protected, drip proof (IP 21), separately excited system(with PMG) of brush less, continuously rated to give rated output at 0.8 pf at 400V, 50Hz, 1500 rpm,3 phase, 4wire.

The alternator shall be tested for confirming to IEC 60034.

The insulating material of the alternator shall be class H, non-hygroscopic.

The Alternator shall be suitable for operation with its neutral solidly grounded. The neutral shall be formed at the terminal box.

a) Volt : 400 V
b) Frequency : 50Hz
c) Power factor : Lag. 0.8PF
d) Phase : 3 ϕ 4 W
e) Pole : 4 Pole
f) Insulation : "H" Class
g) Cooling method : Air cooled self-ventilation

12.5.3.3 Engine control panel

a) DC power
b) Oil Press Gauge
c) Oil Temp Gauge
d) Water Temp Gauge
e) RPM Gauge
f) BCG Gauge
g) Hour Gauge

12.5.3.4 Generator control panel

a) AC Voltmeter
b) AC Ampere meter
c) Frequency meter
d) KW meter
e) Power Factor meter
f) Emergency switch
g) Battery Voltage meter(DC-V)
h) Battery Current meter(DC-A
i) V.S / A.S (Selector switch)
j) Auto - Stop - Manu (Selector switch)
k) Generator Control Unit
l) Alarm Lamp & Buzzer
m) CTT / PTT
n) Main Breaker : MCCB(ACB) 4P
o) EOCR, EOVR, EUVR

12.5.4 Engine Safety and Alarm Device

When following engine trouble is occurred, engine is to automatically shutdown and turn on trouble check lamp.

- High coolant temperature auto shutdown 93℃ degree over
- Low oil pressure auto shutdown 1 Kg/㎠ under
- Over-speed auto shutdown 110% over
- 3 times of engine starting failures

12.5.5 Generator Characteristics

- Voltage regulation : Less than ±2.5%
- Frequency variation : Less than ±5%
- Waveform distortion : Less than 10% at no load, rated voltage, rated frequency.
- Voltage adjusting range : more than ±10%

12.5.6 Earthing

The alternator neutral shall be connected to earth.

The Engine- alternator frame shall be connected to earth bars installed inside the pumping station.

12.5.7 Test and Inspections

The purpose of testing is to prove the validity of all technical data and sound performance of the diesel generator.

The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. All testing shall be performed with calibrated metering.

The following tests and inspections shall be carried out at manufacturer's shop in accordance with the relevant rules.

- Construction inspection.
- Measurement of winding resistance.
- No load saturation test.
- Voltage regulation test.
- Wave form distortion measurement.
- 110% over load test.
- Temperature rise test
- Insulation resistance
- Circuit Test - Shutdown test by Engine or generator trouble.

12.5.8 Installation

Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for onsite power system.

The rated capacity, size, air supply opening, exhaust opening, foundation of the generator can be changed according to the manufacturer.

The contractor should build that, in consultation with the architecture works by the data of the approved manufacturer.

Equipment shall be installed on concrete housekeeping pads.

The length and width of foundation should be at least 300 mm more on each side than generator set length and width respectively.

It is recommended to have foundation height of 300 to 400 mm above ground level to maintain cleanliness and avoid flooding.

Check the foundation level diagonally as well as across the length and width for even flatness and same should be within + 50 mm in horizontal plane in any one direction only.

All protective settings shall be adjusted as instructed by the consulting engineer.

All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

The Contractor shall provide a quiet installation. All items of generator and equipment shown on the drawings shall be carefully chosen with a view to minimizing sound levels.

Noise levels outside generator rooms shall not exceed 75 dBA when measured 5 meters from the

external wall.

Vibration of a diesel generator set should be taken in consideration and kept away from quiet working location.

12.5.9 On Site Acceptance Test

The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work.

Testing shall be conducted by the Contractor or manufacturer, with required fuel supplied by Contractor.

The generator set manufacturer shall provide a site test specification covering the entire system.

Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site person

12.5.10 Accessories

- Exhaust silencer
- Flexible pipe
- Battery
- Battery holder and cable
- Battery charger
- Fuel tank (Bed Type)
- Fuel hose (Attached)
- Cooling water heater (Attached)
- Tool list

12.5.11 The Others (To be later informed)

- Operating manual (Engine, Generator)
- Drawing
- Test report

12.6 Low Voltage Distribution (MCC Panel)

12.6.1 General

This specification covers the requirements for Motor Control Center (MCC) for pumping stations in Kathmandu.

The main distribution board (MDB) shall be connected to the transformer.

The LV panel (MCC) shall be designed according to IEC for design of Switchboards.

The nominal voltage shall be 400 / 230 V, 50 Hz.

Installation form : Floor mounted metallic enclosure

Each individual functional group should be according to IEC standard.

12.6.2 Standards

All materials and equipment, fabrication and testing shall conform to the latest edition of the

following standards.

IEC- International Electro-Technical Commission

Other internationally acceptable national standards equivalent to IEC may be considered.

(if approved by the supervisor(Owner))

12.6.3 Basic Engineering Information

The electrical system ratings and quantities are as stated on the single line diagram as attachments.

400V MCC shall be suitable for operation, without deleterious effect, with variations of supply voltage and frequency as follows:

- Voltage ± 10 %
- Frequency ± 3 %

12.6.4 Structure (indoor self-supporting)

The protection degrees for MCC are as follows.

- Protection degree for the MCC enclosure ; IP41 (INDOOR)

Low voltage distribution boards(MCC) shall be of fabricated sheet metal construction, arranged for conduit and/or cable entry as required, fully rustproofed, painted to an approved finish and protected against ingress of solid foreign bodies.

MCC shall be equipped with control device and main-circuit switches each of unit circuits. And it shall protect motors which are connected to circuits of below 600V and resistive load.

The horizontal and vertical buses must be made to endure mechanical shock from short circuit current.

All of load terminal and control terminal are connected by terminal board in MCC.

Motor Control Center (MCC) shall be of indoor self-supporting sectional panel.

Circuit breaker and switch shall be operated in front of MCC.

Electrical box of MCC shall be made of cold-rolled steel sheet. When MCC operates, Electrical box of MCC shall have sufficient strength which can stand impact. Steel sheet thickness is as follows;

Structure	Minim Steel Sheet Thickness(mm)	Remarks
Frame	2.3	
Sides	2.3	
Unit Door	1.6	
Top	2.3	
Rear	2.3	
Other	1.5	

Cable which is used in MCC is as follows;

- Main circuit : above 4㎟

- Control circuits : above 1.5㎟

Busbar and conductor which is connected to busbar shall be copper goods, and they have enough capacity and strength about rated current and rated short time current.

12.6.5 Equipment Included

The motor control cetners shall include necessary equipment presented herein.

12.6.5.1 Moulded Case Circuit Breakers

Circuit breakers shall be of the molded case type with auxiliary switch, bolted-in.

Circuit breakers shall have an interrupting current value not less than the short current (asymmetry value) of the system.

If required, the circuit breaker shall be furnished with motor operation for interlocking and operating.

Circuit breakers shall have a combination of thermal and magnetic tripping giving an inverse time delay protection against sustained overloads and instantaneous tripping under heavy overloads and short circuits.

Poles shall be constructed to open, close and trip simultaneously.

Ampere ratings shall be clearly visible.

Breakers shall be completely enclosed in a moulded case to IEC Standard, suitable for installation inside switchboards.

Non-interchangeable trip breakers shall have the trip unit sealed.

Breakers with earth leakage relay protection shall be provided with shunt trips.

Frame sizes shall be as per manufacturer’s standard size and as approved by the Engineer.

Rating

- Rated voltage : 600V
- Input device : manual input
- Trip device : electrical trip
- Ampere : refer to drawings

Rated breaking current : not less than the short current (asymmetry value) of the system

12.6.5.2 Automatic Transfer Switch (ATS)

The ATS shall switch between normal power supply and generator standby power supply.

It is preferable to implement the auto transfer switch by electrically and mechanically interlocking the Distribution TR. And this part shall also be a part of the Main Power and MCC panel.

For the Pumping Station with low power requirements, ATS implemented with contactors may be applied.

However in this arrangement the ATS shall also be supplied by the generator manufacturer, as part of the generator supply.

The Contractor shall by employing an Automatic Transfer Switch with appropriate time delays ensure that his electrical installation will receive power from only one source.

(For starting the Diesel Generator after Mains failure, and for restoration of Mains Power to the installation on Mains power recovery)

- Mains Power : through Distribution TR
- Standby Power : through Standby Generator Panel

At any given time so that there shall be no need for Mains power and Standby power Synchronization.

Time Delays :

Automatic Transfer Switch (ATS) shall incorporate time delays to facilitate the following:

- On loss of Mains power,
  ATS shall be transfer from the power source to the Standby Generator by time delay.
- On restoration of Mains power,
  ATS shall be transfer from the Standby Generator to the power source by time delay.
- Time delay is adjustable to suit generator manufacturer requirements

Rating

- Type : 4 poles, double-throw
- Rated voltage: 600V
- Rated current: refer to drawings
- Operation power : AC

12.6.5.3 Digital Meter

Digital Meter : Digital Integrated Metering Device.

The Digital Meter shall concentrate various meters and communication unit, etc as a device of 1 unit.

Type : Digital type

Control power : AC 230/400V ± 10%, 50Hz

Measuring function :

- Voltage, Current, Watt, Watt-hour, Power Factor, Frequency, apparent electric power, etc.

Display function :

- It can be measured in LCD(or LED) window without a separate device.

Communication function :

- Communication method : RS485/RS422 Modbus
- It shall support the protocol applied at observation control equipment in order to connect with SCADA system.

12.6.5.4 MPR

MPR : Digital Motor Protection Relay

The MPR shall comply with the most relevant national and international standards and recommendations for industrial electrical distribution.

The MPR shall be installed in MCC for protection and control of individual motors.

The MPR shall centralize the measurement of various motor starting panel, a kind of protection relays, indicator lights etc as a device of 1 unit.

The MPR shall enable to apply to various types of motor starter such as direct on line, reactor, wye-delta, soft-starter, inverter and etc

Protection Functions

- Over current/Under current
- Open-phase/Unbalanced-phase/Inverse-phase
- Ground fault
- Leakage current
- Protection of lock

Accessorys (When Necessary)

- Display(attached on a MCC door)
- Communication Functions
- It shall support the protocol applied at observation control equipment in order to connect with SCADA system.

12.6.5.5 Soft Starter

The soft starter shall be of soft start maneuver method supplying voltage from low to full voltage that reduces the inrush current until the entire torque takes place by getting moved from the small torque while motor is in motion.

The soft starter shall be installed in MCC for soft starting, soft stop, protect of motors.

When starting the motor with the soft starter, the starting current of the soft starter must be less than the reactor starting tap 50%.

Function

- Start and stop Function : Torque control for start and stop.
- Protection Function : Motor Thermal Overload, Soft Start thermal overload, Phase imbalance, Phase reversal, Over voltage, Under voltage, Locked Rotor, Excessive Starts per hour for application.
- Control Function : Trip from external signal, output of alarm signal.
- Indicator Function : Three Phase Current, Three Phase Voltage, Run time in hours, , trip factor indicator, etc.
- Pump Feature Control Function : Must extend and protect the life of pump equipment by considerably reducing the water hammer.

Power Source

- Voltage : AC 400V
- Power consumption : According to the manufacturer's standard
- Permitted variation rate of voltage power source : 85 ~ 110%
- Rated output capacity : refer to drawings

The contractor should install a capacity capable of full load operation considering the power factor and efficiency of the motor.

Special Details

- In case of operating on the panel, the bus and insulator must not be damaged or stained.
- The internal wiring conditions must be inspected.
- In case of performing welding operation, the equipment inside panel, wiring and painted sections must be handled carefully.

Testing and Inspection

- Check each connected parts and other places must be inspected to see whether there are any damaged parts.
- For the ones that are the products of related standard, the shape, value and structure, etc should be confirmed and get the performance certified by receiving the submission of test report or test certificate by related agency. The entrance testing and inspection must be performed if required.
- The testing and inspection can be omitted in case of products that have been approved by supervisor.

12.6.5.6 Inverter (Variable speed Controller: Inverter)

Inverter: V.V.V.F. type motor speed controller.

All pumps and other drives required to operate at variable speed shall be provided with variable frequency drives of the AC inverter type based on the pulse width modulation principal of operation.

Inverters shall be constant torque or variable torque type depending on the specified motor application.

Each drive shall be provided with its own dedicated inverter unit.

The Contractor shall furnish and install VVVF as hereinafter specified and as shown on the drawings.

The following standards are referred to:

- IEC 60146-1-1 : Semiconductor converters – General requirements and line commutated converters – part 1-1 : Specification of basic requirements.
- IEC 60146-2 : Semiconductor converters – part 2 : Self-commutated semiconductor converters including direct d.c. converters.
- IEC 60076-11 : Power transformers – part 11 : Dry type transformers.
- IEC 61800-3 Adjustable speed electrical power drive systems.
- IEC 61800-5-1 Adjustable speed electrical power drive systems. Safety Requirements.

Rating

- Type : Sinusoidal PWM control
- Main circuit input : 400V AC, 3 phase, 50 Hz
- Rated output : 400V, 3 phase, 0 to 50 Hz
- Rated output capacity : refer to drawings
  The contractor should install a capacity capable of full load operation considering the power factor and efficiency of the motor.
- Motor to be connected : 400V, refer to drawings and mechanical specification
- Cooling : Air cooled

Speed control system to be furnished and installed under this Contract shall be VVVF system.

The compartment within the Motor Control Centre housing the variable speed drive control equipment shall also include:

- Inverter fault lamp
- Frequency meter

The speed control system shall be capable of smooth step-less control and shall be of a high efficiency, durable, low maintenance and high reliability type.

Inverters shall be selected to ensure that the harmonics generated within the system are within the limits allowed for the system and do not cause interference with plant or equipment connected to the system. The inverter drives shall as a minimum be twelve (12) pulse type or with active filter type.

Wherever possible, the installation equipment shall be designed to limit or avoid harmonics as opposed to employing harmonic filtering equipment.

The variable frequency drive shall comply with the latest edition of IEEE 519 for total harmonic and current distortion limits and calculations.

During pump field test, all necessary data including the high – harmonic distortion at secondary sides of main transformer shall be measured by the Contractor and three copies of all results shall be submitted to the Supervisor for approval.

All instruments and services of a qualified engineer(s) required for measuring of such data shall be furnished by the Contractor at no additional cost to the Employer and if any defect is detected during the testing, the Contractor shall have the full responsibility for improving the system to the owner's satisfaction.

If the Employer, at any time during the Contract period and guarantee period, makes any claims about the influences of high – harmonic distortion and/ or any resulting consequences, and asks the Employer to install any rectifying facilities or any other equipments, the Contractor shall furnish and install such rectifying facilities or equipments to compensate the defects at his own expense.

The Contractor shall take into consideration the power factor, efficiency of the motors and the speed control system to be used, and determine the rated capacity which is actually required.

The speed control system shall comply with the following basic requirements and the conditions as specified hereinafter.

VVVF system shall be composed of diode bridge rectifier (multi pulse), PWM inverter, and others.

VVVF speed control system shall have the function of controller to control one(1) pumping equipment respectively.

Speed control shall be accomplished by varying the output frequency and voltage to vary the speed of a three (3) phase induction motor.

Against also the motor, suitable consideration to make complete sine wave output as far as preferable shall also be required to reduce the switching surge voltage affecting the insulation of the motor.

Special consideration to avoid VVVF equipment overheating at any conditions shall be made on the

basis of the results of site investigation to be done by the contractor.

If undesirable high ambient temperature will be expected at the electrical room to install VVVF equipment, suitable countermeasures such as provision and installation of the air conditioner having ample capacity etc., shall be made by the Contractor.

Speed control shall provide from 0 to 100% of synchronous speed.

Motor to be connected ; As shown on the Drawings and the Specification

Efficiency of system composing of the VVVF speed controller and the motor shall not be less than 90% at full load and highest speed.

Power factor improvement shall not be less than 95% at full load

Motor shall be started without shock due to rush current by application of soft starting.

To make easy maintenance, each cell inverter shall be installed in MCC panel, and air cooling shall be provided preferably.

Tests

- Factory Tests
  Type test and routine test shall be in accordance with IEC standard where applicable.
- Field Tests
  After installation, the following tests shall be executed before energizing:
  Verification of construction
  Electrical operation test
  Measurement of insulation resistance

12.6.5.7 Other's materials

Potential Transformer (PT)

- Type : indoor epoxy mold
- Rated 1st voltage : 400V
- Rated 2nd voltage : 110V
- Rated burden : Determined based on corresponding circuit burden
- Error Class : 1.0 Class

Current Transformer (CT)

- Type : indoor epoxy mold
- Rated 1st current : Refer to drawings
- Rated 2nd current : 5A
- Rated burden : Determined based on corresponding circuit burden
- Error Class : 1.0 Class
- Current transformers shall have thermal and mechanical rating at least equal to those of the main circuit breakers.

Static Condenser

- Type : Indoor sealed type
- Phase number : 3 phase
- Rated burden : 400V

- Rated capacity : Refer to drawings
- Other : Must supply necessary accessories

Series Reactor

- Type : Indoor, dry type
- Rated burden : 400V
- Capacity : 6% of condenser capacity

Zero-phase Current Transformer (ZCT)

Type: Indoor Epoxy Molded

Signal Lights

- Red signal lights shall be used for "ON" position and green light for "OFF" position.
- Color caps shall be made of a material which will not be softened by the heat from the lamps.

Bus Bar

- The entire bus bar shall be made of copper.
- A continuous main horizontal bus bar shall be furnished.
- Ground bus bar shall be furnished the entire length of the motor control center.
- The bus bar must withstand the short-circuit current of power system
- Bus bar shall be adequately supported by porcelain or moulded insulators spaced on suitable centres so that the complete assembly can withstand the maximum mechanical stresses to which it may be subjected to under fault conditions.
- Bus bar shall be housed in separate adequately ventilated compartment which shall not contain any wiring or apparatus other than that required for connections for bus bar.

Panel Lighting

- Each cubicle, where a door is required to be opened for access, shall be provided with fluorescent lighting which shall be automatically switched on when the panel door is opened.

Lamp Indication

- A pilot lamp for each panel shall be provided.
- The lamp shall light up when the input cable is live irrespective of the position of the circuit breaker in the panel.

12.6.5.8 Labels

All the components in the switchboards shall be identified by means of white labels of an approved design engraved with black lettering adequately describing the function of the unit to which it is attached and shall be secured by screws to the outside of each item. Labels secured by adhesive are not acceptable.

All labels shall be engraved in both Nepali and English and shall be approved by the Supervisor (owner).

12.6.5.9 Earth Bonding

Each panel section shall be individually bonded to main earth bar located in the electrical rooms.

Each panel section shall be cross bonded to adjacent panel section earthing terminal

12.6.5.10 Installation

The motor control center shall be furnished as a completely factory assembled unit where transportation facilities and installation requirements permit.

When required suitable holes, it shall be provided to the top or bottom of the board to accommodate all incoming and outgoing cables through rubber washer glands.

The motor control centers shall be mounted on steel channels which are installed on the floor. The channels shall run the full length for the switchgear and shall be installed level in all directions.

The motor control centers shall be maintained in an upright position at all times. Lifting shall be only at the floorsills or the tip mounted lifting angle.

The motor control centers shall be protected against damage at all times. Any damage to the paint shall be carefully repaired using touch – up paint furnished by the switchgear manufacturer.

The MCC shall be supplied and installed in the electrical room as indicated on the Drawings.

- The Contractor shall submit details of proposed equipment and method of installation to the Supervisor (Owner) for approval prior to commencement of installation work.
- Provide all the motor control equipment installations, wiring installations and tests, including connections and interconnections for the electrical controls as indicated, specified and required.
- The MCC shall be installed level and securely attached to the concrete foundations (or "⊐ or I" shape plate) with anchors.
- Install all the wiring and control equipment as indicated, specified and required.

The sections shall be joined together with bolts, nuts and washers to form a complete unit assembly.

Floor standing equipment shall be installed on concrete housekeeping pads as shown on the Drawings.

12.6.5.11 Tests

Factory Tests

- The motor control centers shall be completely assembled at the factory. The motor control centers shall be subject, unless otherwise noted, to the following tests by the Contractor.
- Verification of construction
- Mechanical operation tests
- Electrical operation tests

Field Tests

- After installation, the following tests shall be executed before energizing:
- Verification of construction
- Mechanical operation tests
- Electrical operation tests

12.7 Cable Trays

12.7.1 General

Provide all labour, materials, equipment, services and accessories necessary to furnish and install the work of this Section, complete and functional, as indicated in the Contract Documents and as

specified herein.

This specification shall be applied to cable tray construction works.

The cable tray system shall be of one manufacturer and shall include factory-made trays, tray fittings, connectors and necessary accessories and supports to form a complete cable support system. The cable tray system shall include the following factory-made tray elements:

- Straight cable trays and ladders.
- Fittings as horizontal and vertical bends of various angles, crosses, tees, wyes, reducers, vertical riser elements.
- Connectors.
- All necessary fixing accessories.

Manufacturer's standard accessories shall be used and site fabrication shall only be allowed where special sections are required subject to the approval of the Supervisor.

12.7.2 Materials

Cable trays shall be hot dipped galvanized ladder type.

Cable trays shall be constructed from mild steel hot dip galvanized and of minimum thickness of 2.5 mm.

Tray components shall be accurately rolled or formed to close tolerances and all edges rounded. Flanges shall have full round smooth edges.

The rungs shall be spaced at maximum 300 mm.

For all trays, flanges shall be a minimum of 100 mm deep, unless otherwise specified.

12.7.3 Installation

The cable tray System shall be delivered and installed as specified in the General Technical Specification Requirements

The cable tray shall be carried according to the drawings.

- If it is mismatched with existing conditions, cable trays shall be designed by the contractor.

The cable tray should be constructed by a plan, and should be have an approval by a supervisor in case needs to be changed to keep away from the pipe and the other equipment.

The cable tray supporter should be installed in a turning point and each supporters should not be separated over 2 meters in the other case.

Drilling, machining or cutting shall not be carried out after application of protective coat, unless previously agreed by the Supervisor. If cutting or drilling is necessary, edges shall be cleaned up and painted with zinc based paint before erection.

A welding an iron frame supporter to fix a tray is permitted, but a welding is not permitted for a tray.

Joint plate is used for connection a cable tray each other, a tray should be apart 3-5 millimeter each other and attached ground bonding jumper to consider expansion and contraction by heat.

Cable should be connected to body of a cable tray completely using compressing terminal.

End plate should be attached at end of a cable tray.

The cable tray should be installed apart from ground over specific height to avoid passing trouble.

The cable tray shall be raised 100mm or higher from finished floor level.

Before inserting cable, all cable tray should be cleaned and removed sharp part to prevent the damage of cable insulation covering.

Cover is needed on the tray that installed in the open place.

The cable tray should not be attached to the ground or wall directly, it should be attached with channel or something like that.

In case a power cable and measuring control cable are spread at once in the same cable tray, it should be installed separator to prevent the interference by electromagnetic induction.

The cable trays shall be fixed in accordance with site conditions and manufacturer's recommendations.

The Contractor shall submit, as required, all calculations relating to traywork and tray supports demonstrating acceptable mechanical stresses

12.7.4 Earthing

Bonding jumper wire shall be fixed on cable tray.

Bonding jumper wire for grounding shall be installed every connection parts of tray or duct.

12.8 Conduits

12.8.1 General

Provide all labour, materials, equipment, services and accessories necessary to furnish and install the work of this Section, complete and functional, as indicated in the Contract Documents and as specified herein.

12.8.2 Products

12.8.2.1 PE Conduit

PE Conduits shall be high density polyethylene type.

Conduits shall not be less than 20mm diameter size.

Conduit and conduit fittings shall be in accordance with IEC or NEC or ISO.

PE Conduit and conduit fittings shall be fully suitable for installation, storage or transport at the temperatures encountered at the job site and at this temperature the material shall not suffer any structural degradation.

All PE Conduit and conduit fittings shall be suitably marked and identified by the Manufacturer.

Conduits used throughout shall be of one manufacturer and marking on the conduit shall include the nominal size. All markings shall be indelible and easily legible.

The inside and outside surfaces of conduits shall be smooth and free from burrs, flash and other

similar defects.

The interior and ends of conduit fittings shall have no sharp edges and surfaces and corners over which the cables are likely to be drawn shall be smooth and well rounded.

12.8.2.2

12.8.2.3 Rigid Steel Conduit

Conduits shall not be less than 20mm diameter size, and shall be complete with all necessary threaded fittings, couplings and connecting devices having galvanized equivalent finish.

Conduits and fittings shall be manufactured for electric wiring purposes.

When manufactured by a continuous weld process, weld heads both inside and outside the tube shall be completely removed prior to galvanizing.

All conduits and fittings shall be free from rust or other defects on delivery to the site and shall be properly stored in covered racking so that it is protected from mechanical damage and damage by weather and water whilst stored on the site.

All conduits shall be can coupled to boxes and trunking wires using male bushes.

12.8.2.4 Flexible Conduit

Flexible conduit shall be galvanized sheet iron (or SUS) type.

Flexible conduit shall be used for the final connection of rigid conduit to the terminal boxes of machines fitted with a means of drive adjustment and/or where vibrations is likely to occur.

12.8.2.5 Conduit Boxes

All boxes and covers shall be galvanized, zinc plated or equal rust-proof finish equivalent to conduit finish.

All boxes, other than those to which a fitting or accessory is to be directly mounted shall be fitted with covers screwed to the box by screws.

12.8.3 Installation

Light and power circuits, signal and other low current system wiring and cables feeding shall be drawn in conduits unless otherwise indicated.

Conduit system shall generally be concealed and installed as indicated, unless otherwise indicated.

Normal light and power circuits, signal wiring and low current system wiring shall each be run in separate conduit and wireway.

Cable insulated for two different categories of circuit shall be segregated irrespective of service.

Conduit and fitting used shall be :

- Where embedded : PE conduit
- Where underground : PE conduit or Rigid steel conduit
- From terminal box to machine : Flexible conduit

Submit drawings of proposed conduit layout and obtain approval before commencing work.

Run conduit in square, symmetrical lines, parallel to or at right angles to walls and in accordance with the accepted practice.

Installation shall permit easy drawing in of cables.

Where conduit runs are to be concealed in the structure or are to pass through floor slabs, the Contractor shall be responsible for marking the accurate positions of all chases and holes on site.

The Contractor shall arrange the conduit routing to make maximum use of any preformed conduit holes and slots provided in structural beams.

Conduit installation on shear walls shall be kept to a minimum.

All routings necessary on shear walls shall be agreed with the Engineer before work is put in hand.

Install conduits so as not to interfere with ceiling inserts, lights or ventilation outlets.

All conduits shall be of sufficient size to permit the easy withdrawal and replacement of cables at a later date, no conduit smaller than 20 mm shall be used.

A space factor of 40% shall not be exceeded. The tubing shall be perfectly smooth inside and out and free from flaws and imperfections of any kind. Both ends of every length of tubing shall be properly reamed with all sharp edges removed before erection.

Runs in Reinforced Concrete

- Obtain approval for placing PVC before pouring concrete.
- Run conduits in concrete slabs parallel to main reinforcing steel.
- Additional openings in finished slabs, where approved, shall be made by drilling, not by breaking.

Horizontal or cross runs are to be avoided in partitions and side walls.

Concealed Conduit

- Fix securely to prevent movement before casting of concrete and screeds, application of plaster and the like.
- Supports for exposed conduit shall be fixed at each side of bends.

Underground line works

- Excavation & refilling
- Underground-embedded conduits shall be laid at least 1m in subsurface depth.
- Sand should be laid at least 10cm thick layers to protect the conduit.
- Single brick should be laid on top the conduit to protect the conduit.(if necessary)
- Tapes for warning shall be installed at 30cm below the final level.
- Box shall be ensured that an extra length of cables can be secured in box.

Cleaning

- The conduit outlets when installed and before wiring shall be temporarily closed by means of well fitting wooden plugs, and immediately before cables are drawn in, conduit systems shall be thoroughly swabbed out until they are dry and clean.

12.9 Wires and Cables

12.9.1 General

This Section to include the supply, installation and commissioning of all wires and cable systems in accordance with the Specifications and Drawings.

The Cable System shall be delivered and installed as specified in the Specification Requirements.

12.9.2 Standards

Applicable standards referred to in this Section:

- IEC 60227 Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
- IEC 60228 Conductors of insulated cables
- IEC 60502-1 Power cables with extruded insulation and their accessories for rated voltages from 1kV up to 30kV – part 1 : Cable for rated voltages of 1kV AND 3kV.
- IEC 60502-2 Power cables with extruded insulation and their accessories for rated voltages from 1kV up to 30kV – part 2 : Cable for rated voltages of 6kV AND 30kV
- IEC 60947-7-1 Low-Voltage switchgear and control gear
  part 7–1 : Ancillary equipment – Terminal blocks for copper Power cables with extruded insulation and their accessories for rated voltages from 1kV up to 30kV
  part 7-2 : Cable for rated voltages of 6kV AND 30kV

Other internationally acceptable national standards equivalent to IEC may be considered. (if approved by the supervisor)

12.9.3 Quality Assurance

If cable sizes are not indicated on Drawings or in schedules, determine the correct size based on current rating, voltage drop and short circuit current, as relevant, after taking into consideration:

- type of cable and wire
- ambient conditions
- method of installation
- the disposition of each cable relative to other cables.

Calculate voltage drop and current ratings based on information given in supply authority's regulations or IEE Regulations, whichever are more stringent.

All cables and wires shall be suitable for installation and continuous service in the ambient conditions.

12.9.4 Products Delivery, Storage and Handling

Each drum length of cable shall be allotted a distinct and separate reference number. This number shall appear on the test certificates covering the respective length of cable and shall also be clearly marked on the cable drum.

The Contractor shall advise the Supervisor upon delivery to site of each drum length, quoting the reference number, the test certificates shall be handed to the Supervisor for examination and approval.

All cables shall be delivered to site with the manufacturer's seals, labels or other proof of origin intact. These labels and seals shall not be removed until the cable is required for use and shall be

retained for inspection by the Supervisor.

The Contractor shall be responsible for the off-loading and handling of the cables on site, and shall ensure that cables are delivered to site on drums and properly protected against mechanical damage. Where lengths are cut from cables, the open cable ends shall be sealed.

12.9.5 Performance Requirements for Environmental Conditions

The Contractor shall be aware of the need to supply and install all wire and cables for this Contract which are most suitable for the environmental conditions prevailing.

All conductors shall have good fatigue resistance and not subject to breaks due to nicks or cuts when terminating.

12.9.6 Cables

Unless otherwise specified, cables and wires of the following specified voltage ratings shall be used as indicated.

- 12,000/20,000V rated cables : 11,000V equipment circuits
- 600/1,000V rated cables : Main and sub-main distribution panels, motor control centres, circuits serving process equipment
- 450/750V rated cables : Final sub-circuit supplies for lighting, socket outlets, etc.
- All multicore cables shall be 600/1000V rated.

12.9.6.1 General

Conductors shall be high conductivity copper, to IEC 60228 unless otherwise indicated.

Copper conductors shall be stranded for 2.5 mm2 and over.

Signal control cables shall have solid conductors.

Flexible cords shall have fine stranded conductors.

Conductor sizes shall be metric. Conductors with cross sectional areas smaller than those specified will not be accepted.

Insulation for each conductor shall be color coded or otherwise identified as required by the Regulations. Color coding shall be maintained throughout the installation.

The current carrying capacity of conductors has been determined in accordance with the specified regulations, the specified type of insulation and the expected conditions of installation.

All cables shall be as far as practicable, of one manufacturer only. All cables shall comply with the relevant IEC.

12.9.6.2 11 KV medium Voltage XLPE power cable (XLPE/SWA/PVC)

The specification covers design, manufacture, testing, supply and installation of 11 KV multi core, cross linked polyethylene insulated aluminium conductor power cable.

- 12,000/20,000V grade
- Conductor : aluminium, stranded circular conductors
- Insulation : cross-linked polyethylene (XLPE)

Sheath : Polyvinyl chloride
Purpose of use : 11kV medium voltage power supply.

Armored : steel wire armored
Conductor temperature : 90 °C

12.9.6.3 Cross-linked polyethylene Insulated PVC Sheathed Cable (XLPE/PVC)

The specification covers design, manufacture, testing, supply and installation of 400V multi or single core, cross linked polyethylene insulated copper conductor power cable.

- 600/1,000V grade
- Conductor : copper, stranded circular conductors
- Insulation : cross-linked polyethylene (XLPE)
- Sheath : Polyvinyl chloride
- Purpose of use : power cable for motor, valve etc.
- Armored : Non-armored
- conductor temperature : 90 °C

12.9.6.4 PVC Insulated PVC Sheathed (PVC/PVC) Control Cable.

- 600/1,000V grade
- Conductor : copper
- Insulation : Polyvinyl chloride
- Sheath : Polyvinyl chloride
- Purpose of use : control cable for control circuits
- Armored : Non-armored

12.9.6.5 PVC Insulated (PVC) Cable.

- 450/750V grade
- Conductor : copper
- Insulation : Polyvinyl chloride
- Sheath : Non-Sheathed
- Purpose of use : power cable for lighting, socket etc.
- Armored : Non-armored

12.9.7 Sundries

12.9.7.1 Joints

For conductors up to 16mm2 barrel type connectors with pinching screws, the whole shielded in porcelain or hard resistant materials are not permitted.

For conductors exceeding 16mm2 to be made with bakelite shrouds.

12.9.7.2 Jointing Boxes

For use where intermediate joints are necessary on MICC mains cable and shall be suitably sized galvanized malleable iron adaptable box with glands and fixed base mechanical clamping connectors of approved design. For external use the jointing box shall be enclosed in a second galvanized box with glands.

For use on plastics and elastomer insulated cables of a type recommended by cable manufacturers having an inner box with provision for making a watertight seal into inner sheaths of cables, and an outer cast iron box with provision for making a watertight seal to cable outer sheaths, clamping cable armour and bending the armour across the joint. Where applicable suitable connections shall be provided to ensure electrical continuity of the cable screen is maintained.

12.9.7.3 Compression Glands

For terminating plastic or synthetic cables to switchgear, switchboards, motor control centers and other equipment.

12.9.7.4 Cable Terminations

For plastics or synthetic rubber insulated cable with suitable brass compression glands, unless otherwise recommended by cable manufacturer. Glands for armoured or screened cables shall have suitable clamps therefore.

External compression glands shall have close fitting PVC shrouds.

Earthing for armouring and metallic sheaths shall have suitable brass or copper clamps, and copper strip conductor of selection not less than 2.5 mm2.

Cables forming part of a LAN or structured cable system shall be terminated to floor plates or wall sockets compatible with the media interface connector specified for the particular network being used.

12.9.7.5 Cable Sockets

It shall be correct size for type of cable.

It shall be sweating type, or an approved crimping type used with an approved crimping tool.

Sweating sockets for conductors 70 sq.mm and over : machined cast brass.

12.9.7.6 Fire Barriers

Shall be purpose made, comprising a rigid fixed frame with adjustable seals and a suitable clamping device.

In fire compartment separation walls and floors t shall be same standard of fire resistance as wall or floor.

12.9.7.7 Others

Pipe ducts shall be PVC or as indicated

Cleats shall be cast aluminum, gunmetal or brass of approved type.

Cable sealing compounds shall be approved by cable manufacturer or Supervisor; shall be tropical grade and shall be an oil-resisting compound where the difference in level between cable ends exceeds 6m.

12.9.8 Installation

12.9.8.1 General

Pull cable into position by hand, where possible using an adequate number of operative roller guides suitably positioned along cable length.

Obtain approval of pulling cables by winch or similar appliance.

When pulling by winch or the like, fit a suitable tension gauge into the haulage line between winch and cable. Pulling tension shall not exceed the limit recommended by the cable manufacturer.

Do not allow cable to twist or rotate about its longitudinal axis.

Lay 3-phase groups of single core cables in trefoil formation. If this is not possible obtain instructions.

Install cables to allow any one cable to be subsequently removed without disturbing the remainder.

Bending radii shall be as large as possible and not allow cable to bend to a radius less than that specified in IEEE Regulations, or manufacturer's recommendation, whichever is largest.

12.9.8.2 Underground Cables

Lay in conduit.

Cable duct(trench) size shall be as specified in the Drawings.

Run cables at least 300mm clear of other services, whether the latter run parallel or transversely to cable trench.

Run cables below intersecting piped services, unless the cable would be at a depth exceeding 2m, in which case seek instructions.

12.9.8.3 Installing Cable in Cable Trays

Install cables on trays in a single layer, unless otherwise specified.

Use purpose made straps or saddles to maintain cables in a neat regular disposition.

Secure cables with load bearing cleats securely fixed to the tray, where trays do not directly support the cables.

Space cleats saddles and straps at maximum centres recommended in supply authorities regulations.

12.9.8.4 Above Ground Cables

Protect exposed cables where they are likely to be damaged.

Run cables at least 50 mm from each other.

Run cables at least 150 mm from piped services.

12.9.8.5 Jointing

Joints in wires and cables shall be avoided wherever possible. Joints in flexible cables and cords are not permitted. Where joints are unavoidable they shall be permanently accessible and made only in junction boxes.

Leave at least 150mm of free conductor at each outlet, switch point and pull box for the making up of joints or the connecting of fixtures and devices, except where conductors are intended to loop without joints through lamp holders, socket outlets and the like.

Complete joints and termination in the shortest time without interruption.

Do not commence jointing and terminations without approval, except where the work is in a dry, weather-proof place.

Do not make joints in wet or dirty conditions.

Make outdoor joints under a suitable tent or shelter.

Fill joints with compound filling in stages to allow the material to flow. Do not allow compound to cool to the point where re-heating is necessary.

Ensure sealing compounds are pouring at the correct temperature. Check compound level and top up if necessary, after cooling.

Make intermediate joints on plastic and elastomer insulated cables in a joint box. Arrange to have each joint inspected by the Engineer before closing and filling

On external joints on MICC cable fill outer box with jointing compound..

Joint cables in straight through joints and main cables in tees and other branching joints core to core.

12.9.8.6 Terminations

Take cable cores through the termination box directly to equipment terminals, without crosses, unless impracticable and make off with sweated cast brass or hydraulically crimped sockets.

Sweat cable core solid 25 mm on each side of compound level and over-tape the exposed core insulation with two layers of PVC or other approved tape in appropriate phase colour, half-lapping the tape.

Plumb the cable sheath to the brass wiping gland neatly lay back the armour wires over the gland and fix with an amour clamp effectively bonded to earth.

Cut back tape of tape armoured cables neatly below the wiped gland, thoroughly clean, secure with a suitable armour clamp and bond to the body of the terminating box with two soft copper tapes at least 70 mm^2 aggregate cross section.

Equipment to which cables are connected shall have blank, undrilled gland plates. Drill holes necessary for fitting glands.

12.9.8.7 Cable Support

Run single core cables used to make up 3 phase circuits in trefoil formation, unless otherwise indicated, and support in cleats.

Adjust spacing of cable supports and fixing devices below the specified maximum as necessary to prevent cables sagging and where cables must deviate to pass obstructions.

XLPE/SWA/PVC, XLPE/PVC and PVC/PVC cables run on cable trays, in trunking, in conduit or direct buried as indicated.

PVC/PVC cables run on cable trays or in conduit as indicated.

12.9.8.8 Heat Resistant Cables

In areas where a constant ambient temperature exceeding 55°C will occur, run all final sub-circuits and distribution circuits in heat resistant cable.

Make conversation from PVC cable to heat resistant cable with a fixed block connector housed and fixed into a conduit box or equal, except where the conversion of cable types emanate from a switch, ceiling rose or similar fixed connector accessory.

12.9.8.9 Flexible Cables

Keep flexible cable to a minimum

Install out of sight.

Mechanical retainment shall not depend on electrical connections.

12.9.8.10 Sealing Cables

Seal both ends of cables immediately after tests.

Seal MICC cables immediately after cutting to prevent hygroscopic action by the dielectric.

Seal aluminium sheathed cables with a metal cap plumbed to the sheath.

Seal plastic sheathed cables with a plastic cap embracing the wires and outer sheath.

Mark cable ends.

12.10 Wiring Devices

12.10.1 General

This Section shall include all labour, materials, equipment, appliances and accessories necessary for the complete performance of all switches, socket outlets etc.

Items not mentioned in the specification are in accordance with the drawings.

12.10.2 Products

12.10.2.1 General

All individual items of materials shall be of the same make throughout the project unless specifically approved by the Supervisor.

12.10.2.2 Outlet Boxes

a) Outlet Boxes
   - Galvanized or sherardized one piece pressed steel, sizes and designs shall suit devices to be fitted.
   - In fuel tank room and battery room: explosion proof.

b) Exterior Mounted Boxes
   - Totally sealed to ensure water tightness.

12.10.2.3 Switches

a) Lighting Switches
   - Grid fixing type unless specified otherwise. The grid shall be provided with suitable earthing terminal.
   - Single pole, double pole, one way or two way, as indicated.

b) Switch Plates
   - Where two or more switches are grouped together and connected to the same phase, multi-gang devices and common plates shall be used.
   - Rectangular, chrome finished switch plates shall be used in all areas unless specified otherwise. The rocker shall be insulated with ivory finish.

12.10.2.4 Socket Outlets

a) General purpose Socket Outlets
   - 3 rectangular pin (2P+E) shuttered, with combined switch.

b) Socket outlet plates shall be matt chrome finish in all areas unless specified otherwise readily identifiable.

12.10.2.5 Junction, Pull and Terminal Boxes

a) The Junction Box shall be completed with a terminal block suitable for connecting up to 10 mm2 copper conductor (phase, neutral and earth) and an all insulated moulded white cover plate with removal covers.

b) The cover plate shall be raised for connecting outgoing cable.

12.10.3 Installation

12.10.3.1 Outlet Boxes

a) Location of Boxes
   - Determine exact location of boxes on site and obtain the Supervisor's approval before commencing installation.
   - Make allowance for overhead pipes, ducts, variations in arrangement, thickness of finish, window trim, panelling and other construction when locating boxes.

b) Mounting Heights
   - Where mounting height is not shown or specified, obtain instructions.
   - Boxes for similar equipment mount at uniform heights within same or similar areas.

c) Fixing
   - Fix outlet boxes securely.
   - Fix exposed outlet boxes to permanent inserts or lead anchors with machine screws.

12.10.3.2 Lighting Switches

Lighting Switches near door:

a) Located at the strike side of the door.

b) Plates shall be installed with all four edges in continuous contact with finished wall.

c) Plates shall be installed with an alignment tolerance of 1.5 mm.

d) All switch assembly louvered plates shall have their earthing terminal connected to the earth terminal attached to the switch box by an insulated above 1.5 mm2 protective conductor.

12.10.3.3 Junction, Pull and Terminal Boxes

a) Generally:
   - Fix junction, pull and terminal boxes where indicated and where required to facilities pulling of wires and cables and connection of future appliances.
   - Locate boxes as inconspicuously as possible, but accessible after work is completed.

b) Pull Boxes
   - Fix at maximum 10 m spacing and to limit the number of bends in conduit to not more than two 90° bends.

12.10.3.4 Testing

Test all switches, socket outlets etc. for correct polarity and continuity of conductors.

12.11 Lighting

12.11.1 General

This section includes the supply and installation of lighting fittings as shown on the Drawings.

12.11.2 Design & Quality

Design Criteria:

a) Lighting fittings shall be of first class quality, made by approved manufacturers and shall be suitable for trouble free operation on the system voltage at the site.
b) Lighting fittings shall be complete with internal wiring between lamp holder and termination point. Wiring shall be in PVC insulated cables of appropriate sizes.
c) All lighting fittings shall be complete with accessories and fixing hardware necessary for installation whether so detailed under fixture description or not.
d) Outdoor lighting fittings shall be installed at mounting heights as specified or instructed on site by the Engineer.
e) All outdoor lighting fittings shall be suitably constructed and protected to withstand the corrosive atmosphere and high ambient temperature of the site, whether indicated under the fittings description or not.
f) Lighting fittings shall have power factor not less than 0.9.
g) All light fittings shall be earthed.

12.11.3 Submittals

a) Fluorescent fittings and other electrical discharge lamp fittings, submit:
   - full technical details of the fittings, including the control gear, indicating the type and size of materials used in construction;
   - relevant sheets of manufacturer's catalogues and dimensional drawings of the fittings, clearly showing the location of the component;
   - wiring diagram of international connections indicating color, size and type of wiring;
   - the power factor under operating conditions and illumination data sheets;
   - type and quality of any plastic materials used in the fittings.
b) Other lighting fittings, submit:
   - full technical details of the fittings, with relevant manufacturer's catalogues and illumination data sheets;
   - type and quality of all metal finishes;
   - size and quality of all glassware.
c) At least one piece of each of the lighting fixtures originally specified shall be submitted and displayed at the project office for comparison in the event an alternate make is offered unless otherwise specified.
d) The detailed design must be forwarded to the Supervisor with calculations for lighting installations including measuring reports as documentation for the lighting calculations.

12.11.4 Products

12.11.4.1 Types & Quality of Lamps

a) Lamps
   - Lamps shall be furnished and installed in all lighting fixtures covered under the Contract.
   - Lamps used for temporary lighting services shall not be used in the final lamping of fixture units.
   - Lamps for permanent installation shall not be placed in the fixtures until so directed by the Engineer, and this shall be directly before the building areas are handed over.
b) Fluorescent Lamps

- Tubular fluorescent lamps.
- Tube color: cool white, unless otherwise indicated.

c) Control Gear for Fluorescent Lamps
- High frequency electronic ballasts not less than 25 kHz to IEC.

d) Lamp Holders
- Lamp holders: to be designed so that the lamp cap only makes electrical contact when fully screwed home and to have means to prevent the unscrewing of the lamp due to vibration or similar cause.
- Lamp holders for fluorescent lamps shall be the spring-loaded rotor type for use with bi-pin lamps.

12.11.4.2 Outdoor Lighting

a) General
- The Solar Panel shall be providing electricity to charge the battery during day time.
- The battery's charging shall be controlled by a charge controller.
- The operation of the LED bulb shall be controlled by a control circuit either by using sensors such as Light Dependent Resistor (LDR) or voltage or current sensor.
- All these components shall be fixed on a pole as shown drawing.
- The solar panel shall be mounted at the top of the pole to minimize the possibility of any shading on the panels
- The contract must furnish document in the form of literature (catalogue), certified dimensional drawings, and detailed description of goods with essential technical information.

b) A basic solar powered LED street light system components are:
- PV(Photovoltaic) Module
- Lighting Fixture - LED lamp set
- Rechargeable Battery
- Solar Charge Controller
- Light Pole

c) PV(Photovoltaic) Module
- Module Capacity : 100W x 2set
- PV module Type : Mono Crystalline
- Minimum efficiency at STC (Standard Test Condition) : Minimum 14%
- Junction Box : IP 65 or above
- PV module shall be installation towards due south around local latitude.
- PV modules shall be tested for durability and reliability according to standards developed by the International Electro-technical Commission.
- Standards Standard : IEC 61215, IEC 61730

d) LED lamp
- Type : Light Emitting Diode (LED)
- Rated : 40W
- Expected Life : LED life shall be minimum 50,000 hours
- The lamp must be protected against reverse polarity
- Must submit IP65 or above Compliance Certificate

e) Battery

Type : Gel tubular plate containing epoxy resin
- Rated Capacity : 100Ah
- Voltage : 12V
- Battery Efficiency : Minimum 85%
- Operating Temperature : -5 °C to 55°C
- Charging instructions shall be provided along with the batteries
- Warranty : 5 years replacement guarantee.
- The contractor must submit replacement guarantee of the street light manufacturer with a

replacement warranty (5-years replacement warranty) to the owner.

f) Charge Controller
   - Type : Solar Charge Controller
   - Control Mode : PWM
   - Protection Function : Solar reverse-charging protection, solar reverse-connection protection, battery over charge protection, battery over-discharge protection, battery reverse-connection protection.

g) Street Light Pole
   - Type : Hot Deep Galvanized
   - Hight of Pole : 7m
   - Thickness of Pole : Top 2.5 meter - At least 3mm, Bottom 4.5 meter - At least 3mm
   - Diameter of Pole Sections : Top 2.5 meter - At least 76mm, Bottom 4.5 meter - At least 101mm
   - A vented, acid proof and corrosion resistant metallic box with a locking arrangement for outdoor use should be provided for housing the battery.

12.11.5 Lighting Fittings

All lighting fittings shall be supplied complete with appropriate control gear where necessary, lamps, mounting and fixing accessories etc. whether explicitly mentioned in the description of each light fitting or not. All the fittings shall have the same appearance, material, technical details and approximate dimensions.

12.11.6 Installation

The building installation shall be designed according to IEC or local norms and the drawings.

All lighting equipment in the buildings and outdoors shall be carried out according to local norms.

Lamp posts shall be as detailed in the Particular Specifications or as shown on the Drawings.

Conduits shall be either galvanized steel or PE and shall be laid straight on the center line.

General fluorescent fittings mounted direct to conduit outlet boxes shall have the circuit wiring run direct to the fittings terminal position. Provide flexible conduit pigtail for all fixtures to J-box.

Install lamps in all lighting fixtures at substantial completion.

Do not use lamps used for temporary lighting in the permanent installation.

12.12 Earthing System

12.12.1 General

12.12.1.1 Description

This Section shall include all labour, materials and accessories for the complete performance of the earthing systems in accordance with the Specifications and Drawings.

System shall also be furnished as per recommendation of local power supply authority (NEA).

12.12.1.2 Quality Assurance

The earthing system shall be in accordance with the supply authority's rules and regulations and to IEC/BS.

12.12.1.3 Submittals

Shop Drawings

a) Submit full technical details and conductor size calculations of each type of cable or wire proposed.
b) Submit exact route of each cable or wire proposed.

12.12.2 Materials

a) Products used in the earthing system shall be copper or an approved copper alloy, unless otherwise specified, and specifically manufactured for the purpose.
b) Earth Continuity Conductors
   Sizes shall be not less than half that of the associated phase conductors or at least 70mm2.
   - Insulation shall be of the same material as insulation in associated sub-circuits.
c) Rod Electrodes
   - Shall be the earth rod electrode type, unless impracticable to drive deep into the particular soil.
d) Earth rod electrodes: 16mm diameter steel core copper jacketed type, comprising a high strength steel alloy core with a molten welded copper covering.
e) Plate Electrodes
   - Copper; or
   - Cast iron where artificial treatment of soil is necessary because of high soil resistivity.
f) Earth Connectors shall connection of rod electrodes: bolted type.
g) Removable Earth Links - to comprise a bolted copper link fixed on porcelain insulators and complete with studs, nuts and washers to take the earth tape and a bolted lug adequately sized for the final connection of the earth electrode.
h) Bolts, Washers and Nuts in Bolted Connections:
   - High copper alloy or silicone bronze. Ferrous hardware is not acceptable.
i) Earth Pit Cover
   - Shall be of heavy-duty cast iron cover.
   - Shall have a recessed lifting hook.
   - Shall have a brass plate, engraved “Electrical Earth Below”.

12.12.3 Installation

a) Circuit Wiring
   - Shall have a green and yellow coloured insulated earth continuity cable connecting the earth bus or earth terminal in switchboards, switchgears, motor control centers and panel boards to the motor, equipment, outlet and device earthing lugs.
b) Main Earth Loops
   - Fix in mechanical equipment rooms and other areas indicated on the drawings, in convenient locations, allowing two return paths to earth.
   - Fix copper tape to structure with copper or brass saddles and/or screws. Make tees and straight joints by riveting and seating, welding or brazing.
   - Make branch connections between main loop and major equipment, such as switchboards, switchgears, motor control centers and large motors, with copper tape of same size as main loop tape.
   - Make other branch connections to equipment with copper conductors of size not less than half that of the relative phase conductor.
c) Removable Earth Links
   - Fix in every main earth lead to enable the electrode system to be disconnected for testing.
   - Install in an accessible position, above ground as close as possible to the earth electrode.
d) Exposed Earth Cables
   - Install and locate to provide maximum mechanical protection, utilizing ceiling corners,

suspended ceiling and webs of beams as much as possible.

e) Bolted Connections
   - Multiple bolt type.
   - Where bare copper is bolted in connections contact surfaces shall be silver electroplated.

f) Brazed Connections
   - Where earthing terminal connections are to be brazed to equipment, thoroughly clean metal prior to brazing and repaint impaired surfaces to prevent corrosion.

g) Connections Between Dissimilar Metals
   - Protect by
     (i) Painting with a moisture resistant bituminous paint or compound, or
     (ii) Wrapping with protective tape to exclude moisture.

h) Equipment Earthing
   - Connect all non-current carrying metallic parts of the electrical/mechanical installation to the earthing system.
   - Non-current carrying metallic parts of the electrical installation include:
     (i) Metal conduit cable armour (steel and aluminium) raceways, outlet boxes, cabinets, and the like.
     (ii) Exposed metal parts of apparatus.
     (iii) Enclosures, doors, grilles, barriers and the like protecting or shielding electrical equipment from direct access.

i) Series earthing of one piece of equipment to another is not acceptable.

j) Motors Earthing
   - Connect the motor terminal box to the relative earth loop. The terminal must be mechanically connected to the frame or, where this is not feasible.
   - Extend the earthing conductor through an insulated bushed opening in the connection box and connect to the frame.

k) Main Switchboards, Switchgears And Motor Control Centers Earthing
   - Connect the special earthing lug or busbars inside the cabinet to the main earth copper tape.
   - Connect all parts of the switchboards, switchgears and motor control centers other than “live” parts, to the earth bar in the board in an approved manner.

l) Connect an earthing conductor from the main distribution earth busbar to an earth connector welded to the cabinet and earthing bushings on the incoming and outgoing feeder conduits.

m) Bus-Duct Feeders Earthing
   - Connect the green coded earth busbar directly to the earth bus-bar in main switchboard with earth copper tape.

n) Connect steel and aluminium armour to the earthing system.

o) Earth Rod Electrodes
   - Drive extensible rods of the same diameter into the ground, either manually or by power driven hammer, to a suitable depth to obtain low resistivity in the particular soil.
   - Weld earth connectors to the top of the rods, in sufficient number to make connection with all incoming cables.

p) Earth plate electrodes shall be used where ground resistivity is low but increases with depth or it is not possible to go deep into soil. Terminations shall be protected against corrosion.

q) Lightning Protection
   - Lightning air terminals and down conductors for lightning air terminals shall be provided and shall be min of 15 mm diameter tinned copper (air termination rod) 0.8 metre long with top spike. Roof conductors and down conductors shall be of PVC sheath 3 x 20 mm copper tape or copper conductor size 50 mm2 PVC colour to be approved by the Engineer. However copper tape may be used.
   - Air termination rods shall be securely anchored and welded. Down conductors shall be run along the outer surface of the wall or column of the building. Down conductors shall be as short as possible protected and directly connected to earth pit. Anchoring bolts shall be

used to hold roof conductors and down conductors in firm position. Lightning conductor connectors shall be provided for conductor splice connections and conductor terminal connections. The connectors shall be heavy duty, cast metal and shall have hex-head screws in the bodies and holes in the tongues for bolts. Handrail and structures in the vicinity of the lightning protection system, if any, shall be bonded to the system by 50 mm2 PVC sheath copper.

- Suitable concrete earth pit and cover supplied by the same lightning protection system manufacture shall be provided.

r) Testing
- Testing earth electrode resistance by earth resistance tester.
- The resistance of the earth electrode shall not exceed 10 ohm.
- Install additional earth electrodes if these figures are not met.

12.13 Electrical Testing

12.13.1 General

a) The Supervisor shall be authorized to inspect, examine and test at any reasonable time and in the premises of the manufacturer the quality of the material used for the equipment to be supplied. These work inspections shall include but not be limited to the following equipment: lighting fixtures, emergency power equipment, switchgear, switchboards, motor control centers, drives, main and sub-main distribution boards. He shall also be authorized to verify the qualifications of the staff employed by the manufacturer.

b) Should part of the equipment be subcontracted to another manufacturer, the Contractor shall ensure that the Supervisor is authorized to inspect, examine and test the equipment in the premises of the Sub-Contractor.

c) These inspection, examinations and tests shall not relieve the Contractor from any of his obligations under the Contract.

d) The Contractor shall notify the Supervisor in writing at least 15 days beforehand of the date and place at which any equipment shall be available for tests to be made according to the provisions of the Contract. Should the Supervisor not have appeared at the place indicated within ten days following the date indicated by the Contractor, the latter shall proceed with the tests and it shall be deemed that they had been witnessed by the Supervisor. The Contractor shall send the Supervisor duly certified copies of the results of the tests.

e) The Supervisor shall notify the Contractor of his intentions to attend the test 24 hours beforehand.

f) Should the Contract provide for tests to be made in the premises of the Contractor or any Sub-Contractors or suppliers, the Contractor shall provide free of charge any assistance, labour materials, electricity, fuel supplies, equipment and instrument required and which can be reasonably requested for these tests to be carried out efficiently.

12.13.2 Testing

12.13.2.1 Tests at the Manufacturer's Works

a) All tests or inspection at the manufacturer's works shall be in accordance with the relevant IEC or such other standards as approved by the Supervisor.

b) All tests or inspection at the manufacturer's works shall be accompanied with test or inspection certificates showing all the relevant information and details relating to the test or inspection.

c) Two copies of Test Certificates signed by the Manufacturer's shall be submitted to the Supervisor on or prior to the dispatch of equipment to site.

12.13.2.2 Electrical Installation Testing

a) On completion of the entire electrical installation work or any separate or distinct part thereof, the Contractor shall notify the Supervisor, in writing, that the complete part of the electrical work is ready for inspection. Before doing so, the Contractor shall perform initial trial tests and test, correct, adjust, balance, regulate, etc., the section concerned as necessary until the required conditions are obtained.
b) The Contractor shall supply all instruments and tools required for carrying out the tests.
c) (If necessary) In case that the above-mentioned tests are satisfactory and no errors or faults appear in the installation, the Contractor shall submit the necessary test forms, duly filled out, to the local electricity supply authority and to repeat, if necessary, the tests in the presence of local electricity supply authority's inspector.
d) The Contractor shall follow-up and makes all necessary arrangements with the electricity supply authority for the purpose of providing permanent electricity supply services to the new facilities.

12.13.2.3 Test Instruments

a) All instruments which are to be used for the purpose of testing (at manufacturer's works or site) shall be approved by the Supervisor and if called for by the Supervisor, shall be calibrated by an independent recognized official authority at the Contractor's own expense.
b) Particulars of the calibration shall be given on the test certificates. Re-calibration of any instrument after testing shall be carried out when requested by the Supervisor. Should an instrument show any difference in readings between the first and second calibrations, both the test and calibration shall be repeated, if so required by the Supervisor.

12.14 Installation works of electrical facility

Installation, assemblage or adjustment of equipment shall be executed after enough examining a design drawing and a manual provided by the manufacturer.

An equipment base founded with concrete shall be fixed with an anchor bolt before laying concrete. A conduit shall be buried before laying concrete and shall be given enough time to cure the concreted surface.

When installing equipment, the contractor shall examine the appearance of a concrete foundation including cracks, holes, or foreign substances, and check the location and figure of foundation, its bolt holes. or buried metals. After he confirms that equipment has been constructed in accordance with the drawing, it can be installed.

When attaching a panel to a wall. A foundation bolt shall be fixed onto the wall first, and then stuck to a panel.

Equipments shall be welded to structure or fixed with a bolt having enough strength to support the equipment's weight.

Before installing an equipment, the constructor shall clean dust or foreign substance happened during storage or transportation. And check damage, oil leaking, or other problems.

When transporting or installing equipment, the contractor shall pay an extra attention not to break equipments, meters, or relays or change the fixed value.

After being fixed hard with a foundation bolt, an equipment shall be operated or adjusted. and then checked by a Supervisor.

Adjustment of an important equipment shall be done under the direction of a Supervisor.

When transporting equipment, the contractor (constructor) shall pack completely and then safely transport to its final destination.

When unpacking at an installation spot, the contractor (constructor) shall unwrap the package using appropriate hand tools and be cautious not to give any shock to the equipment.

The wrapping, transporting or unwrapping of main equipments shall be done under the direction of a supervisor. If a damage is done or a malfunction happens, the contractor shall notify the manufacturer instantly and repair.

Each equipment shall be balanced on s base channel. Then it shall be correctly arranged and fixed without distortion and strongly. The contractor shall examine the drawing thoroughly not to misconnect a bus bar or an electrical wire and make the appearance beautiful and well-ordered.

The equipment requiring assemblage in the field shall be assembled and installed after a drastic examination of its specification and other matters under the direction of a Supervisor.

When assembling accessories connecting panels using a packing, the constructor shall paste adhesive on both sides of packing, and be cautious not to have excessive or lack fastening bolts.

When installing a foundation bolt on a wall or a floor, the contractor shall consult his Supervisor in advance.

The location of equipment shall be in accordance with the drawing. When a change in the location for a cable Hole(Slab Opening) or others, the contractor shall consult a Supervisor.

After installing an equipment, the contractor shall check ground terminals and connect them.

MCC panels shall be installed on a concrete foundation height more than 50㎜. If cable tray is installed to under MCC, MCC panel shall be installed on a shape steel foundation of "ㄱ or I" type height more than 300㎜. Anchor bolts and nuts shall be of hot dip galvanized steel or stainlees steel.

12.15 Particular specification for electrical works

12.15.1 Scope of Work

Contractor's scope of work shall include designing, manufacturing, factory testing, inspection by qualified authorities, delivery, installation, test-run, hand-over and etc. Even if any item that is not stated in this specification, all necessary items for satisfactory operation of the site shall be supplied.

12.15.2 Condition

All equipment that is supplied and installed shall be used for construction of Pumping Station.

The design of equipments shall take characteristics and climatic conditions of the work site in consideration, all equipment and the work shall be adapted to the conditions of the work site.

12.15.3 Oil Immersed Transformer

Three phase transformers, H-pole(or ground) mounted, oil immersed, with standard accessories.

Routine tests and first filling oil included.

Design, manufacturing, routine tests and tolerances is according to IEC standards.

- Rated power : Refer to Drawings
- No. of phases : Three phase
- Type of installation : Outdoor
- Cooling medium : Mineral oil
- Type of cooling : ONAN
- Method of connection : Delta (HV) – Star (LV)
- Type of tap changer : Off load
- Frequency : 50 Hz
- Primary system voltage : 11 kV
- Primary voltage : 11000 V
- HV tapping by links (off circuit) in : 2.5%, +7.5%, -7.5%
- Secondary system voltage : 400V
- Secondary voltage : 400 -240 V
- Considering that the voltage drop of the power supply system is large, the secondary voltage of the transformer was selected as 400V.
- HV impulse Voltage peak in kV : 75 kV
- Power frequency kV rms : 28 kV
- Vector group : Dyn 11
- Max. ambient temp. in Deg. C : 45
- Altitude lower than k in meter : 1300 ~1400
- Temp. rise in winding/soil in) Deg. C : 65/55
- LV winding withstand voltage (1 min) : 2.5kV

12.15.4 Diesel Generator

- TYPE of installation : Indoor
- Control Panel : Mounted Type
- Operation Condition : Prime
- Rated Capacity (Prime) : Refer to Drawings
- Frequency : 50 Hz
- System voltage : 400V
- Phase : 3 ϕ 4 W
- Power factor : Lag. 0.8PF
- Pole : 4 Pole

12.15.5 400V Motor Control Center Panel

The LV panels (MCC) shall be designed for and divided following:

- In-coming
- For feeders and motor starting, operations
- Type : Indoor standing one-side panel
-

In-coming section

- Incoming supply circuit breaker.
- Digital Meter
- Current transformer
- Potential transformer
- Automatic Transfer Switch (ATS)

Feeders and controls

- main breakers : MCCB(molded case circuit breaker)
- Each distribution breakers : MCCB(molded case circuit breaker)

- Circuit for motor starting and operation
- Motor protection relay (MPR)
- Static Condenser
- Auxiliary relay
- Magnetic contactor
- Manual transfer switch/Auto transfer switch (Local/Remote)

Motor Control Center Panel shall be manufacture by followings

- Below 15kW : DOL starter
- Above 15kW ~ Below 30kW : △-Y (Star-Delta)
- Above 30kW : Soft-starter
- Control speed : Inverter

12.15.6 Each Pumping Station

1. Kirtipur Pumping Station

a) Oil Immersed Transformer
- Type of installation : outdoor (H-pole)
- Rated power : 3phase, 150kVA
- Rated voltage : 11kV/400-240V
- Method of connection : △-Y
- % Impedance : 4%
- Type of cooling : ONAN
- Type of tap changer : Off load

b) Diesel Generator
- Type of installation : Indoor (generator room)
- Control Panel : Mounted Type
- Operation Condition : Prime
- Rated Capacity (Prime) : 129kW/161kVA
  The rated capacity can be adjusted slightly as per manufacturer specification.
  However, the capacity should be enough for full load operation and motor starting.
- System voltage : 400V
- Phase : 3 ϕ 4 W
- Power factor : Lag. 0.8PF

c) 400V Motor Control Center Panel
- Type : Indoor standing one-side panel
- Type of installation : Indoor (electrical room)

Size (Approximate value) : Refer to Drawings
Main breakers : Refer to Drawings
Distribution breakers : Refer to Drawings
- Circuit for motor starting and operation : Refer to Drawings
- Static :Condenser : Refer to Drawings
- Load list : Refer to Drawings and Capacity Calculation

SECTION VI-D: TECHNICAL SPECIFICATIONS SYSTEM STABILISATION SERVICES (SSS)

1 SYSTEM STABILISATION SERVICE REQUIREMENTS

1.1 Scope of the System Stabilization Services (SSS)

The scope of the System Stabilization Services (SSS) shall include necessary upkeep and maintenance of the DMA based Distribution system. The Contractor shall manage and maintain the DMA based Distribution network progressively, based on successful trial run and commissioning.

The Contractor shall provide SSS for the Water Supply Distribution System for a period of 12 months after commissioning of each Section of the Works.

The scope of services of the Contractor in brief shall include but are not limited to:

1 Managing the Water Supply system downstream of storage reservoir-tanks (SRT) and/or overhead tanks (OHT) and/or pumping stations including Primary Pipeline Network, OMUs, District Metered Areas (DMA) inlet points and DMA Network pipelines up to the Consumer meters, at the minimum service levels established during the initial (trial run and commissioning) period without further deterioration.

2 Monitoring the baseline data on water loss for the Primary Pipeline Networks and for each DMA and reduce / limit nonrevenue water in the system.

3 Network Management including flow and pressure monitoring and regulation at the DMA Inlet Points and or Critical Measurement Points, established in the network.

4 Carry out leak detection and repair as item 10 below.

5 Carry out meter reading by trained staff as Items 4.4 below.

6 Providing new Connections / disconnection / meter replacement and necessary updating of the database as maybe required as per directives and approval by Employer, Engineer.

7 Carry out water audits as per item 11 below.

8 Carry out water quality test as per item 12 below.

9 Attending to Consumer Grievances, Consumer Services including attending to complaints received and their satisfactory resolution.

10 Providing periodical report on the Water Supply Network. Develop an Information management and report on overall performance of the Distribution System, including for each DMA.

11 Manage a team of professional and technically equipped team to provide all System Stabilization Services for the Distribution system, with adequate resources to carry out day to day activities.

12 Coordination with the Kathmandu Valley Water Supply System SCADA Operator to ensure uninterrupted communication of all necessary signals and data to allow data acquisition.

13 Perform a Demonstrative Performance Period as described in Section 2, items 2.1 to 2.3 below.

14 Prepare and implement an Emergency Response Plan and carrying out necessary actions to deal with emergency situations as per the Plan.

15 Prepare and implement a Training and Capacity Building Plan and provision of training to staff of the Employer.

All necessary replacement of assets, repairs and also servicing shall be carried out to maintain the listed facilities in fully functional condition to meet the output requirements.

1.2 General Obligations

The general obligations of the Contractor for System Stabilisation Services shall include, but are not limited to:

(a) Management and monitoring of the "As Built" components, as required and reporting to the Employer /Engineer.

(b) Work cooperatively with Employer, Engineer and all agencies including the Kathmandu Valley Water Supply System SCADA Operator, to ensure the efficient and coordinated management of the entire water supply distribution system;

(c) Work in a professional and confidential way and not release any information relating to the works and services without the authorisation of the Employer/Engineer;

(d) Engage with consumers in a courteous and helping manner at all times and assist with enquiries and manage complaints promptly;

(e) Undertake all the maintenance and management tasks, and activities as required in accordance with modern practices and safety standards; maintaining all the equipment and tools and making necessary repairs. Standard practice of repair and maintenance should be followed during system stabilization period also. Pipe, fittings and appurtenances used for repair and maintenance should be of same standards which were used in installation/construction phase, temporary arrangement shall not be accepted;

(f) Proposing for the Engineer's approval and providing required spares and maintaining adequate inventory of required pipes, fittings and accessories or equipment for repair of system**;**

(g) Manage the supply to each DMA based on assessed demand, in coordination with the Kathmandu Valley Water Supply System SCADA Operator as necessary; The Contractor should provide a SCADA Expert as necessary to ensure that all data and communication is incorporated into the overall Kathmandu Valley Water Supply SCADA System operated by KUKL.

(h) Periodic and routine maintenance as per the manufacturer's recommendations and recommended schedules, as well as emergency (breakdown) maintenance as and when required. Maintaining sufficient inspection/patrolling vehicles and material hauling vehicles and any other vehicles/ machinery/ equipment for adequate and timely repairs and/or for routine/ periodic maintenance/ patrolling of the system;

(i) Providing all necessary machinery for proper and timely maintenance activities. All the repair and maintenance work has to be done on the war footing basis to ensure the services are restored at the earliest;

(j) Develop and maintain records of all pipeline assets and fittings and fixtures (such as valves and flow meters) and keep the asset register up to date; Maintain all distribution pipelines, fitting, fixtures and instruments in good working order;

(k) Periodically inspect the pipelines and identify any maintenance actions that need to be taken including the repair of leaks, and undertake these actions;

(l) Periodically inspect valves, flowmeters, sensors and the associated meter assemblies and report any connections that have been tampered with, or illegally made to the Employer/Engineer and take follow up actions as required;

(m) Periodically inspect all other water consumer points and report tampering with or malfunction of equipment to the Employer/Engineer and take follow up actions as required, including necessary repairs and replacement works;

(n) Provide / replace any faulty, inaccurate, broken / stolen / damaged meters immediately after identification of such, and update the meter register accordingly; When authorised by the Employer/Engineer install a connection and meter for any new consumers of receiving a notification of such and update the meter register accordingly;

(o) Maintain a log of all maintenance activities in consultation with the Employer, Engineer

Contractor shall maintain full functioning of Water Supply Distribution system downstream of Storage Reservoir Tank (SRT) / Overhead Tank (OHT) / Pumping Station (PS).

All assets (pipes, valves, instruments, flowmeters, pressure sensors etc) laid / installed under the contract must be maintained in proper functional conditions which will help in ensuring desired level of service from the system and help in ensuring the planned service life.

(p) Before any replacement of measuring devices; Bulk Flow Meters & household revenue water meters record of consumed/used water should be taken properly and informed to system operator and employer/engineer immediately.

(q) All house connections should be metered before start of system stabilization services. Any new connection provided during system stabilization period should also be metered. GIS database of new connection should also be updated immediately after providing new house connection. Any house connection without GIS database shall not be acceptable.

1.3 Measurement and Rate

The Contractor shall be compensated for the System Stabilisation Services, to the requirements in this Section VI-D Technical Specification, including performance parameters being within limits for any reporting period.

The reporting period for the performance of the SSS shall be months. The mode of measurement for undertaking the services, shall be as the Payment Terms detailed **in Section 12** below. Pro-rata basis shall be applied for any part of month, in which any DMA / OMU is managed.

The number of WS Connections, managed and maintained shall be as per GIS database and shall be considered payable only where meters are read and reported as functional.

2 Document Submittals

2.1 Documents and Submittals

The Contractor shall prepare and submit the following documents prior to the commencement of the System Stabilisation Services (SSS) period to allow time for review and any necessary revisions:

Document Submittals	Due Date
Emergency Response Plan (ERP)	The ERP shall be submitted not later than 30 days before the Commencement Date of SSS period of each section.
Training and Capacity Building Plan (T&CP)	The T&CP shall be submitted not later than 30 days before the Commencement Date of SSS period of each section.

2.2 Emergency Response Plan

The Contractor shall prepare an emergency response plan (ERP) which shall identify all possible risks anticipated during the SSS period. The emergency response plan shall explore and outline at least the response on the following emergency situations:

- Major pipeline failure (Sudden breakdown of trunk mains, and or damage to primary / secondary main etc);
- Major loss of Supply;
- Contamination of Water Supplies;
- Extreme weather event (Flooding, extreme temperatures) that will have a major impact on the water supply system;
- Natural disaster (Earthquake, Landslides etc);
- Serious injuries or deaths to staff or the public;
- Loss or damage of property due to any events above

The Emergency response plan (ERP) shall be an integral part of the water supply routine operation. The Emergency Response Plan shall be organised typically to deal with:

1. Communication Protocols
2. Emergency Response Procedures
3. Emergency Equipment and Water Supplies
4. Water Supply System Hazard Review
5. Water Supply System Security

The emergency response plan shall be submitted to the Employer/Engineer for review and approval, and shall include necessary mitigation measures, which shall be part of the actions taken up / implemented during the O&M services.

2.3 Training and Capacity Building Plan

The Contractor shall submit a detailed plan for Training and Capacity Building for staff / personnel nominated by the Employer. The Training and Capacity Building activities proposed to be undertaken shall be got done in concurrence of the Employer/Engineer.

The training shall be organized in two (2) stages as follows:

- Basic technical training education to be carried out during the final stages before Commissioning of each section, through literature, manuals, handouts demonstration at site etc.
- Intensive on-the- job training during commissioning and the SSS period.

The training and Capacity building activities shall be detailed in the plan and shall be aligned with the requirements of the Employer/Engineer and nominated staff to carry-out the activities after the end of the contract.

Soft copies (Editable files) and Hard copy of the Training courses including contents and documents will be submitted to the Employer/Engineer. Soft Copy of the Presentations prepared as part of the Training courses shall be shared for approval.

2.4 Measurement and Rate

Preparation of Emergency Response Plan and Training and Capacity Building Plan are incidental to the works and no separate payment will be made. Both the documents shall be subject to the approval and satisfaction of the Employer/Engineer.

2.5 Updating the Operation and Maintenance Manual

The Contractor shall submit the Operation and Maintenance (O&M) Manual, prior to commencement of System Stabilisation Services period, and aligned with Employer's Requirements Section VI-A, General Requirement, item 9.11.

The Contractor shall ensure the O&M manual is updated suitably with suggestions and recommendations and observations during the maintenance of the network. The O&M manual, suitably updated, shall be submitted prior to the completion of the SSS period.

3 Consumer Grievance Redressal System

The Contractor shall facilitate and support the Employer/Engineer in addressing all Consumer grievances and complaints on a day-to-day basis and addressing them in co-ordination with the Employer/Engineer. The Contractor shall manage a dedicated team of Technicians, Plumbers to attend to the Consumer Grievances on a day-to-day basis and to immediately carry out repairs and replacements as necessary to resolve the issue.

3.1 Consumer Grievance Redressal Mechanism

The Contractor shall provide manpower and resources in receiving and recorded the complaints including attending, resolving and closing the consumer complaints received and forwarded by the Employer/Engineer to the Contractor.

The Contractor shall maintain an electronic register to record all grievances, forwarded by the Employer/Engineer and address the same on priority

The Cost of establishment and maintaining the Consumer Grievance Redressal Centre shall be included in the Contractor's fees.

3.2 Functional Requirements

An electronic registry shall be maintained by the Contractor. The registry shall include detailed database for consumer grievances including, but not limited to:

- Time and date of grievance received
- Complaint number
- Mode of receipt of complaint
- Consumer Name, and Consumer identification number
- Supply Point (SRT / OHT / PS) and DMA / Sub-DMA number
- Nature of complaint
- Action taken report
- Time and date of resolution of complaint
- Specified time period for resolution and actual time period for resolution
- Time and date at which Consumer is provided with response
- Status of resolution, if pending

The electronic register should be compatible to be uploaded to the Employer's website / portal, if so desired by the Employer/Engineer.

3.3 Nature of Complaints

Unless specified otherwise, all complaints shall be divided into the nature of complaints. These may include but not limited to:

- Consumer Complaints (No water supply / low supply / low pressure etc.)
- Distribution Network Complaints (Notified leak in the distribution, low system pressure, water quality – turbidity, smell, etc.) and
- Complaints and or requests related to connection / consumer meter (complaints related to new connection / disconnection, meter replacement).

3.4 Measurement and Rate

No separate payment shall be made for managing the Consumer Grievance Redressal System. The costs for the same shall be included in the monthly SSS charges.

4 Consumer Management Services

4.1 Installation of new WS Connection

As part of the SSS, whenever specifically directed by the Employer/Engineer, the Contractor shall provide new water supply connection and install revenue water meters at the premises of the consumers, including all requirements of above Section VI-C Technical Specifications, Section 5.3 and as shown on the Drawings.

All consumer water meters shall be installed within the premises of the consumers as specified in Technical Specification. The location of the consumer water meter shall be such that the same could be accessed by the meter reader. The location of the consumer water meter shall be in-principle acceptable to the Consumer and the Employer/Engineer.

An in-principle agreement will be signed between the Employer/Engineer and Consumer regarding the installation of the consumer water meter. The Contractor is to give at least seven (7) working days' notice of its intention to install or replace a meter.

Each meter should be read and recorded, when the same are being installed at the consumer premises.

The GIS database of the new service connection including initial water meter reading and location shall be collected and submitted to the Employer / Engineer.

4.2 Replacement / Disconnection of WS service connection

Whenever specifically directed by the Employer/Engineer, the Contractor shall disconnect / plug existing water supply connections as appropriate. Disconnections / plugging of existing connections shall be got done with approval of the Employer/Engineer.

In case, where existing water supply connections are replaced, the same shall also be carried with due instruction of the Employer/Engineer.

The Contractor shall ensure that data and information on disconnection / replacement is suitably updated in the GIS and submitted to the Employer/Engineer.

4.3 Replacement of damaged / non-functional / non-readable meters

If the Contractor or the consumer suspects that a meter is not accurate in any respect, the discrepancy or suspected discrepancy shall be immediately reported to the other Party in writing along with any evidence in support of such claim and the Contractor shall arrange for testing of the relevant meter at an accredited meter testing workshop or replace the same with a new water meter.

Meters which are damaged and are non-readable due to ingress of moisture shall be suitably replaced.

4.4 Meter Reading Responsibility and Procedures

Meter reading activities shall be carried out by the Contractor.

The Contractor shall deploy trained meter readers to collect the meter data and share the same with the Employer/Engineer, each month.

The Contractor shall undertake the following measures:

1. Develop meter reading procedures, train meter readers and deploy them.
2. Register all meter readings in the appropriate meter reading database;
3. Develop and implement a plan to ensure that:
    - all consumer meters are accurate;
    - all consumer meters are read and digits are visible;
    - all consumer meters are in suitable locations and accessible for reading;
4. Respond to reports of malfunctioning consumer meters.

To ensure the meter records are correctly read, the meter readers shall ensure photographs of the meter records, distinctly showing the digits. The contractor shall submit all meter data in excel format with GIS data of consumers and meter record. Photographs of the meter records shall also be submitted.

4.5 Maintain and Update e-consumer database

The Contractor shall be obliged to attend to activities as directed by the Employer/Engineer in respect to:

- sanctioned new service connections,
- change of ownership for existing connections
- disconnections in case of defaulting consumers and reconnections and

- dealing with the un-authorized or illegal connections;

The contractor shall maintain a Consumer Contact Management System, record and process all consumer contacts and provide the contact data to the Employer/Engineer. The Consumer Contact Management System shall incorporate all new connections, disconnections, change in consumer details to facilitate serving the consumers.

4.6 Measurement and Rate

Consumer Management Services

No separate payment shall be made for Consumer management services including maintaining the consumer database and updating the same including meter management services. The costs for the same shall be included in the monthly SSS charges.

For New WS Connection and water meter and or Dis-connection

For new WS connection including meter installation and dis-connection the same shall be paid for as per Bill of Quantity rates offered under the contract under BoQ Section C.

For installation of new water meter or replacement of any defective / damaged water meter not accountable to the contractor, the same shall be paid for.

Measurement shall be based on each water meter installed successfully and consumer database being recorded and submitted to the satisfaction of the Engineer.

Domestic water meters, which are non-functional / non-readable (due to ingress of moisture or other reasons) or have been proved to provide erratic readings, shall be replaced by the Contractor at his cost with no extra payment from the Employer.

5 Maintenance Management System

5.1 Scope and Requirements

As part of the SSS, the Contractor shall maintain an electronic register to record all maintenance activities carried out, during the SSS period, for each DMA and the Primary Pipeline Network. The Contractor is to undertake at least the following maintenance in accordance with good practice during the SSS phase.

(a) Planned inspection of all valves, pipelines and instruments (flowmeters, pressure sensors etc);

(b) Record of preventive maintenances actions taken, as per approved O&M manual

(c) Maintaining a history of water supply distribution faults and responsive actions taken.

(d) Maintain an inventory spares and consumables necessary to maintain the supply of water or respond to adverse events;

(e) Roster competent maintenance personnel 24/7 to respond to water supply distribution system faults;

The Contractor's personnel shall maintain a log of all maintenance activities undertaken in an electronic register / format.

5.2 Preventive management

Following activities shall be carried out, as a part of preventive maintenance (All inspections should be structured and recorded separately & properly):

(A) Pipeline inspections (Including walkover Survey)
(B) Valve inspections
(C) Inspection of Instruments (Flow-meters, pressure loggers etc.)
(D) Tank inspections, if applicable
(E) Necessary preventative maintenance work on a periodical basis.

5.3 Reporting

Report monthly on the preventive maintenance activities of the water supply distribution system including details of repair and maintenance activities undertaken.

5.4 Updating the WS System in GIS and Asset Data

The Contractor shall update the GIS database with details of repair activity undertake (repair to pipeline, valves, inter-connections etc), whenever these are laid / installed.

The GIS database should be in line with the data and information collected for the contract and adequate for developing the hydraulic model.

5.5 Measurement and Rate

No separate payment shall be made for deploying the maintenance management system and updating the GIS database for WS system including managing and listing the details of repair and maintenance activities

6 Reporting Requirements

6.1 Monthly Performance Report

Contractor shall prepare Monthly Performance report (MPR) for each month of SSS and submit to the Employer and Engineer. The monthly performance reports shall be submitted by the 10th day of the next month.

The reports shall contain precise information in specific format along with brief write-up on specific matters needing attention of concerned agencies. Overall reporting formats are to be submitted by the Contractor for finalization and approval by the Employer/ Engineer and may have to be modified from time to time.

The MPR shall include, but not limited to:

(a) Summary of the service level data for each DMA with respect to non-revenue water, supply duration, average system pressure maintained at DMA inlet / Critical Measurement Points.

(b) Flow and Pressure data from each DMA Inlet Points and at the Critical Measurement Points showing daily flow and pressure variations (graphically plotted).

(c) Details of consumer connections / new service connection / dis-connection during the reporting period including analyzed consumption data. (Provide information of meters read and meters

not read, assessment of the non-revenue water in the system, based on metered data for each DMA.

(d) Water Audit report for High Consumption users including identification of High Consumption usage consumers and recommendations on demand management.

(e) Summary of consumer grievances and complaints and resolutions effected with timeline for addressing the same.

(f) Summary of the monthly data from each of the Management Information Systems (as described in sections 3, 4 and 5 above) incorporating repair / replacement works undertaken including (i) Description of the work / activity, (ii) time taken for the activity (iii) details of repaired / replaced asset and (iv) personnel involved.

(g) Details of maintenance activities (preventive / routine undertaken) including walkover survey.

(h) Exceptional reports on incidents and emergencies (Extreme weather event, natural disasters, injuries or deaths to staff during working hours etc)

(i) Attendance of Staff and Personnel

(j) Details of Training and Capacity building activities carried out.

(k) Critical issues and suggestions and recommendations for improving the supply system.

(l) Photographs of various activities carried out including major pipeline repairs / leakage identification and plugging, Training programmes.

(m) Leak detection activities, as may have been carried out, for any DMA and repairs, if any.

(n) Any record / data as desired by the Employer / Engineer.

Reporting requirements shall be through hard copy as well as soft copy format. Unless otherwise mentioned, the number of hard copies submitted shall be six (6).

6.2 Record Keeping

Besides, submission of reports, the contractor shall have to keep records on daily data on operation and maintenance (as applicable). The following are the specific data requirements that are required to be maintained during the O&M service period:

Table 1: Record Keeping

Sl No.	Description	Contents
1	Attendance book	Attendance of personnel, workmen and supervisors
2	Consumer Grievance Redressal	Details of Consumer Grievance including redressal
3	Repair and maintenance book	List of Repair activity carried out. Record of regular, preventive and breakdown maintenance. Record of fittings, fixtures, spares used.
4	Consumer database	Consumer details in GIS format, continuously updated.
5	Asset Data	Asset Data (Tanks, Pipes, Valves, Flowmeters, Pressure transmitters etc) including updating as required.

Standard forms to be used with KUKL/PID Website

6.3 Reporting on baseline parameters

DMA The Contractor shall ensure the following data is provided for each DMA, as follows:

Water Loss Parameter:

- Average Supply (As recorded in DMA inflow meter and in Primary Pipeline Network) per day in Kilo Liter (KL)
- Assessed Consumption per day in KL (Based on meter records)
- Unavoidable Real Loss (UARL) per day in KL
- Assessed Non-revenue water / water losses per day in KL,
- Average System Pressure, in each DMA

Consumer Grievances Redressal

- Nos. of Consumer grievances recorded / received from Employer/Engineer
- Nos. of Consumer grievances attended
- Nos. of Consumer grievances, addressed satisfactorily
- Nos. of Consumer grievances, pending to be addressed and the reasons.

6.4 Measurement and Rate

The costs for the preparation of Monthly Performance Report shall be included in the monthly SSS charges and no separate payment shall be made Engineer reserves the right to ensure that all necessary information is made available and included in the monthly performance report and in case the same is not made available / shared, deduct proportional charges for the same.

7 Contractors Personnel and Equipment

7.1 Minimum Staffing Requirements

The Contractor shall provide experienced technical, administrative, and non-technical personnel, and labour necessary to maintain the facilities properly, safely, and efficiently. Necessary stand by provisions shall have to be made to take care of absences / leave.

The Contractor shall submit the Curriculum Vitae of Contractor's personnel to the Engineer for acceptance at least two months (60 days) before the anticipated commencement of the system stabilization period.

Normal duty hours for the Contractor's personnel may be modified as necessary and agreed by the Engineer.

Mobilization and deployment of the staff shall be based on successful trial run and commissioning of DMAs of each section and approval of the Employer/Engineer

The minimum personnel requirements for the Contractor's key personnel for System Stabilization Services shall be as follows.

Table 2: Personnel Requirements: Minimum

Position	Minimum Qualifications and Experience	Suggestive Tasks to be managed
A: Technical Team		
1 no. System Stabilisation Services Manager for the Contract.	BE in Civil Engineering or Equivalent with 7 years' experience in water supply or related field.	(a) Overall Management of the WS System. (b) Preparation of Monthly Performance report. (c) Liaison with Employer/Engineer on key issues, inter-office co-ordination for new connection, disconnection, and pipeline repairs etc. (d) Ensure day-to-day functioning is smooth and water loss targets are maintained. (e) Ensure Inter-Office Co-ordination between various teams.
Sr. Engineers – Maintenance One for Each Section	BE in Civil Engineering or Equivalent with minimum 5 years' experience in water supply or related field.	(a) Screening Meter Data including Meter Data Analytics; identifying potential abnormalities in meter consumption data, data trends. (b) Prepare Water Balance Report (c) Consolidate the monthly Consumer Grievance Report (d) Compilation of List of Potential High Consumption Water Users as necessary / based on consumption records. (e) Recommend for Water Audit to be carried out for all High Consumption Users. (f) Coordinate for replacement of defective / damaged water meters. (g) Ensure record of all pipeline repair works is included in Maintenance Management System.
B: Consumer Grievance Redressal Team		
Executive – Grievance Redressal (One for each Section)	Bachelors with minimum 2 years of relevant experience	(a) Reviewing and Tracking of Consumer complaints including ensuring all complaints are duly addressed. (b) Forward the consumer complaints based on review of the nature of complaints. (c) Review of un-resolved consumer complaints, and suggestions / coordinating for feedback to consumers. (d) Analysis of Complaints, Complaint Categorization and feedback to the DMA / Sub-DMA Manager. (e) Report on Consumer Grievance received and addressed for reporting period.
Plumber (One for each OMU).	CTEVT certified or equivalent in plumbing with	(a) Attend the consumer complaints, check and identify the problem (i.e. any internal pipeline leakage, meter non-functioning, consumer not

Position	Minimum Qualifications and Experience	Suggestive Tasks to be managed
	minimum 3 years' experience	getting sufficient pressure, Ferrule/meter chocked etc.) & resolution the consumer complaint. (b) Installation of new WS service Connection / water meters / replacement of defective / damaged meters, as necessary. (c) Replacement of defective / damaged meters (d) Conduct Water Audit for abnormal consumption (high end consumers / low consumption users) to assess the consumption. Check the consumer premises and identify the reason for abnormal consumption and report to the maintenance department. (e) File / Record resolution process and file closure report.
C: Leak Detection / Preventive Maintenance / Emergency Repairs		
Sr. Supervisor / Foreman (At least one for each Section).	CTEVT certified (Mechanical, Civil or Plumbing) or equivalent with minimum 5 years' experience	(a) Undertake leak detection activities including schedule for step test for each DMA at suitable intervals. (b) Undertake preventive maintenance activities, walkover survey. (c) Inspection of pipes, valves, fire hydrants etc. (d) Monitor and Supervise Leak repair activities including DMA commissioning.
Fitter (At least one for each Section)	CTEVT certified (Mechanical, Civil or Plumbing) or equivalent with 3 years' experience	(a) Perform leak repair works based on the findings of leak detection and report of visible leakage found. (b) Perform Valve Operation of the DMA inlet valve for control purposes, as maybe required. (c) Undertake preventive, routine maintenance of the works and walkover survey.
D: Store / Workshop Manager		
Store Manager – 1 No	Intermediate in any discipline preferably with an experience of minimum two years in store management	(a) Issuance of all materials (pipe, pipe fittings, water meters, valves, saddles) as per requisition. (b) Maintain the record of the incoming and outgoing material. (c) Purchase requisition of the material required for maintenance works to the maintenance department for approval.
E: Meter Reading		
Meter reader (As per requirement)	Class X pass with ability to read and write.	(a) Undertake visits to each Consumer and read water consumption meter data.

Position	Minimum Qualifications and Experience	Suggestive Tasks to be managed
		(b) Enter meter data in route books / data tabs, mobile phones. (c) Upload meter data into office computers collected in the field during meter rounds. (d) Confirm / Validate meter readings in cases where consumption data appears to be abnormal and record possible reasons for fluctuations. (e) Inspect meters and report on damaged / defective meters and or unauthorized connections.

Operational staff such as foreman, plumbers, meter readers, fitters, store manager etc., shall be deployed as per the requirements.

The number of staff for each position should be adequate to meet the output requirements.

The minimum number of personnel per DMA or per OMU as indicated above, shall be engaged, even when only one section is commissioned and shall be increased progressively after each DMA/OMU is commissioned.

7.2 Establishing the Workshop

A standard workshop with key mechanical equipment, tools / toolbox, shall be established within the contract area for facilitating on site repair or reconditioning of the pipeline network including appurtenances, including all critical mechanical and electrical installations as necessary to ensure lowest possible downtime of uninterrupted operations.

The Contractor shall also have the following minimum equipment for carrying on the emergency repair activities.

Table 3: Minimum Requirement of Equipment

Sl. No	Equipment	Quantity
(a)	Backhoe and front loader / Excavator	As required
(b)	Electro-fusion welding machines, Butt fusion welding machines	As required
(c)	Mobile generator	As required
(d)	Dewatering pumps	As required
(e)	Toolbox (Pipe vice, Pipe cutter, threading dies, drill machine etc)	As required
(f)	Handheld recording devices	As required
(g)	Leak detection ground phones	As required
(h)	Portable Ultrasonic Flow-meter	As required
(i)	Portable ladder	As required
(j)	Different size wrenches,	As required
(k)	Pick & axe	As required
(l)	Portable metal welding machine	As required

The Contractor shall provide necessary machinery (tools / equipment) as required for proper and timely maintenance activities. All the repair and maintenance work has to be done on the war footing basis to ensure the services are restored at the earliest.

7.3 Provision of Materials

In good time before the start of the SSS periods for each Section of the Works, the Contractor shall request the Engineer's approval propose sufficient stocks of materials and consumables as necessary to carry out the works effectively without delays.

The Contractor shall complete the supply and delivery of the full stock of materials and consumables as approved by the Engineer before the start of the SSS for each Section.

The stock is to be replenished after items are installed in the Works. However, reductions in the stock towards the end of the SSS periods may be proposed for the Engineer's approval. Reductions are only to be if approved by the Engineer.

7.4 Measurement and Rate

The costs for the Contractors Personnel and Equipment shall be included in the monthly SSS charges and no separate payment shall be made.

The supply and installation rates in Bill of Quantities Section C will apply for payment for materials utilized in the works during the SS Periods.

Any surplus pipes, fittings and valves quantities (not exceeding 10% of BOQ amounts) generated after the completion of works and deemed necessary for the future use of PID/KUKL shall be paid for at the reduced rates stated in the Preamble to the Bills of Quantities based on the Supply and Delivery rates in Bill of Quantities Section C.

8 Training and Capacity Building Plan

8.1 Scope and Requirements

The Contractor will carry-out necessary Training and Capacity Building activities to capacitate the Employer/Engineer in managing the WS system. The Contractor shall make available trainers and competent staff and shall propose schedule information that may be necessary for effective execution of the training programme.

The Contractor shall provide at his cost all local transportation, literature, computers, CDs and other related hardware and stationery to be used by trainers and trainees during the training period.

The Contractor shall provide for Training for personnel nominated by the Employer/Engineer. The details of the Training and Capacity Building Plan shall be prepared, submitted and got duly approved by the Contractor.

The Contractors would provide on-the-job training to the identified Employers personnel on aspects related to Asset Management, GIS updating Grievance redressal mechanism, breakdown and preventive maintenance, detailed procedures for installation of new water connections. The training program shall include:

1. O&M service requirements in running of the facilities
2. SCADA system and Control mechanism (Fault detection, trouble shooting, etc)
3. Maintenance management system (Preventive maintenance, trouble shooting, etc)

4. GIS based Consumer database (Collection of Consumer data, Mapping of Consumer data-base (In GIS platform), updating (addition / alteration / deletion) of Consumer database)
5. Grievance Redressal Management (Receiving and forwarding of Consumer Complaints, Tracking and monitoring of Consumer Complaints including redressal)
6. Leak detection and repair on the DNI networks (including Leak detection techniques, Identification of Leaks, repair techniques, repair parts, nighttime flow analysis etc)
7. Demand management activity (Bench-marking of water demand for consumers, Analysis of meter records and comparing estimated demand vs actual consumption, Benchmarking of demand and Identification of consumers with High consumption)
8. Conducting Household water audit including generating awareness on efficiency in water consumption and eliminating water wastage)
9. Emergency Response Plan,
10. Any other relevant as desired by the Employer/Engineer

The training shall be provided to personnel / staff nominated by the Employer. By the end of this training period the nominated personnel should be able to carry out their respective duties efficiently under the supervision of Employer's representatives and supervisory staff of the Employer.

The Contractor shall print the detailed procedures with photographic illustrations and make the required copies available for distribution to the Employer / Engineer. The shape, size, design and printing of the materials should be attractive enough to encourage its use by users.

The Contractor shall coordinate closely with the Employer/Engineer at all stages, related to time and context of the training program.

Each training program shall be conducted for a maximum of 15 personnel, nominated by the Employer. Training content and disclosures shall be made available in English (and Nepali) language. Location of the training programs shall be finalized / decided in consultation with Employer.

The training program shall run concurrently with the O&M service period, and shall be carried out for a minimum period of five (5) days, each month in consultation with the Employer.

The Contractor shall capture site photographs for the field demonstration activities and also provide videography of the activities.

Details of training program should be reported in the Monthly performance report.

8.2 Measurement and Rate

The costs for providing training activities and capacity building interventions shall be considered to be included in the SSS cost.

No separate payment shall be made for training and capacity building activities.

9 Performance Measurement and Evaluation

9.1 Water Loss Assessment based on meter reading

The Contractor shall undertake Water Loss assessment including meter data analysis, monthly and ensure that the target water loss data is maintained.

To carry-out the Water Loss assessment, the contractor shall access the continuously logged flow data from the flowmeters installed at the inlet of DMA's.

Consumption data shall be based on revenue / customer meter data readings.

In-case, where meter data cannot be read (one/two time) because meters are inaccessible (premises locked or otherwise) and or where meter digits are not visible, the Contractor shall consider past meter data records for reference, in consultation with the Engineer. In general installation of meters in accessible location is the responsibility of contractor.

9.2 Performance Measurement and Evaluation

Unless, otherwise stated, the performance parameters will be measured and evaluated following the methodology stated below:

Table 4: Performance measurement and Evaluation mechanism

Sl. No.	Description	Details
1	Parameter	Water loss assessment in the DMA / OMU
	Minimum Service Level	Water Loss in DMA / OMU shall be limited to or less than 15% of the overall supply. Water Loss in DMA / OMU shall be limited to or less than 20% of the overall supply, for intermittent supply. (Water Loss shall be proportionally worked out based on the actual supply duration. Supply duration shall be based on flow duration recorded as per DMA / OMU inflow meter). The number of connections is the number of connections for which meters have been installed and data recorded at the consumer management system in the format provided by Employer/Engineer.
	Measured by	Water Loss should be estimated as follows: System Input (From DMA or OMU meter) – Assessed authorized Consumption.
	Monitored by	"System Input (DMA Meter)" is the recorded flow data in the DMA inlet meter as registered in the SCADA or flow data stored in local RTU, as appropriate. "Assessed authorized Consumption" is the consumption of all consumer meters, as recorded by Meter reader (supported by photographic evidence). For meters, which could not be read, the consumption data should be assessed based on past recorded consumption, as available. Detailed calculation, showing the Water Loss Calculation should be submitted in each monthly report.
	Allowable Exclusions	Complaints pertaining to 'no water' at times of: • Stoppage of bulk supply, from the Water Treatment Plant / Main Storage Reservoir Tank (SRT)

Sl. No.	Description	Details
2.	Parameter	**Resolution of Complaints / Grievance**
	Minimum Service Level	90% of complaints should be resolved within the time period provided for respective category of complaint. Complaints to be resolved within 48 hours: Complaints related to water quality / Complaints related to no water supply / Complaints related to low pressure and leaks in property service connections Complaints to be resolved within 7 days: Complaints related to delay in providing connection or a reconnection of a meter, a meter not working properly, a notified leak in the distribution system.
	Measured by	Percentage of total number of complaints resolved within the respective month divided by the total number of the relevant complaints received during the month under review.
	Monitored by	An electronic registry maintained by the contractor which shall be maintained with detailed database as outlined. The electronic register should be compatible to be uploaded to Employers Website. Details of the electronic register shall be submitted in each monthly report.
	Allowable Exclusions	Complaints pertaining to 'no water' at times of: • Stoppage of bulk supply, from the Water Treatment Plant / Main Storage Reservoir Tank (SRT)

(*) Design water demand shall be assessed based consumer survey, considering domestic water demand as per norms. Institutional and Commercial and Industrial demand based on design norms.

10 Leak Detection and Repair

The scope of Leak detection shall include all leak detection surveys / investigations (using suitable equipment and technologies, including leak noise correlator and leak noise loggers, etc.) required to be carried out by the Contractor. The required leak detection equipment shall be provided by the Contractor.

The Contractor shall ensure walkover survey is carried out by its staff for the pipe sections / segments in a phased manner to ensure that there are no visible leakages. The contractor shall provide a plan for (a) walkover survey and (b) leak detection activity for each month in advance for approval of the Employer and Engineer. Details of walkover survey and leak detection activity undertaken and repair activities undertaken, if any shall be reported in the monthly report.

Walkover surveys shall cover a minimum of 5% of the pipelines commissioned in each month.

Leak detection surveys, repairs shall be repeated and/or shall continue till Non-Revenue Water in any DMA / Primary Pipeline is within the functional requirements, as stated in the above Table 4 (Performance Measurement and Evaluation Mechanism).

Leak detection activities shall be carried out as per the advice and direction of the Engineer to minimize the physical water losses and limit the same to an acceptable limit.

10.1 Specific Requirements

The Contractor shall carry out leak detection surveys / investigation as maybe required to (i) reduce the water losses in a DMA and or (ii) in-case the minimum night flow exceed the tolerance limits, and or (iii) identify location of leaks in any stretch of pipeline as per direction of the Engineer.

10.2 Repair of leaking pipes / pipe section

Leaks on main pipelines shall be repaired by using repair clamps. In case the damage is too large (e.g. longitudinal split) the damaged pipe shall be replaced by a new section of pipe, connected to the old pipe with flexible joints or flange adaptors. Intrusion of ground water into the main pipe has to be avoided as far as possible.

10.3 Repair / Replacement of Sluice Valves

Leaking sluice valves shall be replaced with new valves, even if only the stuffing box (gland) is leaking. Valves shall be installed complete with extension spindle, protecting tube and surface box or with hand wheel if the valve is located in a chamber.

Replacement of sluice valves due to inherent defects shall be dealt as per contractual conditions and shall be dealt with accordingly as per recommendations of the Engineer.

10.4 Replacement of Fire Hydrants

Leaking fire hydrants shall be replaced with new hydrants. Fire hydrants found with other operational deficiencies shall be reported to the Employer / Engineer and shall be replaced / repaired in due consultation with Employer / Engineer.

10.5 Measurement and Rate

No separate payment shall be made for walkover survey and leak detection activities, which are to be carried out to ensure the functional guarantee parameters, are met.

11 Water Audit for Consumer Connections

11.1 Scope and Requirement

Water audit for Consumers shall be carried out with directions of the Employer/Engineer.

Based on the average monthly metered consumption data, the consumers with high (above 50% of baseline demand) water consumption to very high water consumption (above 100% of baseline demand) records will be identified. Water audit shall be carried out for all high / very high consumption, through field visits to the households to ascertain the reasons for high consumption. The field inspection shall be to find out visible leaks, if any upon closing all known taps and checking the consumption during supply hours and identifying the leakages & creating an inspection check list report.

Contractor shall carry out internal water audit for such identified consumers, after receiving directions from the Employer/Engineer and submit the internal Water Audit Report to Engineer.

The Contractor shall identify all possible sources of excess consumption (including visible leakages while closing all known taps during supply hours at consumer premises and or water wastage due to tank overflows). The Contractor shall submit report to Engineer after certification of same from consumer.

The Contractor shall develop a Water Audit Form in consultation with the Engineer for reporting on the Water Audit carried out in the premises of each Consumer. The Water Audit report shall be duly signed by the representatives of Contractor and Employer/ Engineer, or their representatives, and the Consumer.

The following minimum information shall be collected during the Water audit:

- Confirmation / Validation of the information, data as per the consumer database, particularly the population data and type of usage (domestic, domestic + commercial, institutional etc).
- Meter data and meter functionality check.
- Meter accessibility for meter data reads / Visibility of meter digits etc
- Leakages from pipe, pipe-joints and fitting, ball valves etc in the service connection after the water meter including an assessment of the same.
- Wastage / overflows from the ground level tanks including provision of float valves in the storage tanks for automated closure, when tanks are full.
- Ensure photographs are taken of the meter (showing the registered data) to ensure the functionality or non-functionality, identified leakages if any in the connection, water wastage through overflows etc.
- Unauthorised tapping, if any.

Based on the water audit carried out, inferences will be drawn to the reason for high consumption / usage (like leakages, from pipes / pipe fittings / ball valves and or overflows from tank, over-usage, other usage not accounted for etc).

The water audit report shall recommend appropriate measures to be undertaken and for the reduction for water usage and also ensure further follow-up and monitoring is carried out after at least 7 days.

Detailed status of compliance of the follow-up action (2nd visit) by the water audit team shall also be reflected in the water audit form.

Unless stated otherwise and or directed by the Engineer, the Consumer shall be solely responsible for rectification / arresting of leakages after the consumer meter.

In cases where meters are inaccessible the same shall be rectified by re-installing the meters at a suitable location. Meters where digits are not visible, shall be suitably replaced.

11.2 Measurement and Rate

The costs for undertaking water audits shall be included in the monthly SSS rates and no separate payment shall be made.

The monthly SSS rates shall include, for each Water Audit, the cost of initial and follow-up visits to the consumer property, carrying out the necessary investigations at consumer premises and identifying the reasons for high consumption, and engagement of technical staff adept at carrying water audit including

necessary equipment's and the contractor submission of the duly signed water Audit form to the Employer and Engineer.

12 Water Quality Test at Consumer connection level

12.1 Scope and Requirement

Water quality Test for Consumers shall be carried out with directions of the Employer/Engineer.

Contractor shall collect the sample minimum 1% of total service connection for water quality test in every month. There should not be repetitions of samples and the samples should represent the coverage area as per satisfaction of Employer/ Engineer. Contractor should carry out the test and result should be incorporate in each Monthly performance report.

The following minimum parameters test shall be conduct during test:

- PH value
- Free Residual Chlorine (FRC)
- Total Dissolved Solids (TDS)
- Turbidity

In case the test report result shows the water quality below the National Water Supply Standard, then the contractor must study for the reason and suggest the possible solution.

12.2 Measurement and Rate

The costs for the undertaking water quality test shall be included in the monthly SSS rates and no separate payment shall be made.

The monthly SSS rates shall include, for water quality, the cost of visits to the consumer property, collecting and testing the required sample, carrying out the necessary investigations, engagement of technical staff adept at carrying water quality test including necessary equipment's with required chemicals and the contractor submission of the duly signed water quality test report to the Employer and Engineer.

13 Decommissioning of Old Networks

13.1 Scope and Requirement

The Contractor through meter readers and water audit survey shall ensure that all HHs within a commissioned / operational DMA with service connection are not receiving water from the old / existing KUKL network, during the system stabilization period. In case, HHs are receiving supply from old / existing system, the Contractor shall report the same to the Employer, Engineer suitably for requisite measures to be undertaken. These actions shall be undertaken only as per direction of the Employer, Engineer.

The disconnection may require at different level, House hold level, Primary Pipe line level, Secondary Pipe Line level and Distribution Pipe Line level. As per the pipe connection size the disconnection points are grouped in 3 level as follows.

- Service Connection level of size 1/2 inches to 1 inch.
- Primary, Secondary and Tertiary Pipe Level of size 1.5 inches to 4 inches.

- Primary, Secondary and Tertiary Pipe Level of size more than 4 inches.

13.2 Measurement and Rate

The composite item disconnection of existing network shall be measured in number as constructed and accepted by the Engineer. The composite item decommissioning of old networks shall be paid as per contract unit rate which shall be the full and the final compensation for the cost of required all civil works including reinstatement of the surface and the supply installation and testing of pipe fittings for the size and dimensions explain above, including safe disposal of suitable and unsuitable material as instructed by the Engineer.

14 Payment Terms

14.1 General Terms and Conditions

Payment shall be made to the Contractor for System Stabilisation Services (SSS) on a monthly basis as follows:

a) A monthly fee for general SSS, as described above, is included in on the Bill of Quantities (BoQ) items for after commissioning of each Section of the Works. Payment of the monthly invoice will be released in accordance with the General Conditions of Contract (GCC) and Particular Conditions of the Contract (PCC).

b) Separate payment will be made based on BoQ items provided for the following works:

- Supply and Installation of new metered water supply consumer connections during the SSS period, whenever specifically directed by the Employer/Engineer, as specified in: Works Requirements Section VI-D Technical Specifications System Stabilisation Services (SSS) Items 4.1; Works Requirements Section VI-C Technical Specification Item 5.3 Service/Household Connections; and as shown on Drawings Nos. TP-2-1 and TP-2-2.
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All other services and works described in Section VI-D Technical Specification for SSS shall be included in the monthly fee with no additional payment.

c) All monthly invoices shall be submitted along with a copy of the monthly performance reports for record and reference. Failure to submit the monthly performance report will render the invoices invalid.

14.2 Payment Terms and Linked components

The monthly fees shall be calculated for each DMA under the section which is commissioned.

The monthly fees are linked partly to performance guarantee (Water Loss targets and time bound Consumer Grievance redressal) and partly with managing the system with dedicated staff and providing data, information to the Engineer, Employer in the Monthly Performance report, as outlined in the technical specifications.

Overall, the monthly fees for each DMA / OMU shall be worked out, considering the various activities undertaken and stated below:

Table 5: Payment Terms and Components

Sl. No	Description	% of monthly fees	Remarks
1	Deployment of minimum Personnel / Staff requirements (Excluding meter readers)	20%	Minimum Personnel / Staff requirements shall be abided by and shall be engaged in consultation with the Engineer, Employer. To be evaluated and applied with respect to all commissioned DMA and OMUs/Primary Pipelines.
2	Meter Readers and Meter reading data	20%	Failure to provide meter readers or meter reading data to the Engineer as per technical requirements will lead to non-compliance.
3	Performance Guarantee	50%	To be applied for each DMA / OMU • Water Loss parameter and • Consumer Grievance records • Regular (monthly) submission Monthly Performance assessment reports
4	Others, including: • Managing the consumer database and asset database, including updating in soft copy • Walkover survey, Leak detection activities and record of repair and maintenance • Hands on training as applicable • Other activities as outlined in the technical specifications	10%	Softcopies of GIS data should be provided in appropriate format for validation. Data, information to be submitted in the monthly performance report. To be evaluated and applied with respect to all commissioned DMA / OMU. Final Report on assessment, Suggestion of **Modus operandi** (recommended operation model) for future operation.
	Total	100%	

14.3 Compliance to Minimum Personnel Requirements

The Contractor shall ensure the minimum personnel requirements are met. Contractor will facilitate a phased deployment of its staff / personnel. The applicable rates or % of the monthly fees, which is payable for deployment of staff for managing the water supply distribution system are as presented below:

Table 6: Compliance to minimum personnel requirements

Sl. No	Staff / Personnel actual as % of minimum required	% of monthly fees to be paid (To be applied for all DMA's)	Remarks
1	100% (or more)	20%	Engineer and Contractor may discuss and negotiate on the deployment schedule and requirement of staff / personnel. % of monthly fees shall be interpolated, when staff / personnel deployment is less than indicated for a month or part thereof
2	50%	10%	
3	Less than 50%%	0%	

14.4 Compliance to Meter Reading

The Contractor shall deploy trained meter readers to collect the meter data and share the same with the Employer, Engineer, at the end of each month. The Contractor shall ensure maximum meter reading data to be collected. Meter reading shall be as per protocols outlined in the technical specifications.

The applicable rates or % of the monthly fees for any DMA, which is payable for meter reading activities is presented below:

Table 7: Compliance to meter reading

Sl. No	Meters read and validated as % of consumers as per GIS database in the DMA	% of monthly fees to be paid (For the DMA)	Remarks
1	100%	20%	% of monthly fees shall be worked out based on the actual % of meters read and validated, based on interpolation. No payment will be made, in-case meter reading in and DMA is 80% or below. Interpolation shall be done, when meter reading is in between figures.
2	90%	10%	
3	80%	5%	
4	Less than 80%	0%	

14.5 Compliance to Performance Parameters

Compliance to Water Loss Targets

Failure to provide meter reading shall allow the Employer / Engineer to engage their own / outsources staff to undertake meter readings, and provide the Water Loss values, which the Contractor shall have to agree to.

The applicable rates or % of the monthly fees for any DMA/OMU, which is payable for performance parameter with respect to Water Loss targets are as presented below:

Table 8: Compliance to Water Loss targets

Sl. No	Water Loss as % of supplied water (for 24 hours' duration)	% of monthly fees to be paid (For the DMA)	Remarks
1	12% (or less)	30%	% of monthly fees for each DMA shall be worked out, based on assessed water loss. Interpolation shall be done, when water loss figures are intermediate.
2	13%	20%	
3	14%	10%	
4	15%	5%	
3	More than 15%	0%	

Soft copy of the Water Loss assessment data shall be submitted by the Contractor to substantiate the Water Loss Targets.

Compliance to Consumer Grievance

Compliance to consumer grievance shall be undertaken based on the electronic register to record all grievances, forwarded by the Employer/Engineer and address the same on priority.

The applicable % of monthly fees to be paid for addressing the consumer grievance in a time bound manner shall be the responsibility of the Contractor.

Table 9: Compliance to Consumer Grievance

Sl. No	Consumer Grievance addressed	% of monthly fees to be paid (For the DMA)	Remarks
1	90% (or more)	20%	Interpolation shall be done, for intermediate assessed values.
2	80%	10%	
	70%	5%	
3	Below 70%	0%	

14.6 Other Terms and Conditions.

The personnel engaged by the Contractor shall not be absorbed by the in the Employer in any circumstances.

1. The Contractor shall have to ensure timely payment to their personnel and comply with the provisions of all labour legislation and rules.
2. In case of any difficulties faced by the Contractor in performing the System Stabilization Services activities, the same shall be reported immediately to the concerned Engineer, Employer or taking necessary action.
3. The Employer shall not be responsible for any untoward incident of accidental death, injury, and medical treatment etc. during on-duty hours. The payment of compensation if required under Workmen Compensation, The Labour Act, 2017 (2074) & Regulation 2075 and any other.
4. The Contractor shall keep himself informed of the relevant and related laws & ordinances and shall conduct the work in compliance with such laws. Fees for necessary permits, licenses, & taxes required by law shall be paid by the Contractor as per GCC.

5. For filling the vacant position on the event of death or otherwise, the Contractor must inform and seek consent from the Engineer for the appointment of new staff / replacement of existing staff.
6. The Employer reserves the right to terminate the contract of the plant (s) in case of non-performance by the Contractor of the SSS based on reports of the Engineer. The termination shall however be governed by the GCC of the contract.

Annex 1: Customer Survey Questionnaire

Customer survey questionnaire

Q. No.	Question Description	KUKL Data	Meter data	Household connection contractor data	GIS Attribute Detail
A1	Date of the visit	App must record automatically			
A2	Start and end time of visit to household				
A3(a)	Enter Surveyor Name				
A3(b)	Enter Surveyor ID				
A5	Select District/region	Can be fill base on municipality			
A6	Select the KUKL BRANCH (Select one)	Can be fill based on Municipality			
A7	Select Municipality (Select one)	Municipality			
A8	Select Ward (Select one)	Ward number			
A9	Enter Tole name (Street name)	Road Street	Address	Street Name	Address
A10	Area Classification (Select one)				
A13	8-digit Unique ID (with <0.01% duplicates)				

B. Information about the Unit whose Survey is Being Done

Q. No.	Question Description	KUKL Data	Meter data	Household connection contractor data	GIS Attribute Detail
B1	Click photograph of the Structure / Building / Plot (Ensure that your App/Phone				

Q. No.	Question Description	KUKL Data	Meter data	Household connection contractor data	GIS Attribute Detail
	is set for lowest resolution)				
B2	Record GPS Location of the Plot Structure / Building / Plot (Optional)		X-Coordinate and Y-Coordinate		Latitude and longitude
B3	Are GPS measurements taken successfully? (Not to be asked - Record this question at the backend of CAPI based on B2)				
B4	Ask if B3 = 0 Reason why GPS could not be recorded?				
B5	House number on street (Optional)		House number		House number
B6	Landmark (if any) (Optional)				
B11	Category of customer Single Select				
B7	Building storey (Select one)				
B8	Building Construction				

Q. No.	Question Description	KUKL Data	Meter data	Household connection contractor data	GIS Attribute Detail
	type (Select one)				
B9	Are the pipeline drawings and details available?				
B10	Ask if B9 = 1 Pipeline Drawing Details for the Unit				
A	Select the PACKAGE			Can be identified based on DMA	
B	Select DNI number			Can be identified based on DMA	
C	Select DMI number			DMA	
D	Select Sub DMI number			Sub-DMA	
E	Ask if B9 = 1 Enter the start point of Node-Pipe Number				
F	Ask if B9 = 1 and B10(E)! =-97 Enter the end point of Node				
G	Ask if B9 = 1 and B10(E)! =-97 Enter the distance between START POINT of NODE				

Q. No.	Question Description	KUKL Data	Meter data	Household connection contractor data	GIS Attribute Detail
	and CURRENT PROPERTY: **Information about user-unit**				
B12	Is survey of this user-unit possible?				
B13	Please request to see the Land-Owner Certificate				
B14	Ask if B13 = 1 Write Name of the Land-Owner as per the certificate			Can be collected from KUKL Database	
B18	Ask if B13=1 Write Land-owner identification Number				
B15	Ask if B13=1 Write Kitta number as per Land-Owner Certificate				
B16	Ask if B13 = 1 Ask for permission to take snapshot of the Proof/Document 'Land-Owner Certificate				

Q. No.	Question Description	KUKL Data	Meter data	Household connection contractor data	GIS Attribute Detail
B17	Ask if B16 = 1 Take snapshot of Proof/Document 'Land-Owner Certificate (Ensure low resolution setting in the App/Phone and take a clear picture)				

C. Identification Details of KUKL Customer and Non-Customer

Q. No.	Question Description	KUKL Data	Meter data	Household connection contractor data	GIS Attribute Detail
C1	**Is this a KUKL Customer or Non-Customer?**				
C2	Ask if C1 == 1 KUKL Connection is under the name of any person or a company/organization?	Customer name	Name of customer	Customer Name	

C3	Ask if C2 = 1 Please request to see the Address Proof/Document with name of the KUKL Customer *(If KUKL customer is not present during the visit, ask his/her ID to be shown to you or request the same from the customer over WhatsApp)*				
C4	Ask if C3 = 1 Address Proof/Document Type (Select One)				
C5	Ask if C3 = 1 Write the Passport/Citizenship ID number	Citizenship number			
C6	Ask if C3 = 1 Ask for permission to take snapshot of the Proof/Document				
C7	Ask if C6 = 1 Take snapshot of Passport/Citizenship ID card (ensure low resolution setting in the App/Phone and take a clear picture)	Can be collected from KUKL database			
C19	Please request to see the KUKL customer card				

C20	Ask if c19=1 Write the KUKL customer id number	Customer id	Kukl customer number	Customer number	Kukl Customer number
C21	Ask if c19=1 Write the KUKL Area number	Near area number			
C22	Ask if c19=1 Write the connection number	Connection number			
C8	Name of the [Person / Company / Organization] on whose name the KUKL connection is installed / billing is done				
C9	Mobile number of the [Person / Company / Organization] on whose name water connection is given (Enter-99 if not available / refused)	Phone/mobile number			Contact number
C10	Alternative Mobile number of the [Person / Company / Organization] on whose name water connection is given (Enter-99 if not available / refused)	Phone/mobile number			Contact number

C11	EMAIL of the [Person / Company / Organization] on whose name water connection is given(OPTIONAL)				
C12	C2 =1 Age of the customer (years)				
C13	C2 =1 Sex of the customer				
C14	Is the current occupant different from the KUKL customer?				
C15	Ask if C14 = 1 Name of the current occupant (Person or company)				
C16	Ask if C14 = 1 Mobile/ Phone number of the current occupant (Enter-99 if not available / refused)				
C17	Ask if C14 = 1 Alternative Mobile number of the current occupant (Enter-99 if not available / refused)				
C18	Ask if C14 = 1 EMAIL of the current occupant (Optional)				

D. KUKL Customer water supply, collection, and storage details

Ask Module D only if C1 == 1 (KUKL customer)

Q. No.	Question Description	KUKL Data	Meter data	Household connection contractor data	GIS Attribute Detail
D1	Which of the following water sources do you have access to or use? Read each of the alternatives one by one and code answer for all applicable Option 1 must be mandatorily selected since it's a KUKL customer				
D2	Is the KUKL connection shared, private or bulk? (Select one)				
D3	Location of KUKL water connection/				

	tap (select One)				
D4	Please Select the KUKL connection Size				
D5	Do you receive bill for water from KUKL? (we are not asking if they actually pay it, only if they receive it)				
D6	Is there a KUKL Meter for water connection? Single Code	Can be identified based on meter number			
D7	Ask if D6 = 1 or 3 Is OLD meter functional?				
D10	Which of the following water storage facilities available within the property? code answer for each as Yes or No				

D11	Ask if D10 = 1, 2, 3 or 4 What is the total amount of water storage capacity for this customer (Answer only in litres)				
D12	Maximum number of occupants present at-a-time in this unit who require to use water				
D13	Which of the following disposing toilet waste / liquid waste / sewage facilities available? Read each of the alternatives one by one and code answer for all applicable code answer for each as Yes or No				

E. Demography Details

E1	How many families ordinarily reside in this unit?
E2	Total number of adults (>= 18 years) in the household (Include maid/staff/TENANT who stay permanently in the house)
E3	Total number of children (<18 years) in the household (Include maid/staff/ TENANT who stay permanently in the house)
E4	Is this a female headed household?
E5	Does the household include any differently abled member?
E6	Total number of rooms in household (exclude toilet and kitchen)
E7	Total number of toilets
E8	Total number of kitchens
E10	How many family members are engaged in work?
E11	Income source of family Multiple select (Read all options)
E9	What is the total monthly expenditure on water and waste water?
E12	Does any water purification is done before drinking the water?
E13	If E12=1 or E12=2 How the water is purified?

Kathmandu Valley Water Supply Improvement Project (Phase 2)

Bidding Document
For

Procurement
Of

Distribution Network Improvement Works in Kirtipur

Contract No.: PID/SKV/DNI2-Kirtipur

Volume I: Main Bidding Document
Volume II: Employer's Requirements
Volume III: Drawings

Issued on: 16 June 2026
Invitation for Bids No.: PID/SKV-R-01
OCB No: PID/SKV/DNI2-Kirtipur
Employer: Project Implementation Directorate, Kathmandu Upatyaka Khanepani Limited (PID/KUKL)
Country: Nepal

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE
Anamnagar, Kathmandu, Nepal.

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

DISTRIBUTION NETWORK IMPROVEMENT WORKS IN KIRTIPUR

CONTRACT No.: PID/SKV/DNI2-KIRTIPUR

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

Validated By: STC-BN JV, DSC/SKV-01, June 11, 2026

List of drawings

S.N.	CODE	NAME	TOTAL SHEET
		GENERAL	
1	LM	Location Map	1
2	GP	General Plan Design Works	1
		PRIMARY PIPELINE NETWORK	
3	PPL	Primary Pipeline Layout	1
4	PPLP	Primary Pipeline Longitudinal profile	8
		DISTRIBUTION NETWORK	
5	DN-OMU	Distribution Networks OMUs	1
6	DN-DMA	Distribution Networks DMAs	1
7	DN	Distribution Network	35
8	DPLP	Distribution Pipeline Main Longitudinal Profile	7
9	ODLPL	OMU&DMA Location Photo Layout	4
10	OMU	OMU&DMA Assembly	6
		DISTRIBUTION NETWORK-KUMARICLUB	
11	DN	Distribution Network	11
12	OMU	OMU&DMA Assembly	1
		TYPICAL DRAWINGS	
13	TP-1	Trench typical sections& Road Reinstatement	2
14	TP-2	House hold service connections	2
15	TP-3	HDPE pipe connection details	6
16	TP-4	Butterfly Valves Assembly	1
17	TP-5	Hydrant types assembly	5
18	TP-6	Air release valve	2
19	TP-7	Underground gate valves for HDPE	1
20	TP-8	Flushing valve Assembly	4
21	TP-9	Pressure Test Point Assembly and chamber details	1
22	TP-10	OMU&DMA structural Details.	1
23	TP-11	General Chamber structural details	1
24	TP-12	DI pipe connections details	1
25	TP-13	Utility crossign.	1
26	TP-14	Horizontal Directional Drilling (HDD)	1
27	TP-15	Comunication scheme OMU&DMAs	5
28	TP-16	Typical stream crossing	1
29	TP-17	Soring Details	2
30	TP-18	Catch Pit	1
		CIVIL STRUCTURES	
31	OHT	Overhead tank 1500 m3 Architectural/structural drawing	18
32	RVT	RVT Kwacho	19
33	VCK	Valve Chamber Kwacho RVT	7
34	PS-C	Pump station and guard house drawings	10
35	SDT	Structural Drawing Truss	10
		MECANICAL WORKS	
36	CK	Connection Kirtipur SRT&Pumping Station&Network	7
37	RVTK	Kwacho RVT mechanical connections	5
38	PS-M	Mechanical details of Kirtpur Pumping Station	8
		ELECTRICAL WORKS	
39	PS-E	Electrical details of Kirtpur Pumping Station	13
40	LCR	kwacho RVT Level Control	1

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: LIST OF DRAWINGS
GENERAL LIST
DETAILS OF DRAWINGS

		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRETE	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	TOC	5	

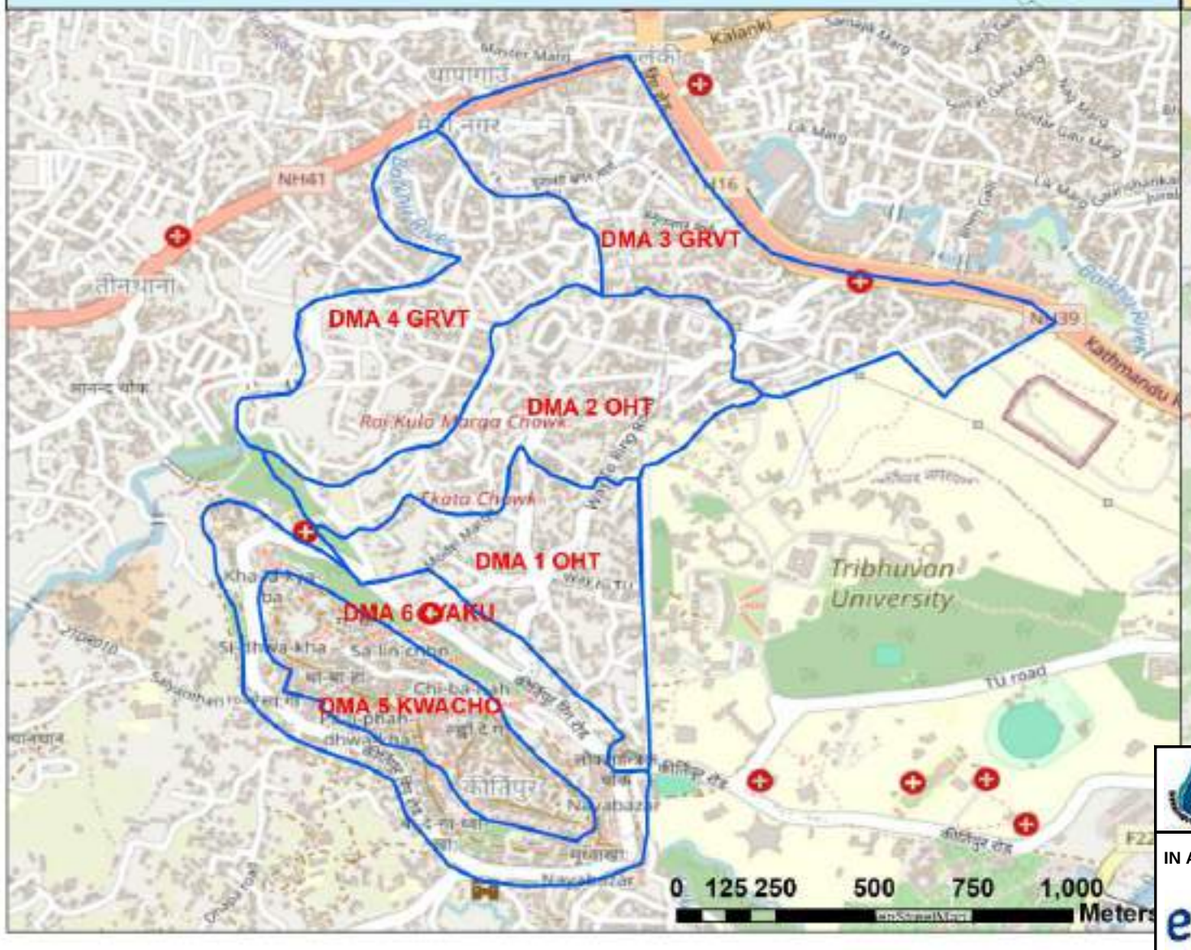
DISTRIBUTION NETWORK IMPROVEMENT WORKS IN KIRTIPUR

CONTRACT No.: PID/SKV/DNI2-KIRTIPUR

GENERAL









KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

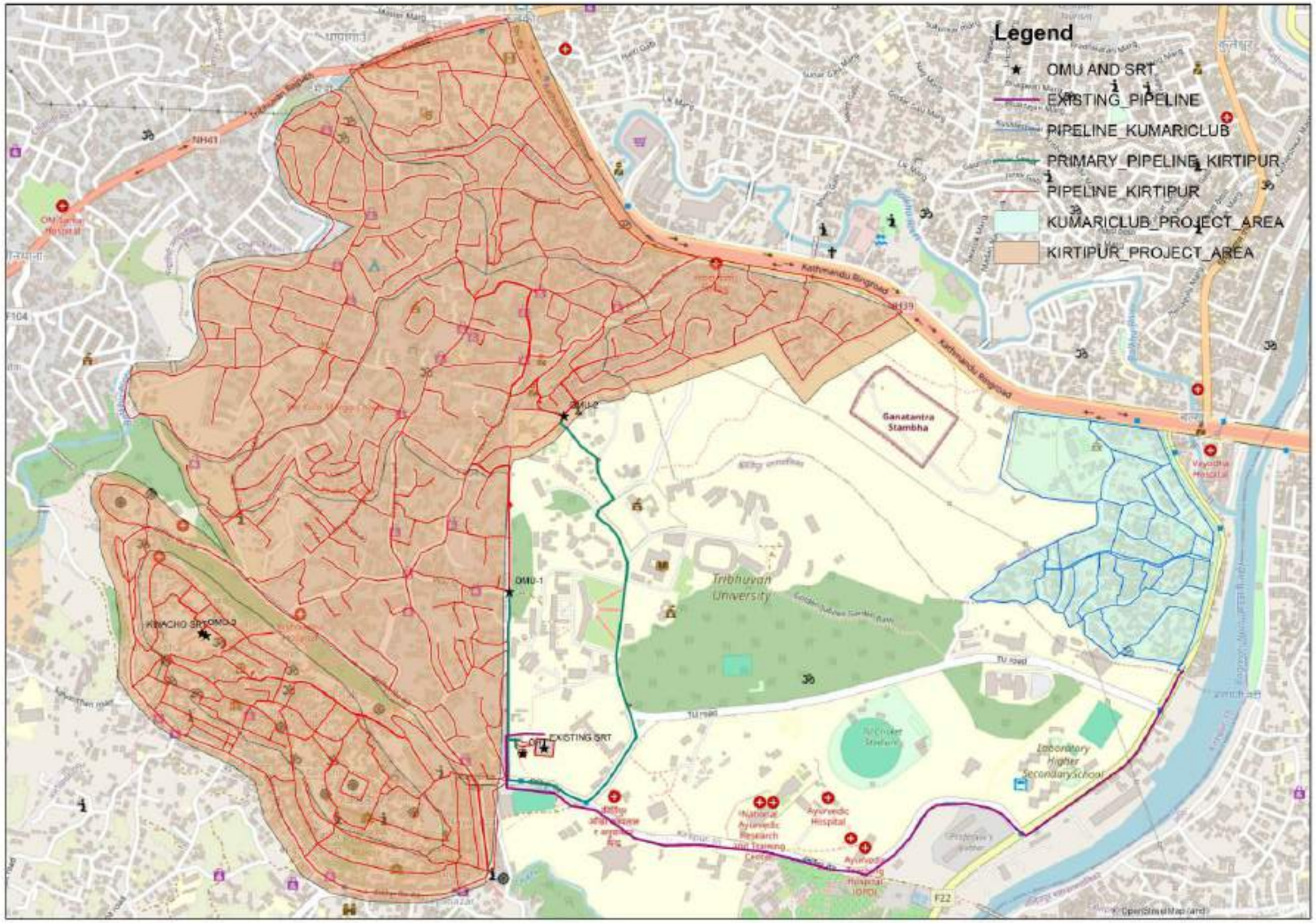
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2-KRITIPUR

DRAWING TITLE:
LOCATION MAP
GENERAL MAP

		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J.M.NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	LM	5	



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2-KIRTIPUR

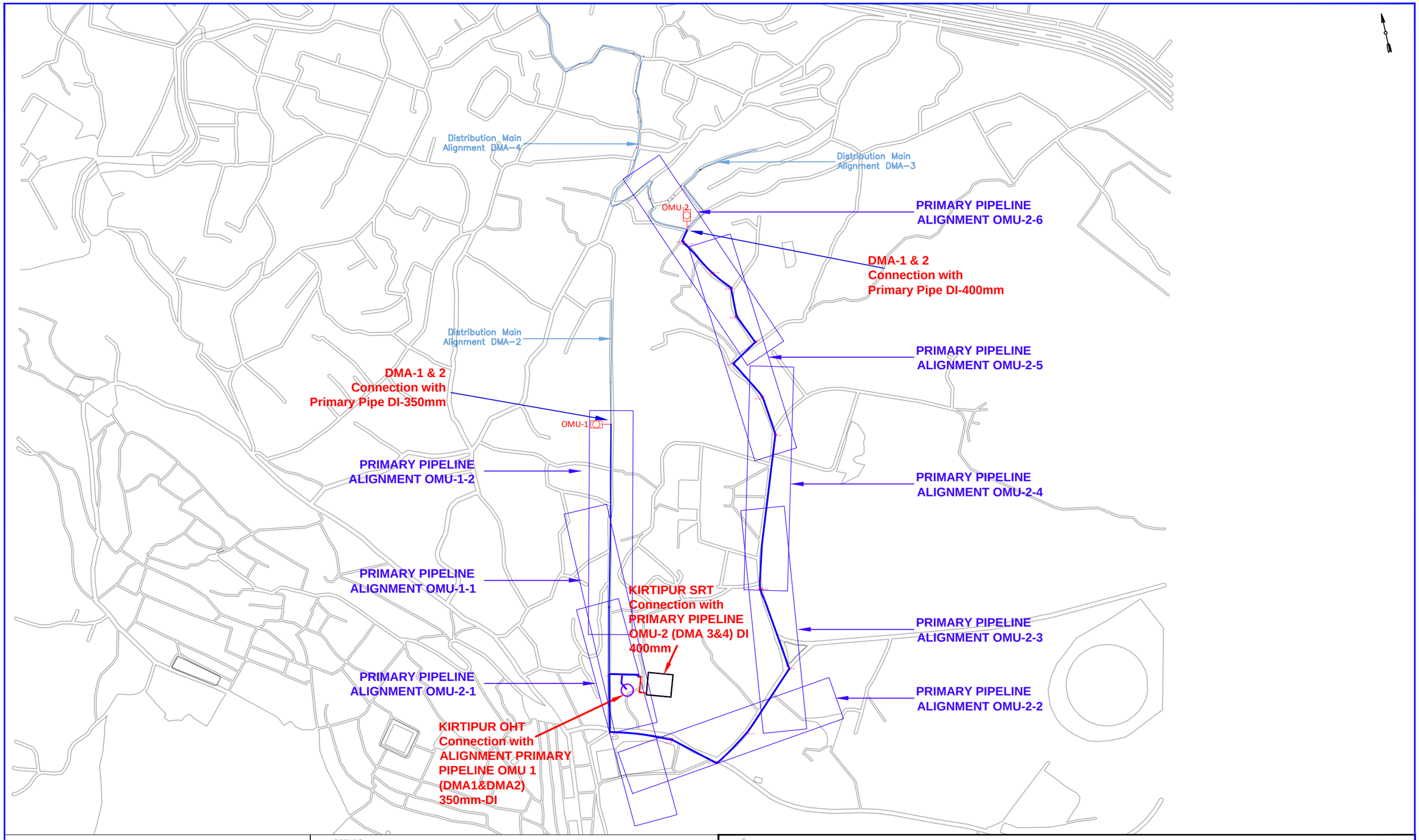
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GENERAL PLAN
DESIGN WORKS

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M.NAVARRO	1	
APPROVED:	M.BENAYAS	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	GP	5	

DISTRIBUTION NETWORK IMPROVEMENT WORKS IN KIRTIPUR

CONTRACT No.: PID/SKV/DNI2-KIRTIPUR

PRIMARY PIPELINE NETWORK



LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

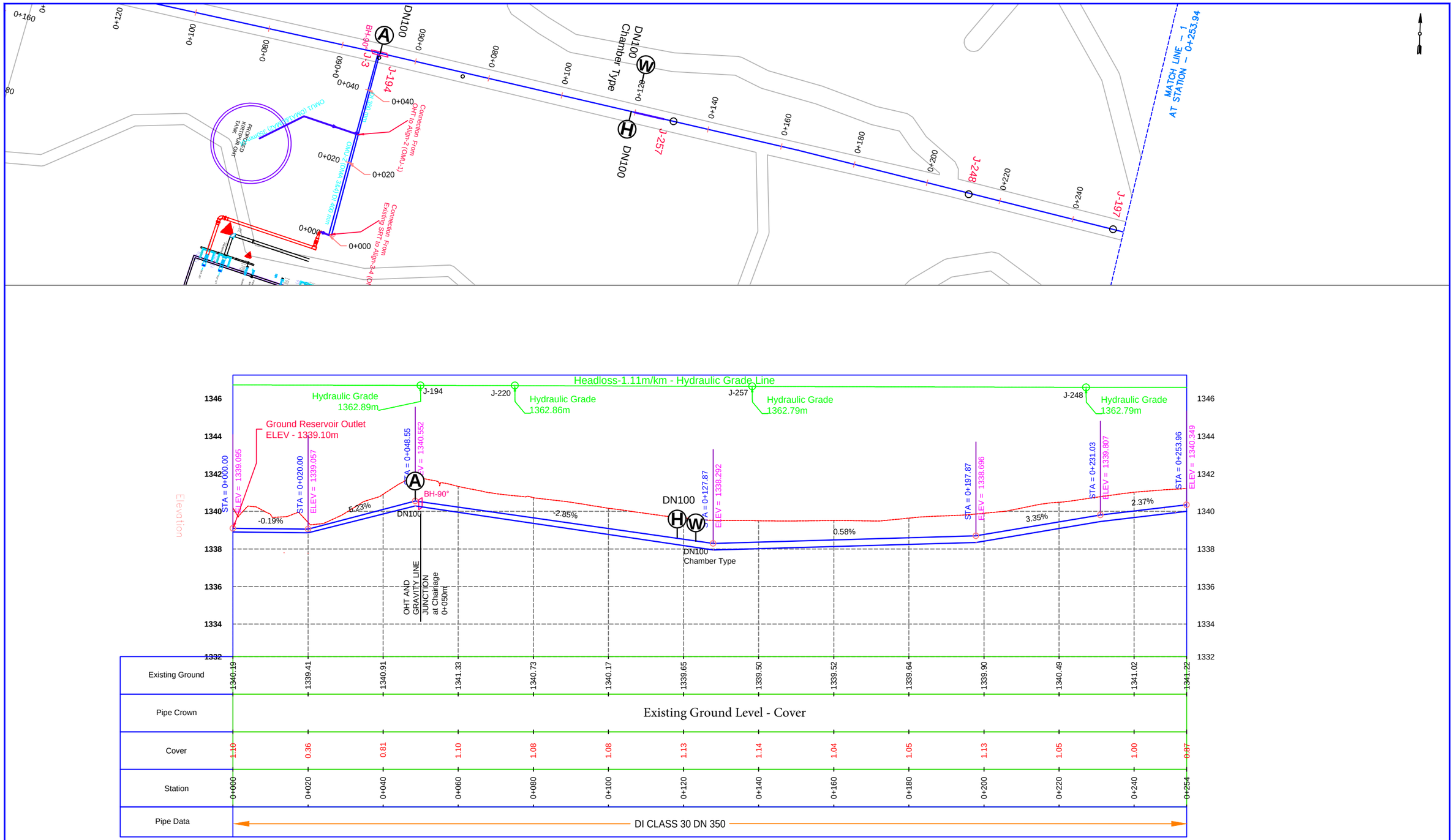
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PACKAGE: PID/SKV/DNI2 - KIRTIPUR

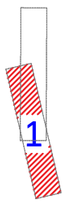
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Primary Pipeline Network Layout

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DRAWN:	S. PAUDEL		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BRAVO-RES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	PPL	5	



KEY PLAN
NTS



N

LEGENDS:

Benchmark	Air Valve	Electric Pole
Transformer	Washout	Manhole
Chamber	Road	Bend
Slab	Hydrant	Culvert
Footpath	OMU	Drain
Pipe	Butterfly Valve	River

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

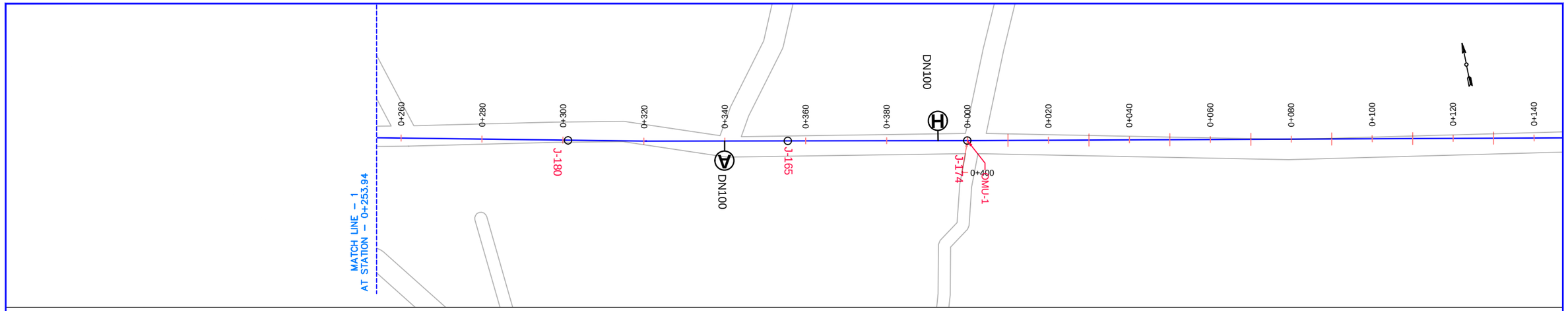
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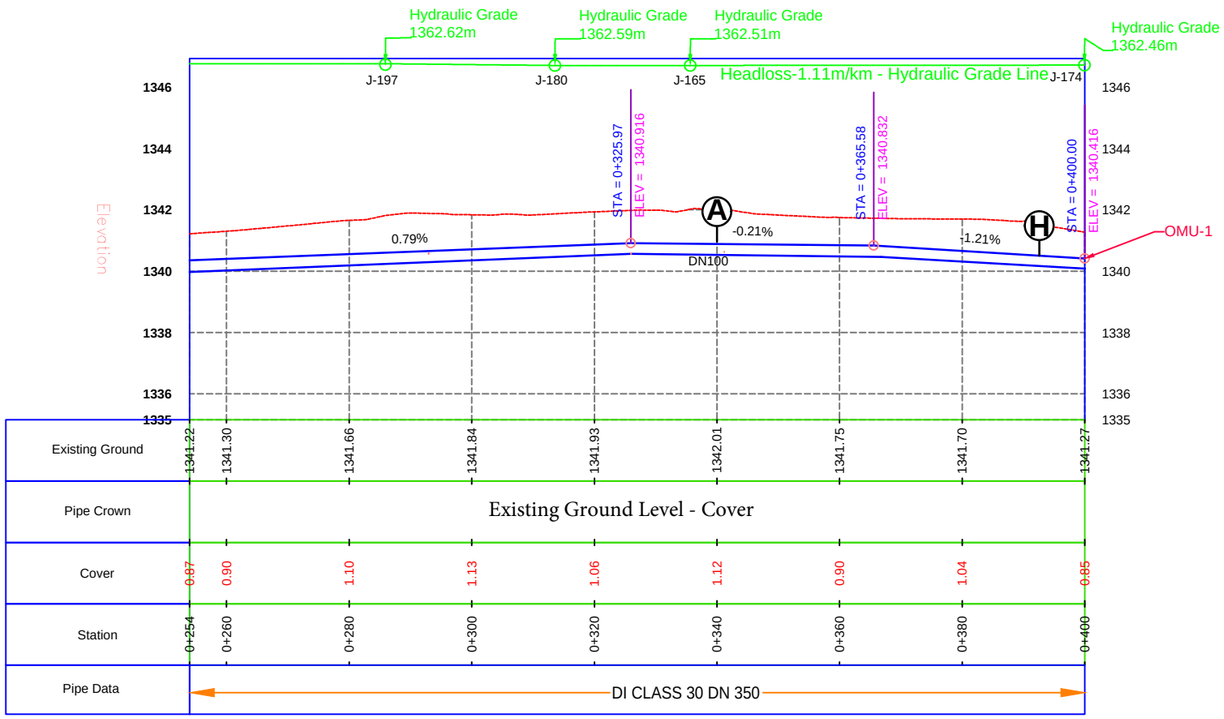
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PACKAGE: PID/SKV/DNI2-KIRTIPUR

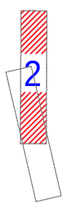
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DISTRIBUTION NETWORK
Primary Pipeline Longitudinal Profile
ALIGNMENT OMU-1

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BRAVO	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	Alig-1-1	5	





KEY PLAN
N.T.S



N

LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

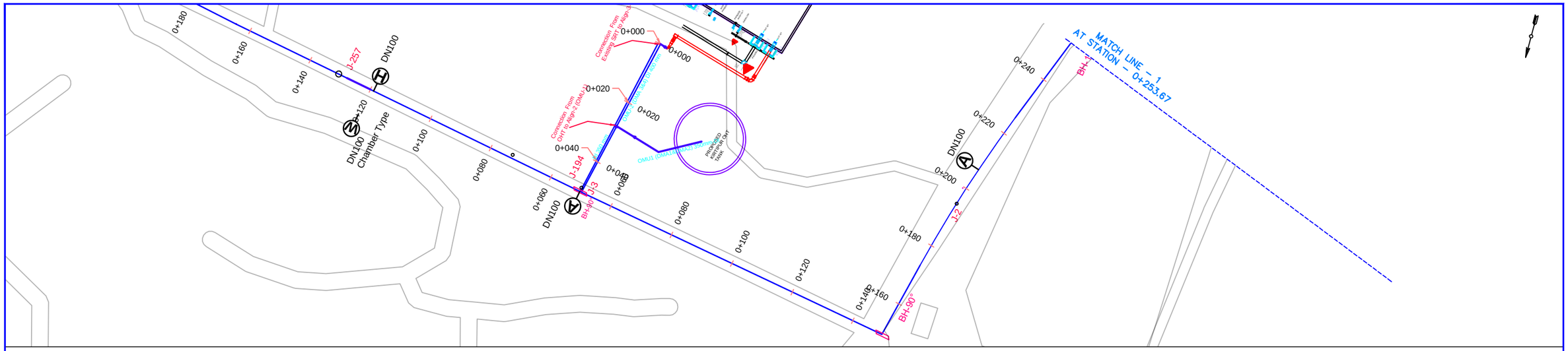
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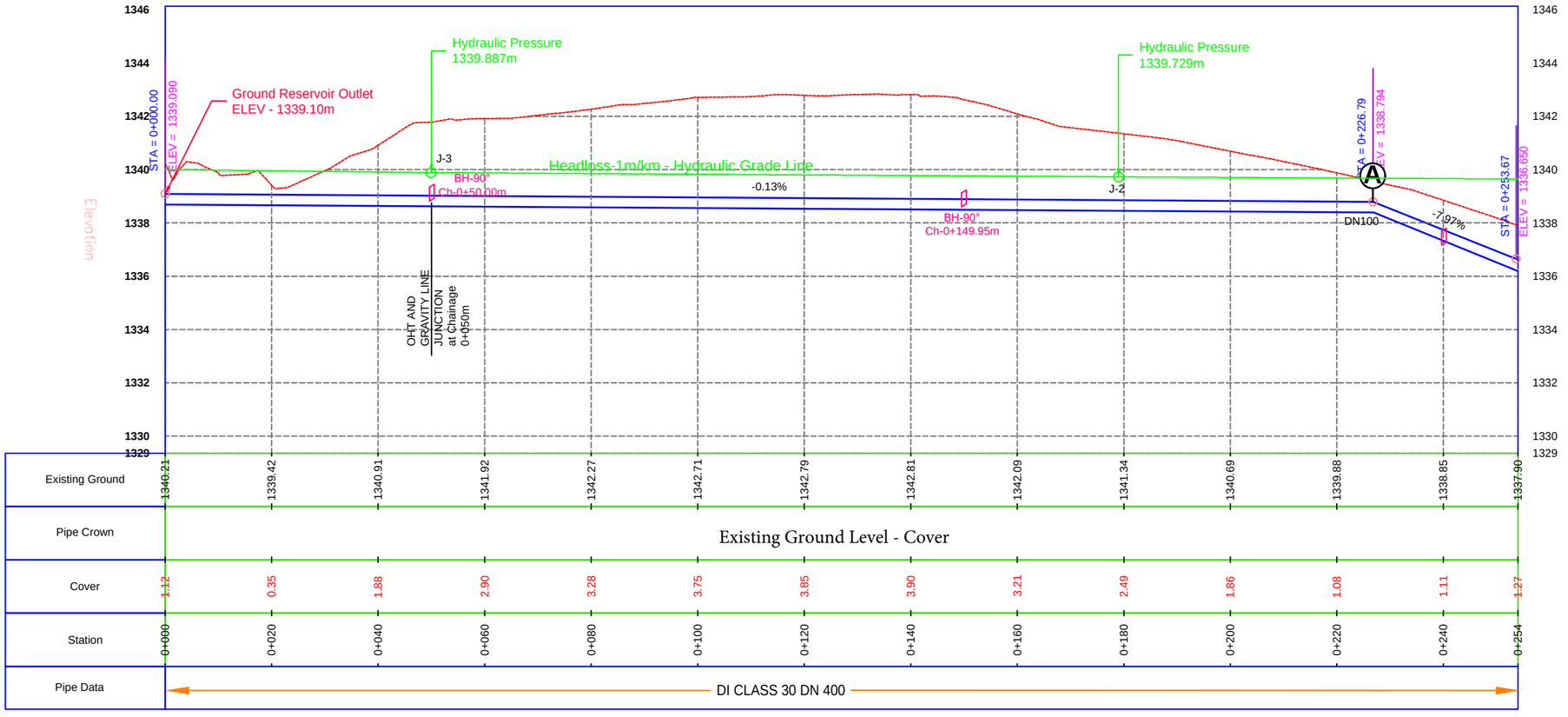
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DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2-KIRTIPUR

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DISTRIBUTION NETWORK
Primary Pipeline Longitudinal Profile
ALIGNMENT OMU-1

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAYDES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	Align-1-2	5	





KEY PLAN
NTS



N

LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

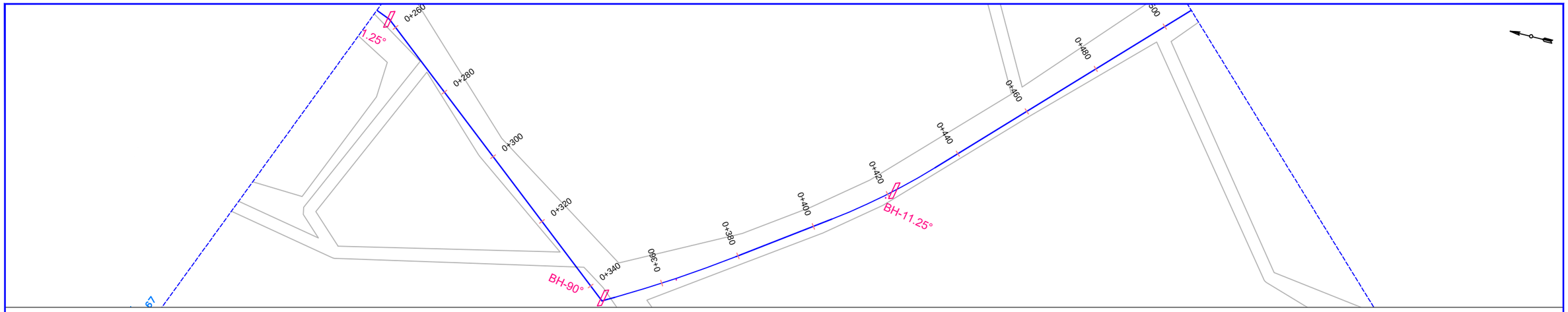
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

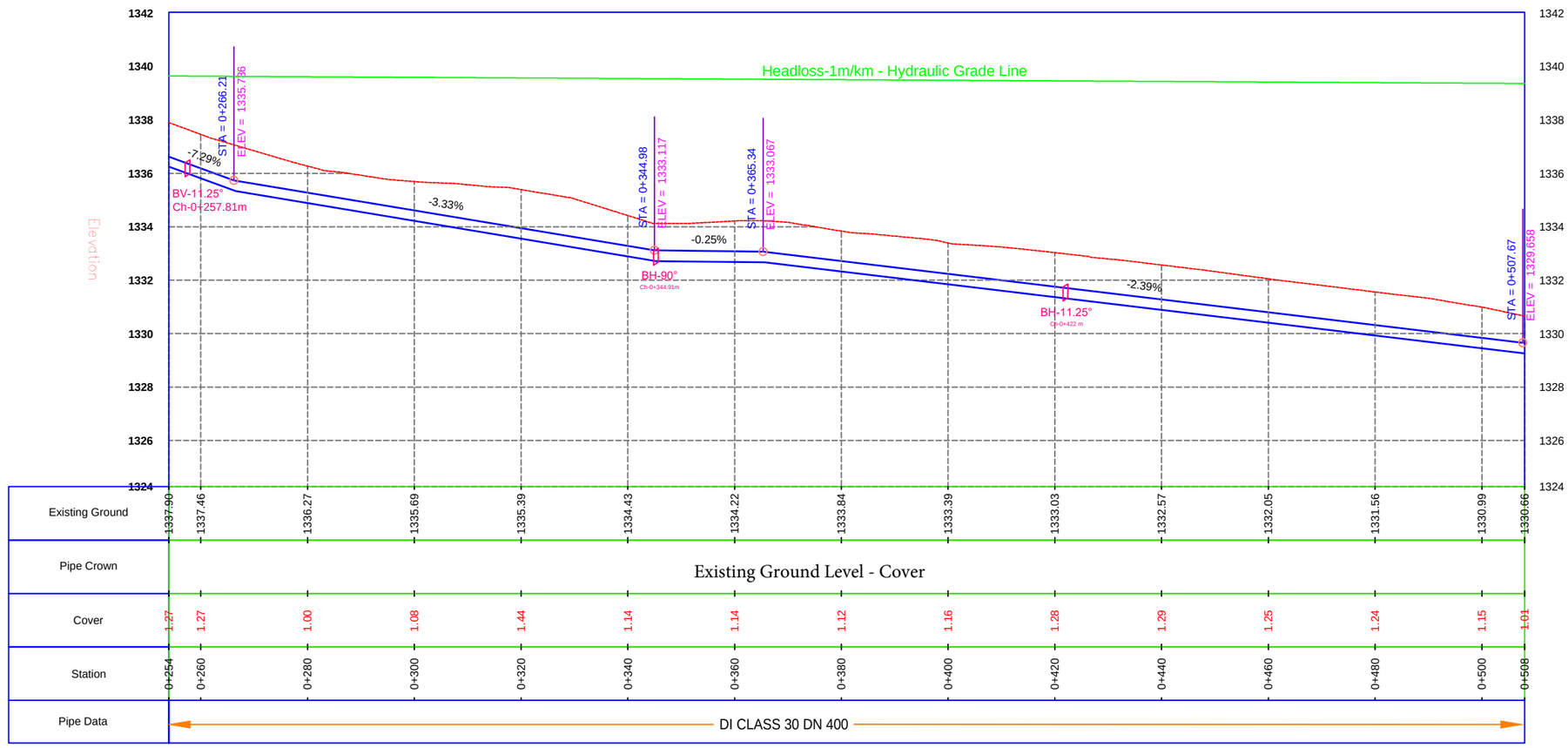
KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

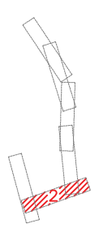
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PACKAGE: PID/SKV/DNI2-KIRTIPUR
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Primary Pipeline Longitudinal Profile
ALIGNMENT OMU-2

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BRAVO	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	Align-2-1	5	





KEY PLAN
N.T.S



N

LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

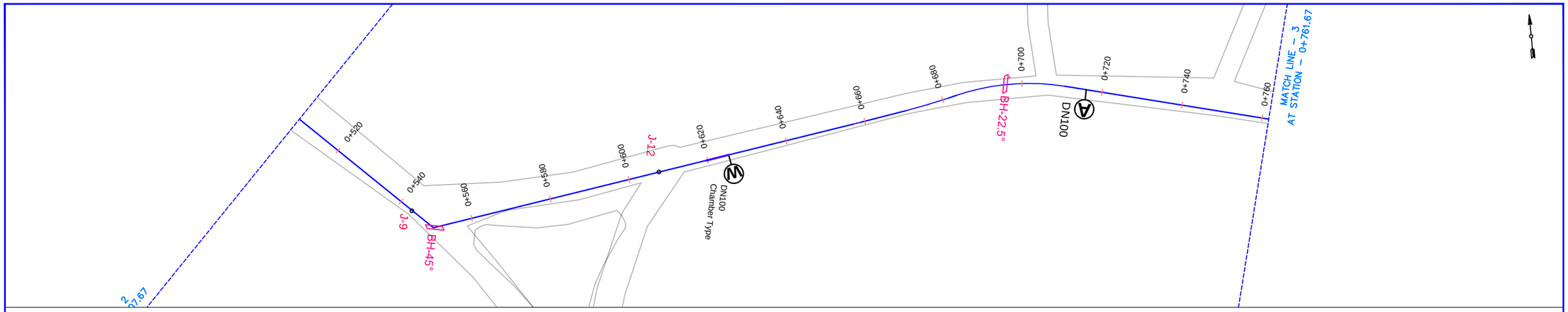
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

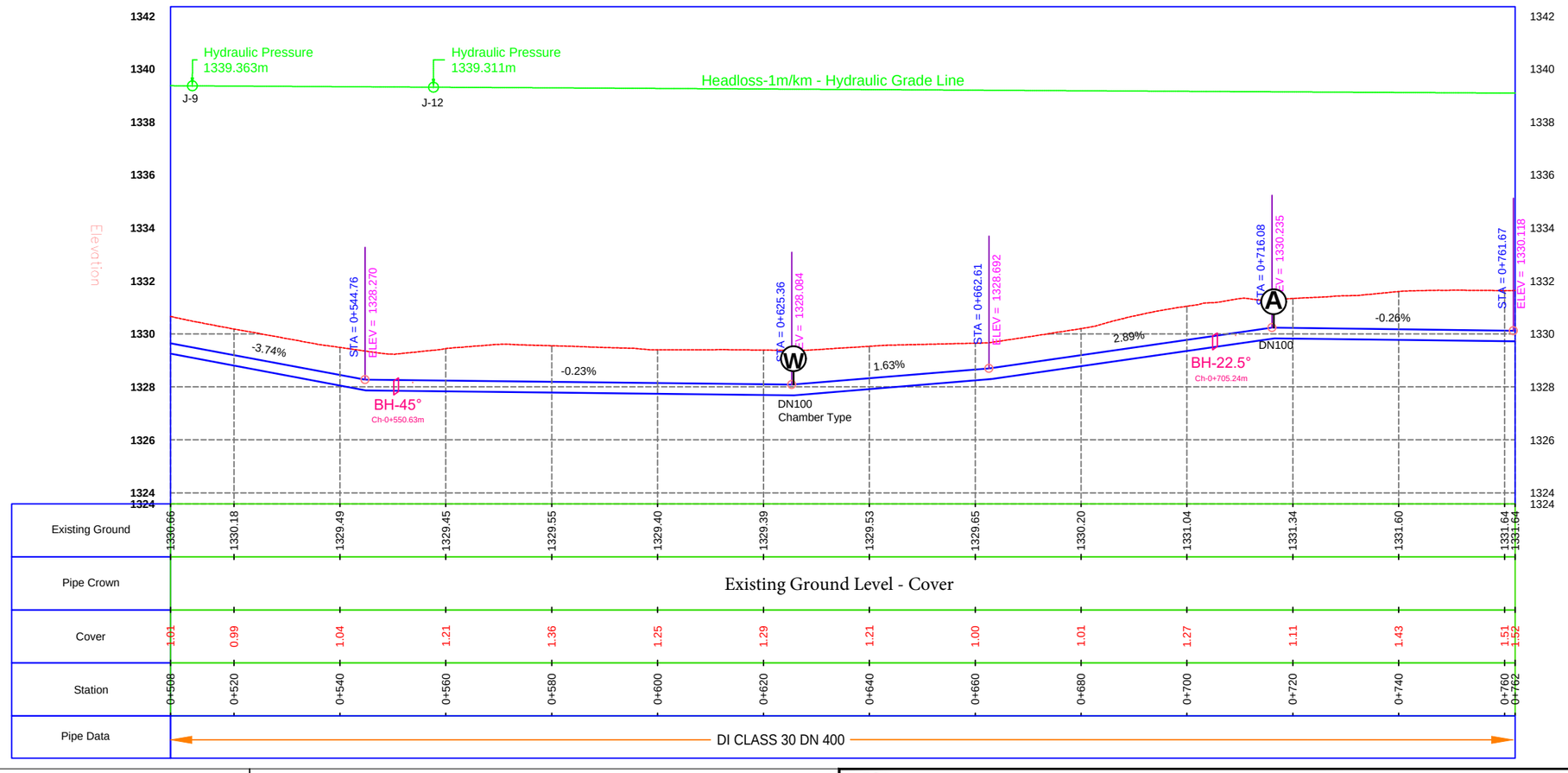
KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

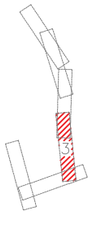
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2-KIRTIPUR
DRAWING TITLE: DISTRIBUTION NETWORK
Primary Pipeline Longitudinal Profile
ALIGNMENT OMU-2

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	Align-2-2	5	





KEY PLAN
N.T.S



N

LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

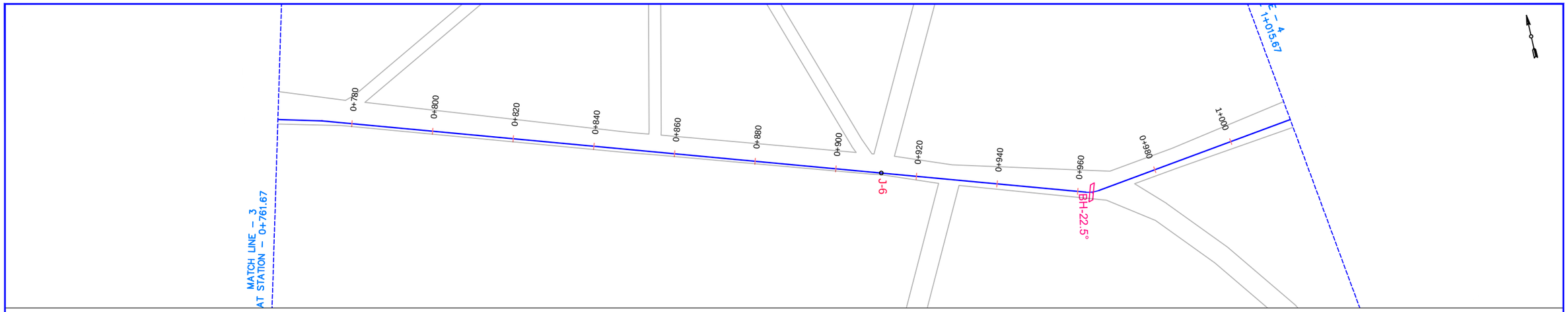
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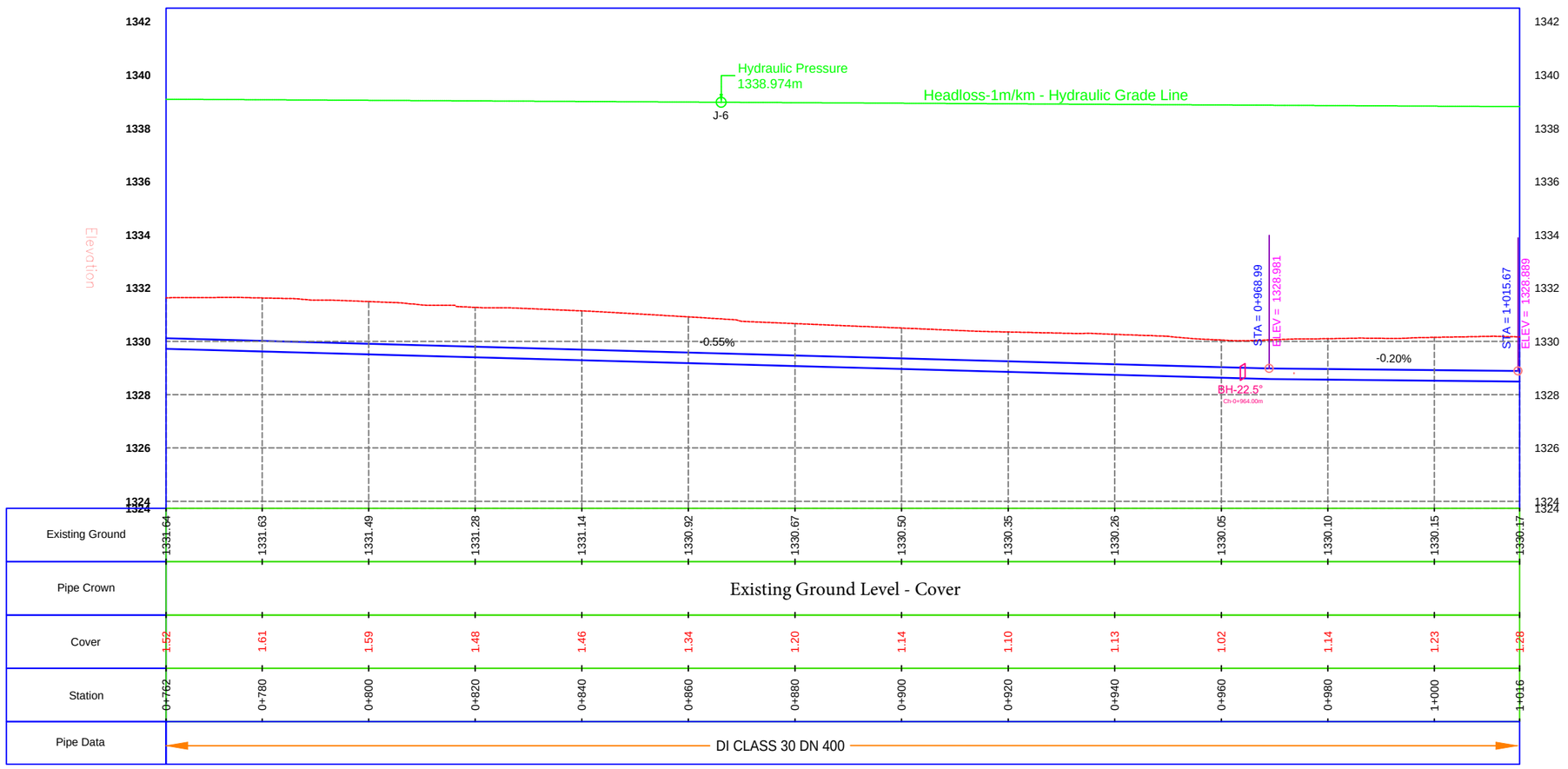
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DISTRIBUTION NETWORK IMPROVEMENT WORKS

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PID/SKV/DNI2-KIRTIPUR

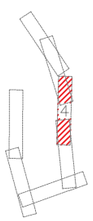
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DISTRIBUTION NETWORK
Primary Pipeline Longitudinal Profile
ALIGNMENT OMU-2

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DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAYNES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	Align-2-3	5	





KEY PLAN
N.T.S



N

LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

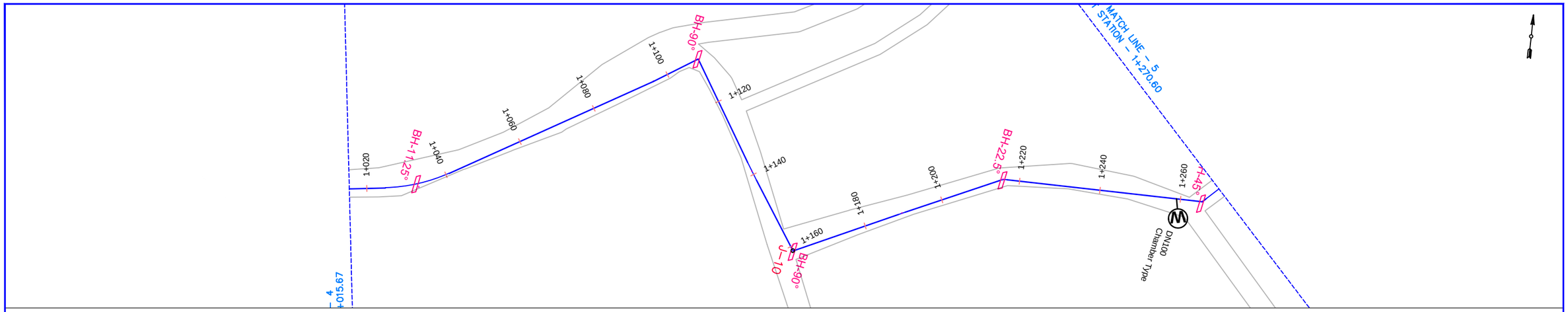
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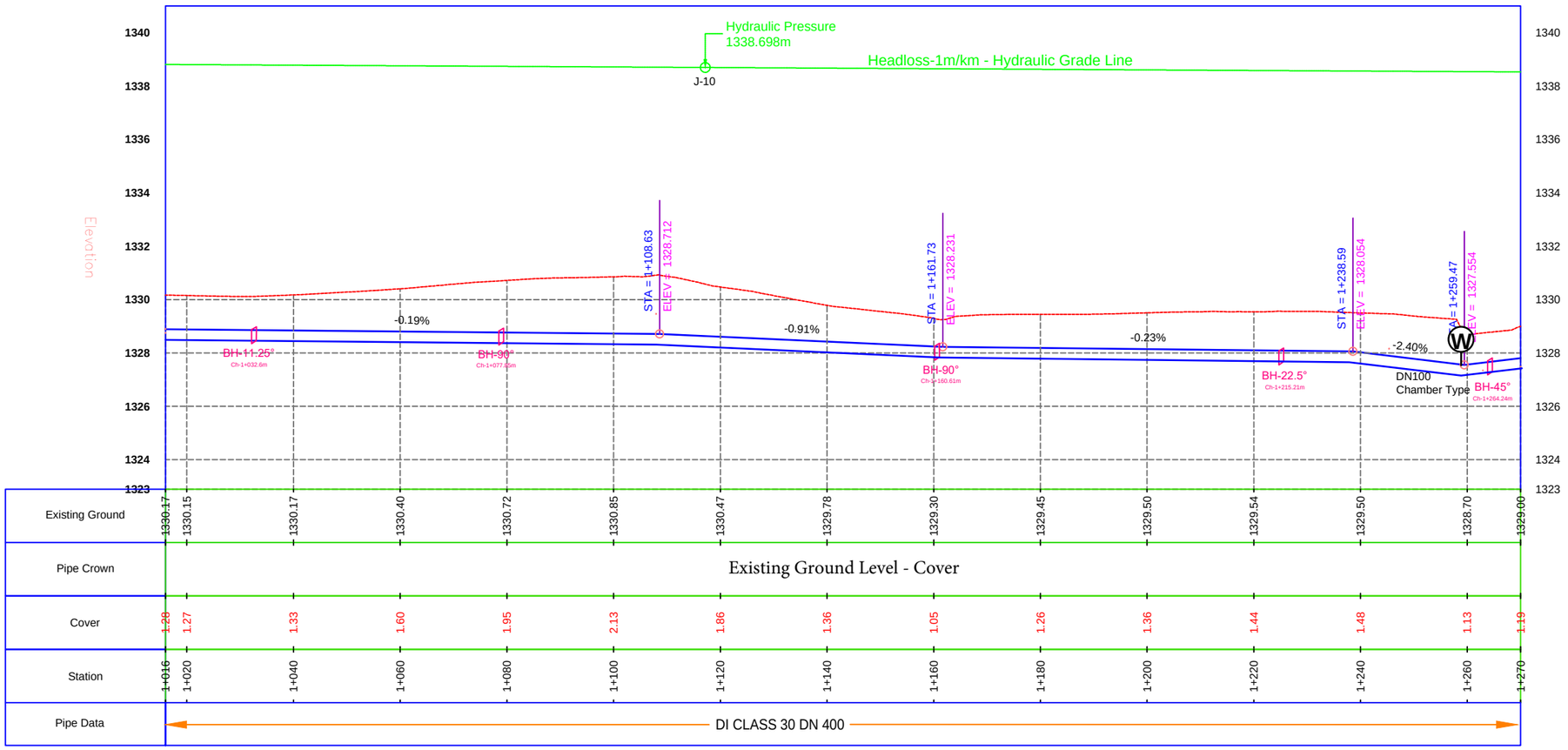
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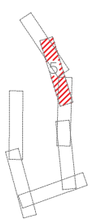
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Primary Pipeline Longitudinal Profile
ALIGNMENT OMU-2

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DESIGNED:	J.M. NAVARRO	2	
APPROVED:	M.BENAYRES	3	
DATE:	Jan-2024	4	
SCALE:	H 1;1000 V1;200	5	
DRAWING No.	Align-2-4		





KEY PLAN
N.T.S



N

LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

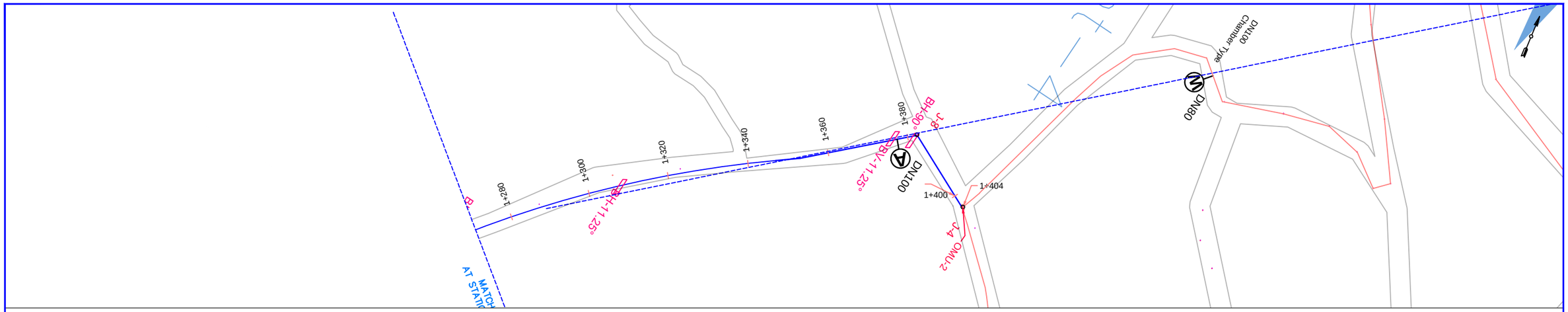
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Eptisa-ERMC JV (DSC-07)

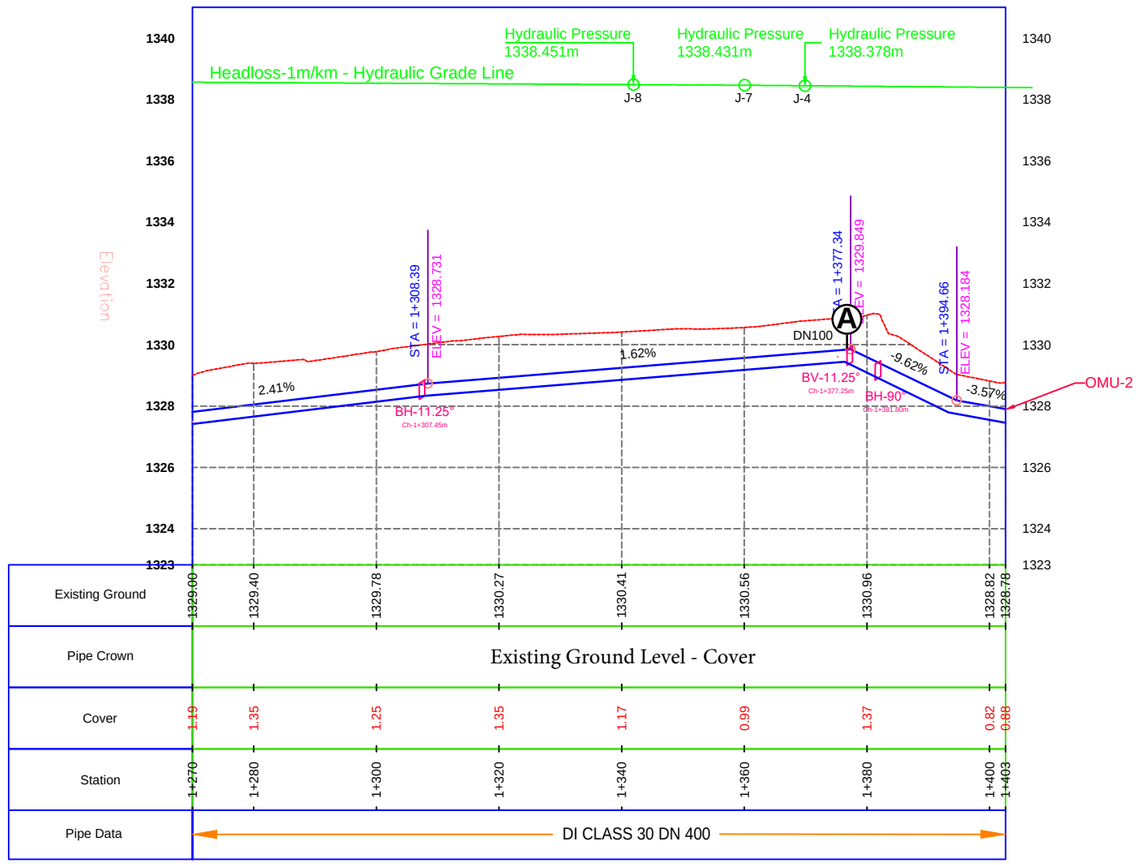
PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2-KIRTIPUR

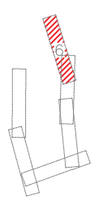
DRAWING TITLE:
DISTRIBUTION NETWORK
Primary Pipeline Longitudinal Profile
ALIGNMENT OMU-2

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	Align-2-5	5	





KEY PLAN
N.T.S



N

LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2-KIRTIPUR

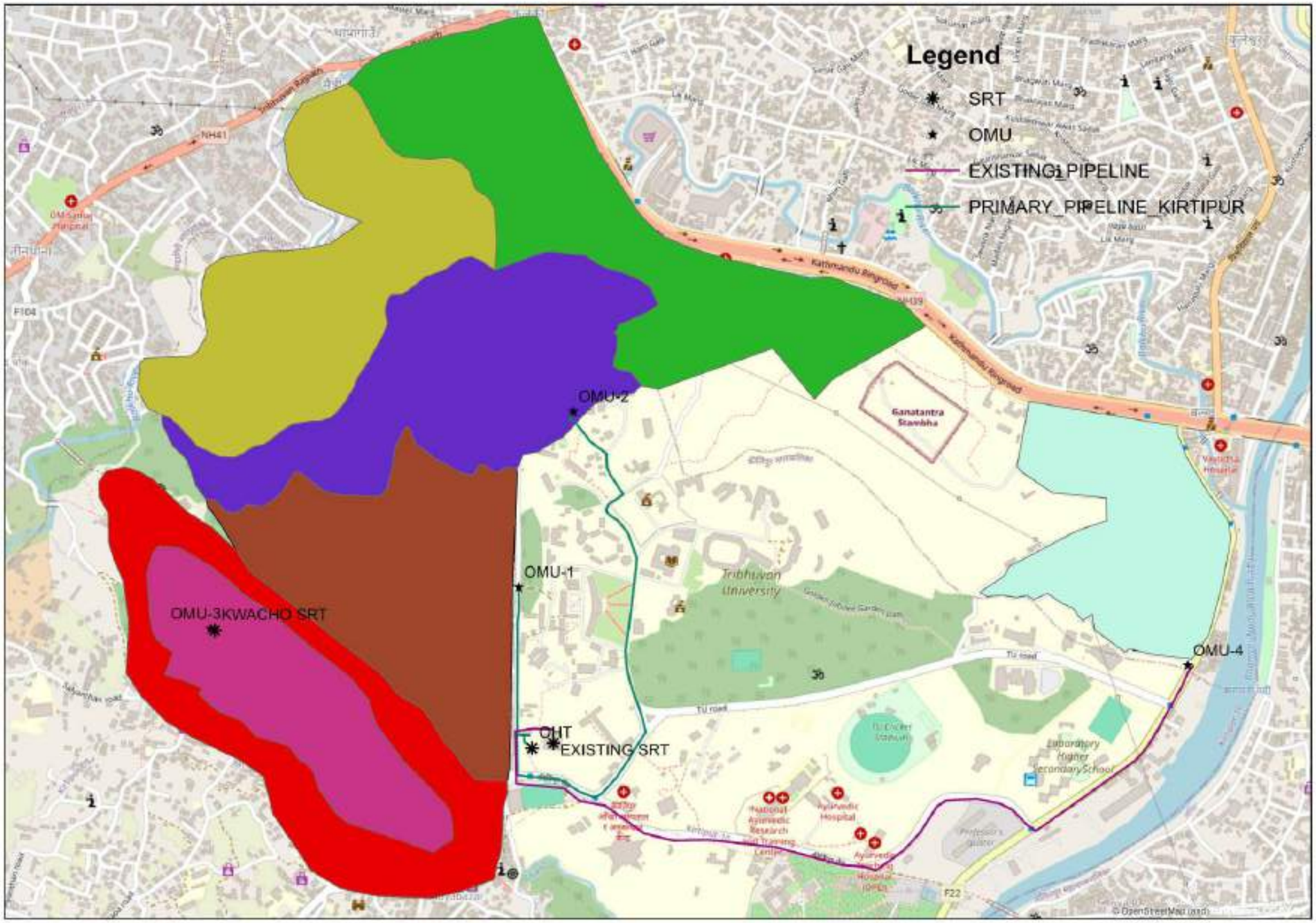
DRAWING TITLE:
DISTRIBUTION NETWORK
Primary Pipeline Longitudinal Profile
ALIGNMENT OMU-2

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	Align-2-6	5	

DISTRIBUTION NETWORK IMPROVEMENT WORKS IN KIRTIPUR

CONTRACT No.: PID/SKV/DNI2-KIRTIPUR

DISTRIBUTION NETWORK



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

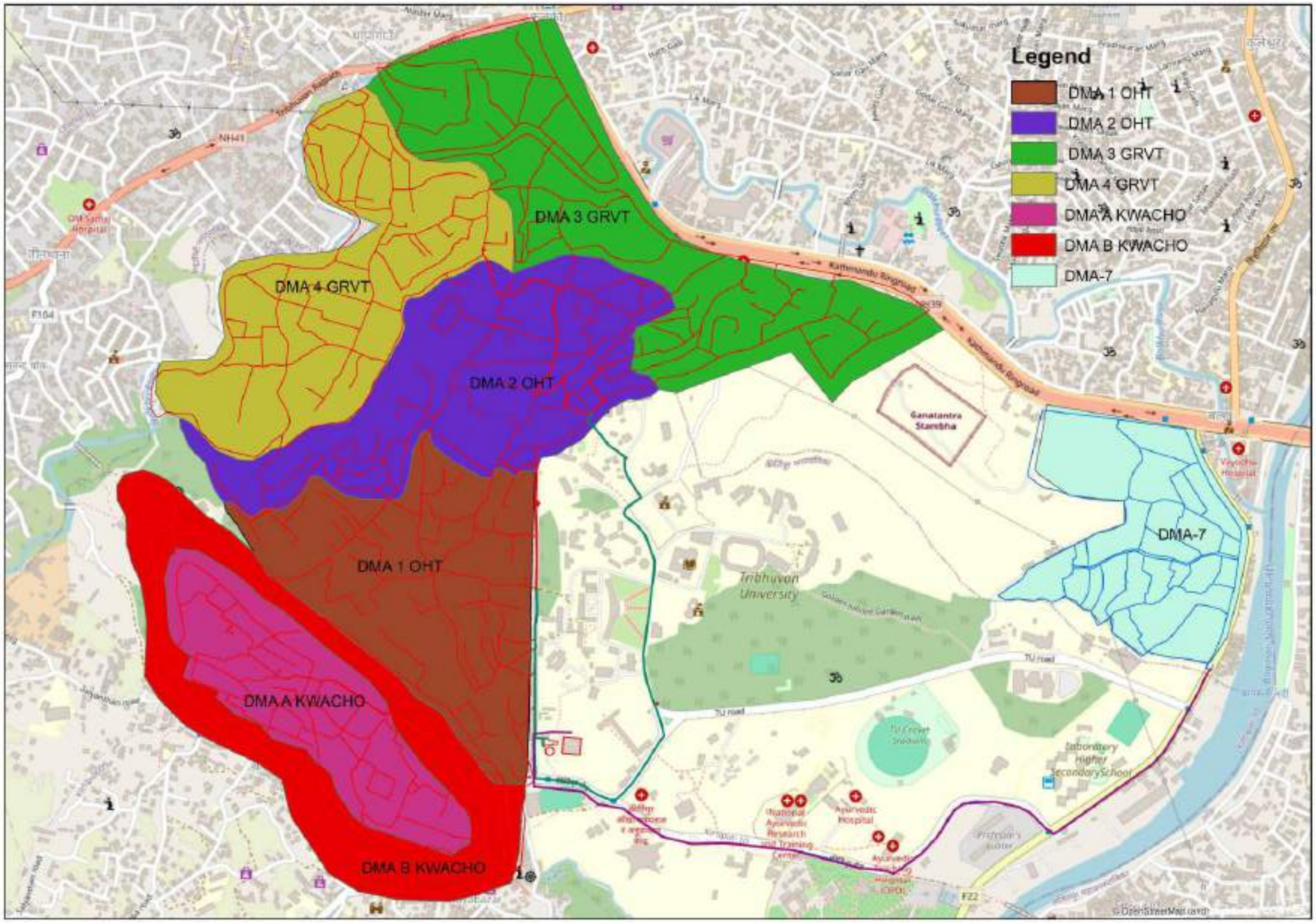
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK OMUs
OMUs DETAILS
GENERAL LAYOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	DN-OMU	5	



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

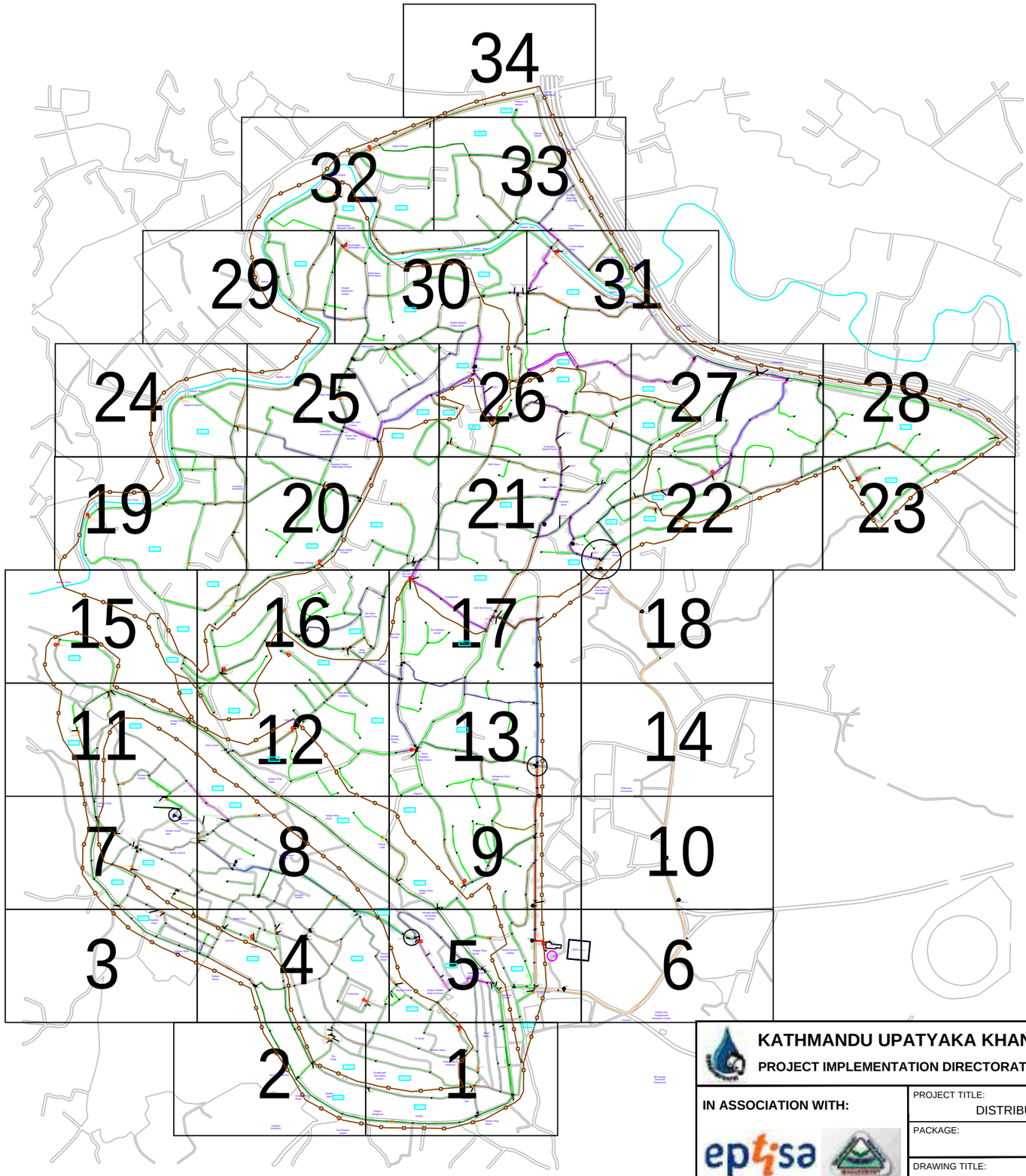
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DMAs
DMAs BOUNDARY
GENERAL LAYOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BERMÚDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	DN-DMA	5	



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

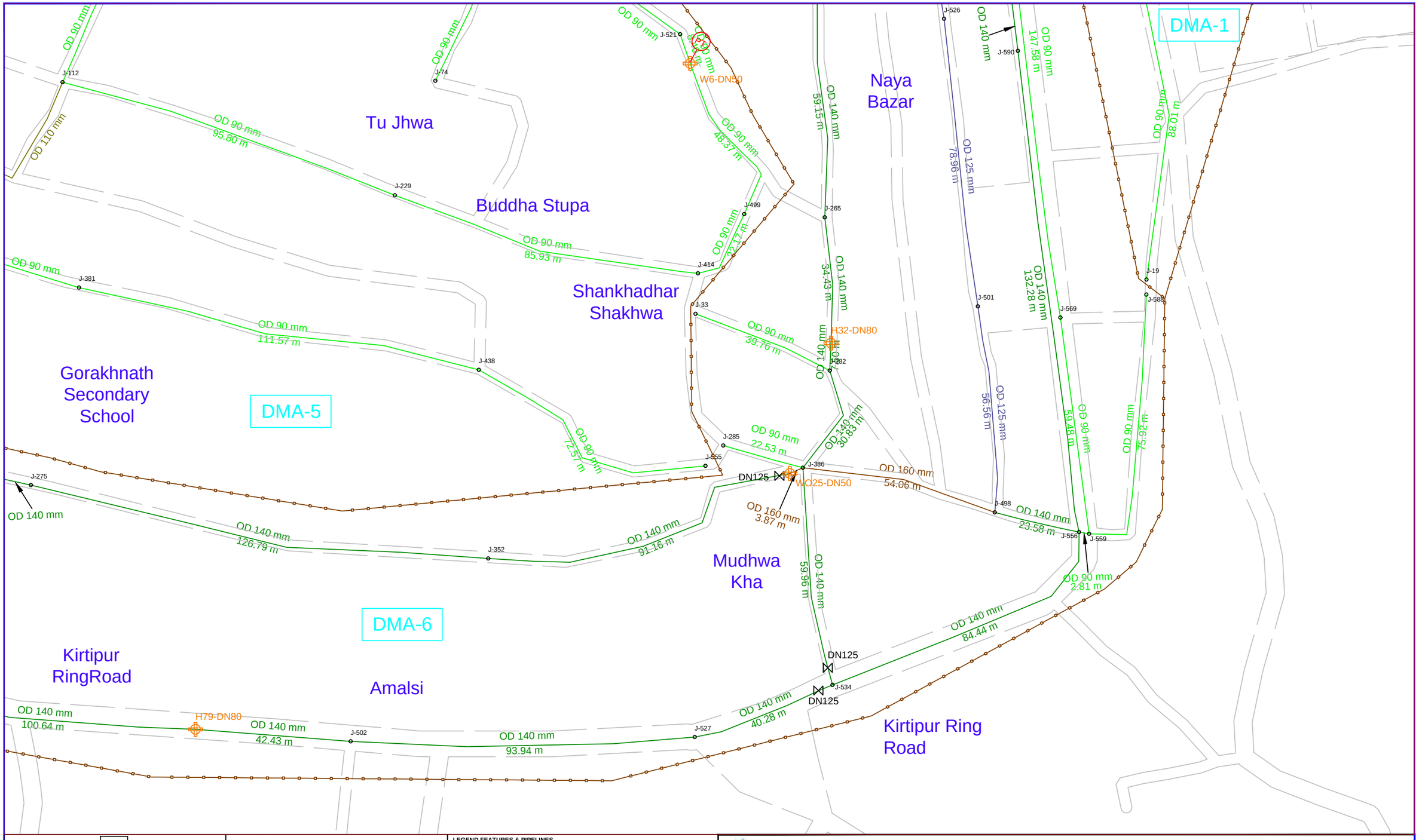
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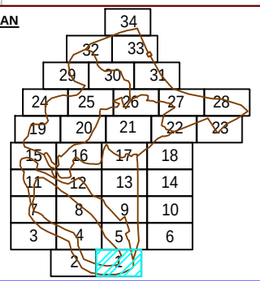
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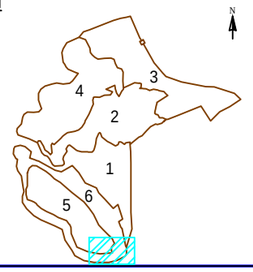
		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	0 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

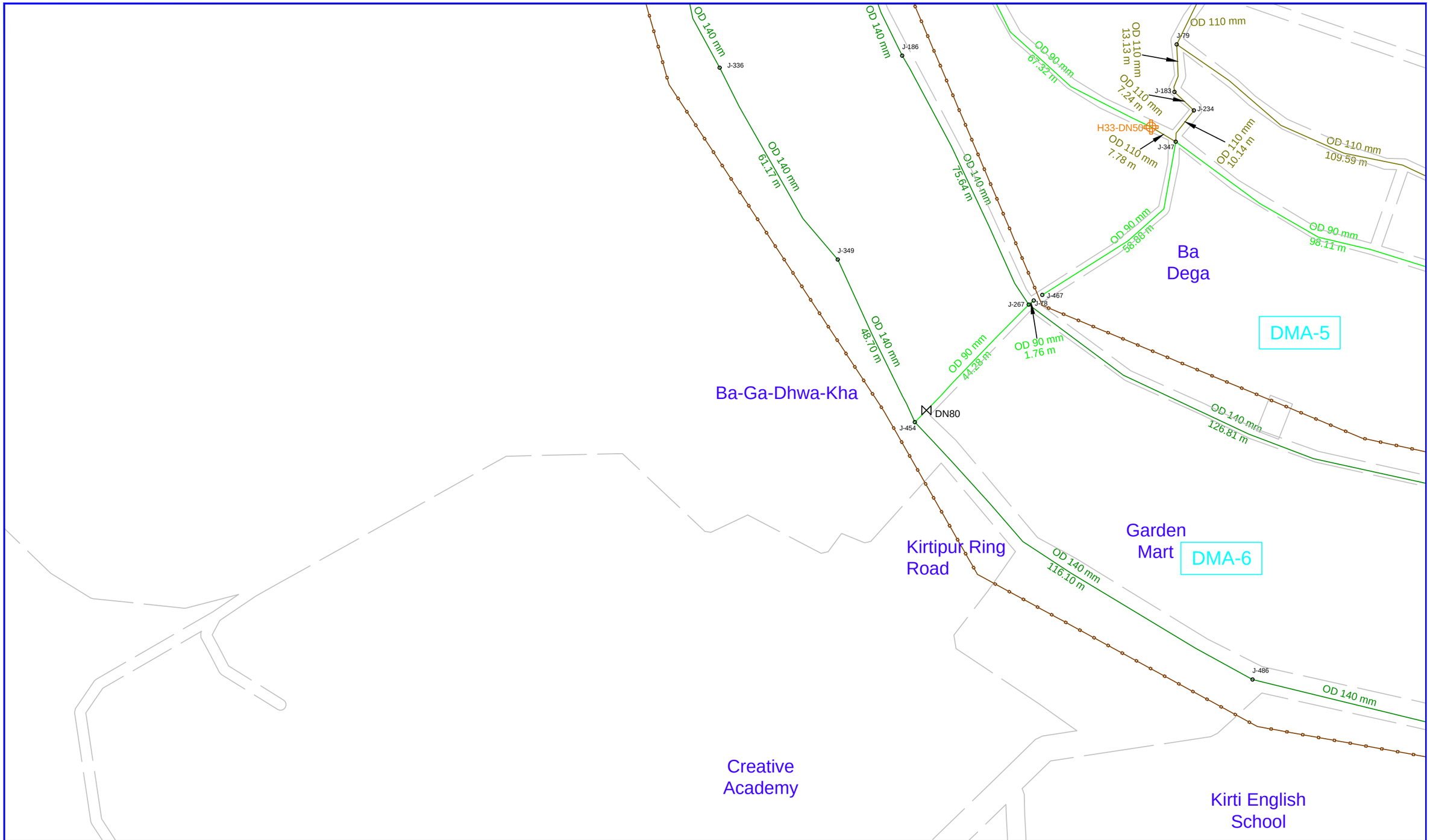
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

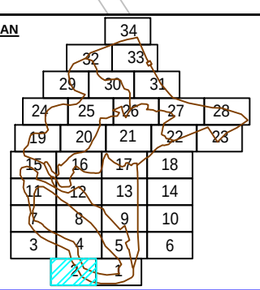
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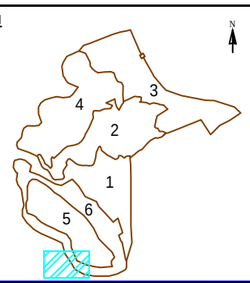
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DRAWN:	SAJ	1	
DESIGNED:	J.M. NAVARRO	2	
APPROVED:	M. BRAVO DES	3	
DATE:	Jan-2024	4	
SCALE:	1:1000	5	
DRAWING No.	1 OF 34		



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

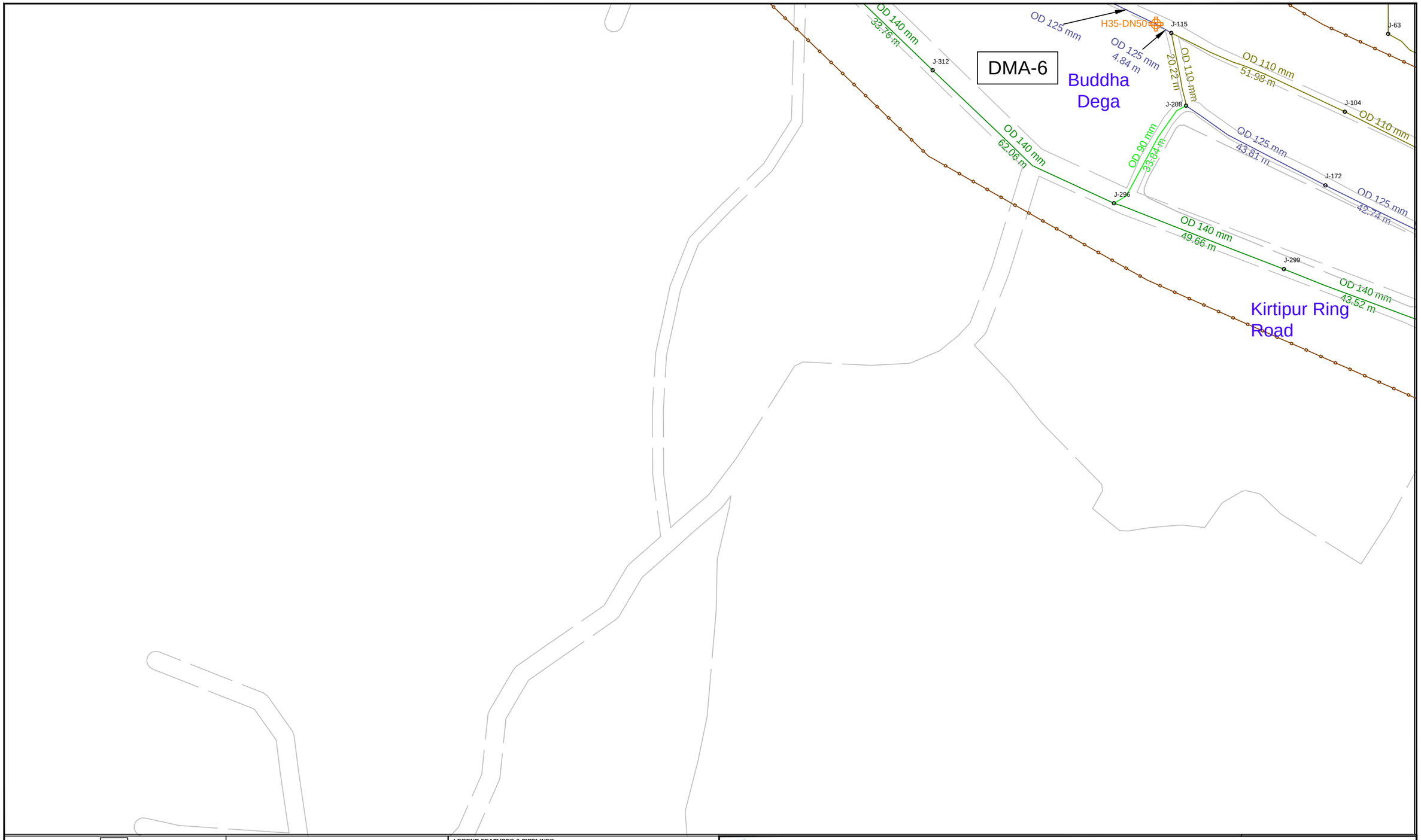
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

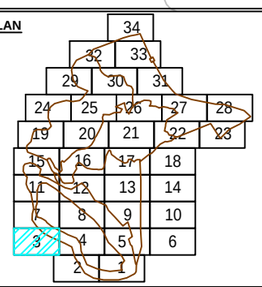
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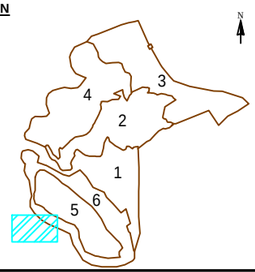
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	2 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

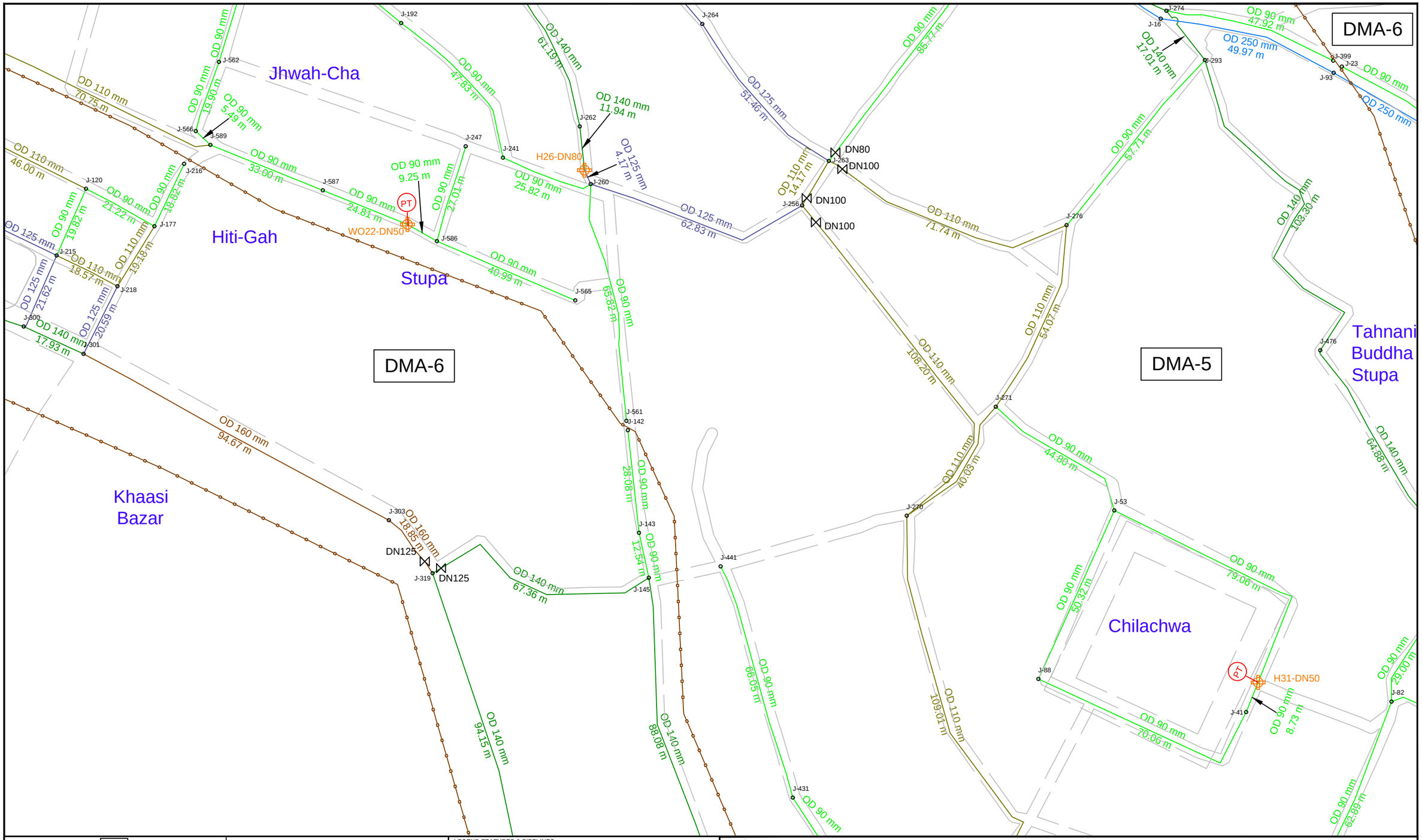
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

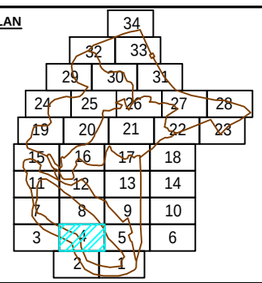
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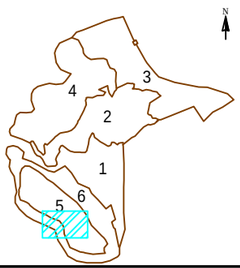
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	3 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

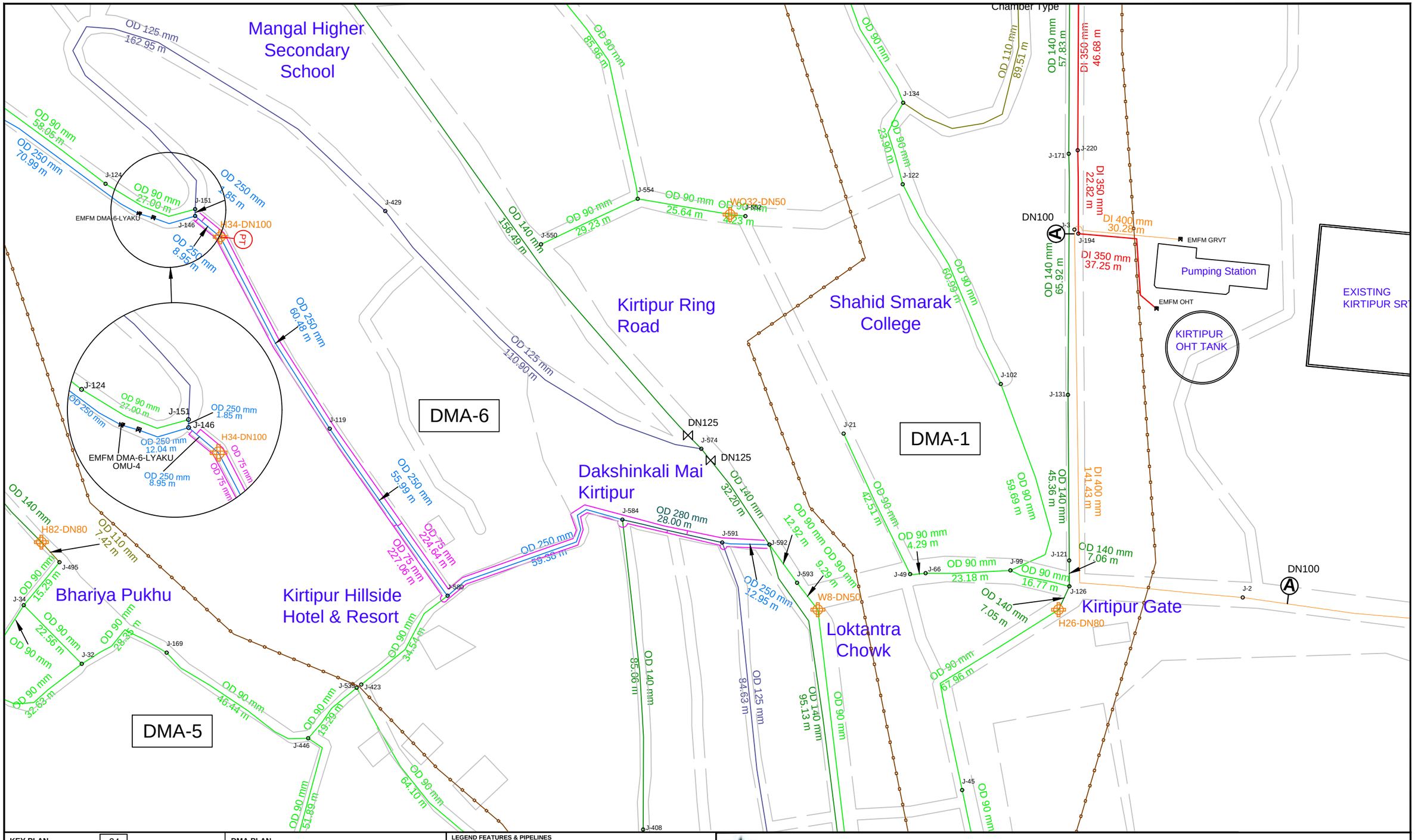
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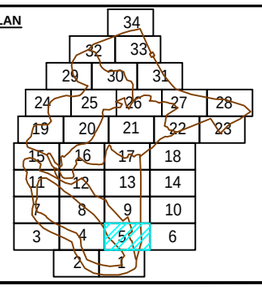
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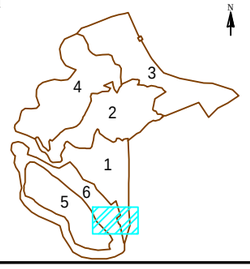
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRETE	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	4 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

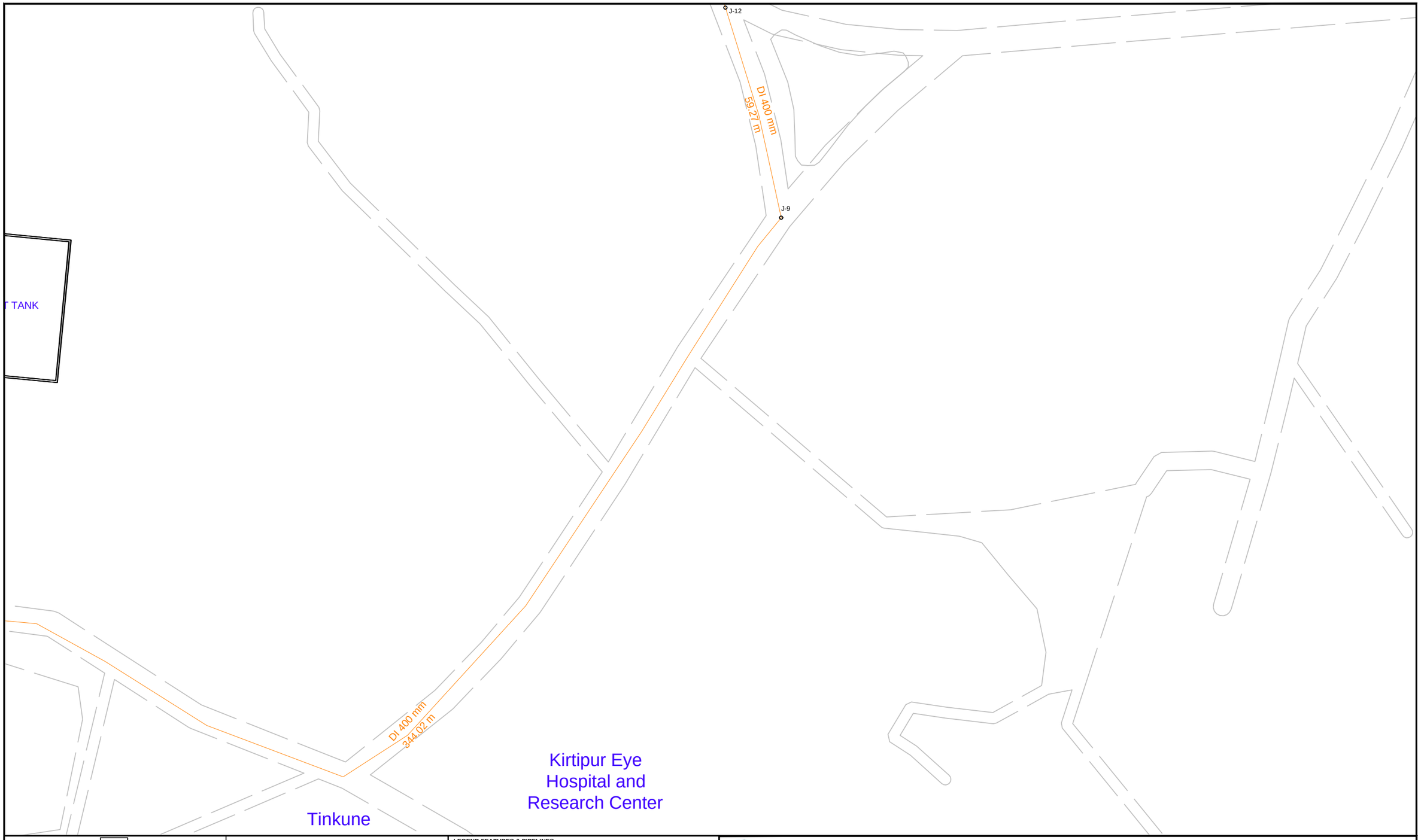
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

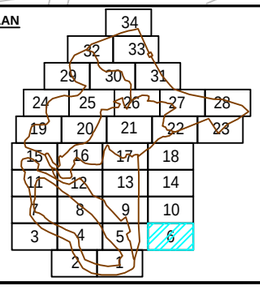
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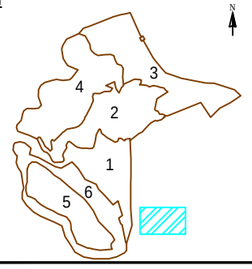
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APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	5 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

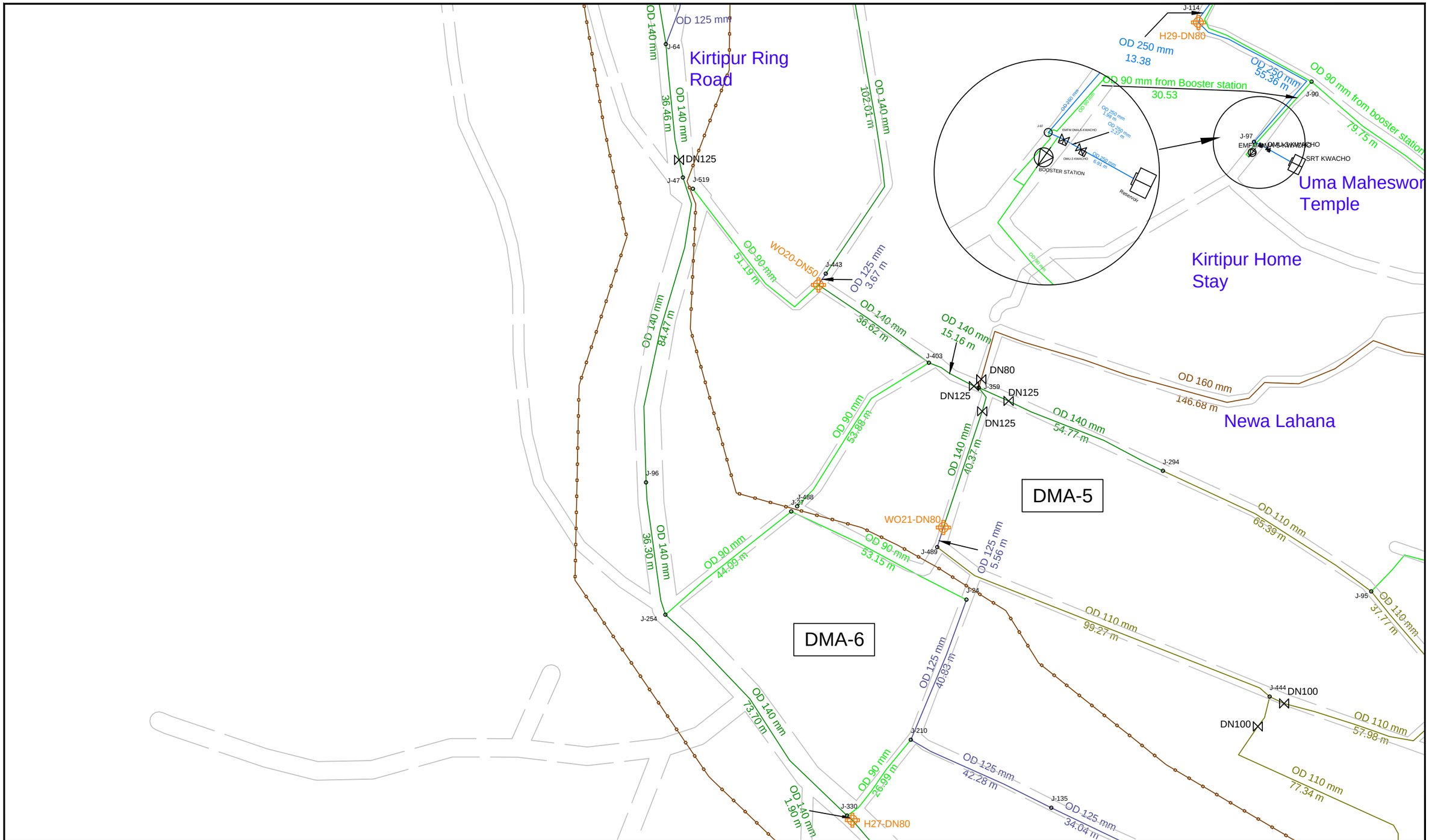
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

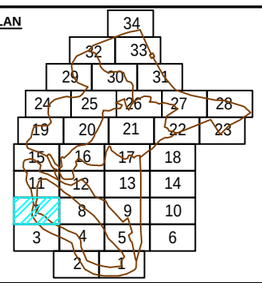
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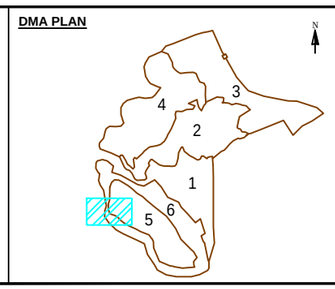
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APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	6 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	7 OF 34	5	

DMA-5

DMA-6

Kirtipur Ring Road

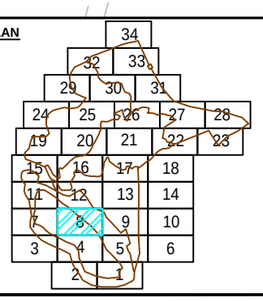
Baag Bhairav Temple

Narayan Temple

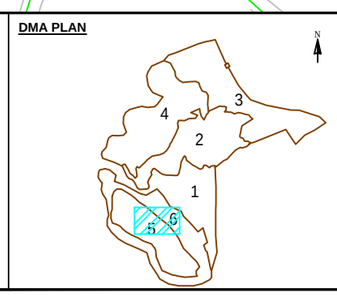
Primar Cafe

OD 75 mm
OD 75 mm
J-43
OD 200 mm
58.09 m
OD 90 mm from booster station
DN125
DN150
J-101
OD 90 mm
56.12 m
W5-DN50
J-478
OD 90 mm
6.64 m
OD 140 mm
37.22 m
J-65
J-57
OD 140 mm
12.85 m
J-56
H28-DN80
OD 140 mm
19.39 m
OD 140 mm
8.69 m
J-84
OD 140 mm
67.37 m
J-189
OD 90 mm
95.28 m
J-170
OD 140 mm
84.73 m
OD 125 mm
84.86 m
SRT LYAKU
(existing)
DN200
OD 250 mm
14.87 m
J-85
J-1
OD 125 mm
80.67 m
OD 250 mm
80.64 m
J-227
J-11
OD 140 mm
33.74 m
DN125
J-266
OD 90 mm
93.86 m
OD 140 mm
84.78 m
J-494
OD 140 mm
86.75 m
J-538
OD 90 mm
75.82 m
WO31-DN50
J-546
OD 90 mm
10.40 m
J-509
OD 140 mm
128.95 m
J-179
OD 90 mm
79.09 m
OD 110 mm
J-428
OD 140 mm
69.01 m
OD 125 mm
63.94 m
OD 250 mm
142.77 m
OD 140 mm
109.84 m
OD 110 mm
66.67 m
OD 110 mm
47.15 m
J-202
DN125
DN125
OD 140 mm
43.84 m
J-420
J-255
J-259
DN125
H27-DN100
OD 140 mm
50.38 m
OD 250 mm
49.08 m
OD 90 mm
34.31 m
OD 90 mm
41.94 m
OD 140 mm
OD 125 mm
42.08 m
OD 90 mm

KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRETE	1	
APPROVED:	M. BERMÚDEZ	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	8 OF 34	5	

DMA-1

DMA-6

Kirtipur Ring Road

OD 90 mm 123.05 m

OD 90 mm

J-109

OD 90 mm 80.19 m

J-98

J-100

J-140

J-83

J-52

OD 90 mm 53.83 m

OD 90 mm 80.71 m

OD 90 mm 71.72 m

OD 90 mm 97.52 m

J-62

OD 110 mm 91.31 m

J-180

J-157

DI 350 mm 25.14 m

OD 140 mm 21.22 m

J-197

J-167

DN125

OD 140 mm 78.56 m

OD 140 mm 74.08 m

DI 350 mm 59.77 m

OD 140 mm 55.37 m

DI 350 mm 53.40 m

OD 110 mm 100.96 m

OD 110 mm 98.19 m

OD 90 mm 66.41 m

OD 140 mm 19.79 m

J-103

J-127

OD 140 mm 22.37 m

J-94

OD 90 mm 38.42 m

J-199

J-248

J-214

OD 110 mm 68.54 m

OD 140 mm 76.08 m

DI 350 mm 80.83 m

OD 110 mm 10.99 m

J-516

J-512

OD 140 mm 89.23 m

H1-DN80

PT

OD 140 mm 4.00 m

OD 140 mm 16.23 m

J-46

OD 140 mm 49.65 m

J-28

J-128

J-204

J-553

OD 90 mm 11.52 m

DN80

J-535

J-540

OD 90 mm 36.85 m

OD 90 mm

OD 90 mm 67.40 m

J-228

J-257

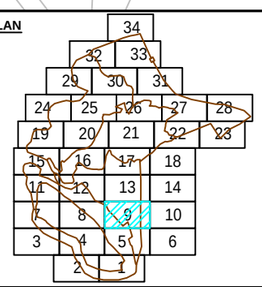
DI 350 mm 10.79 m

H38-DN100

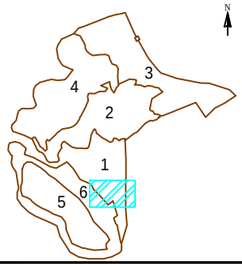
DN100

DN100

KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

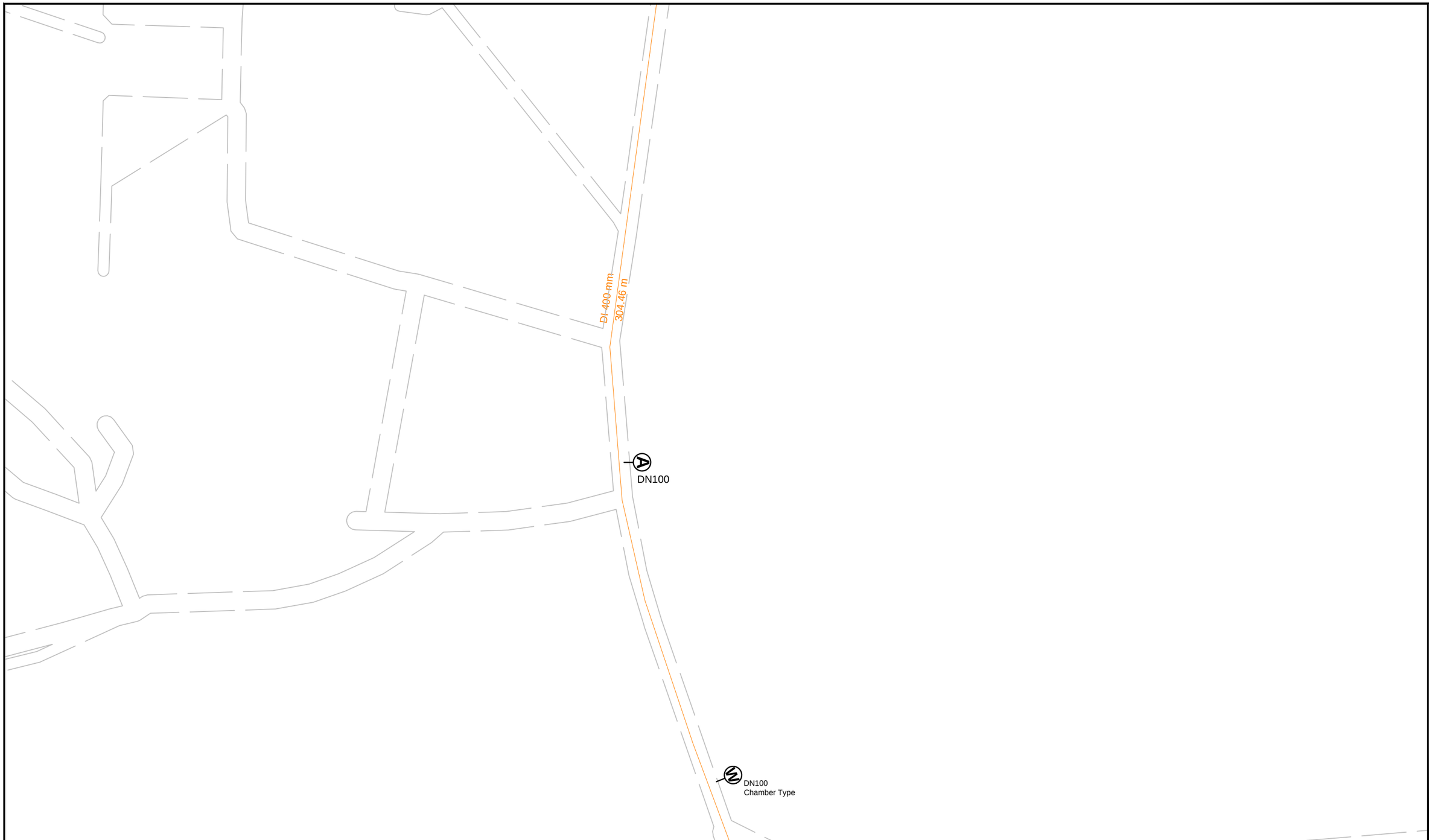
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

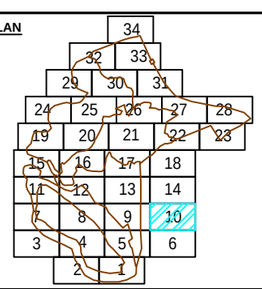
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

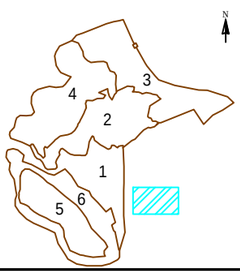
		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	9 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

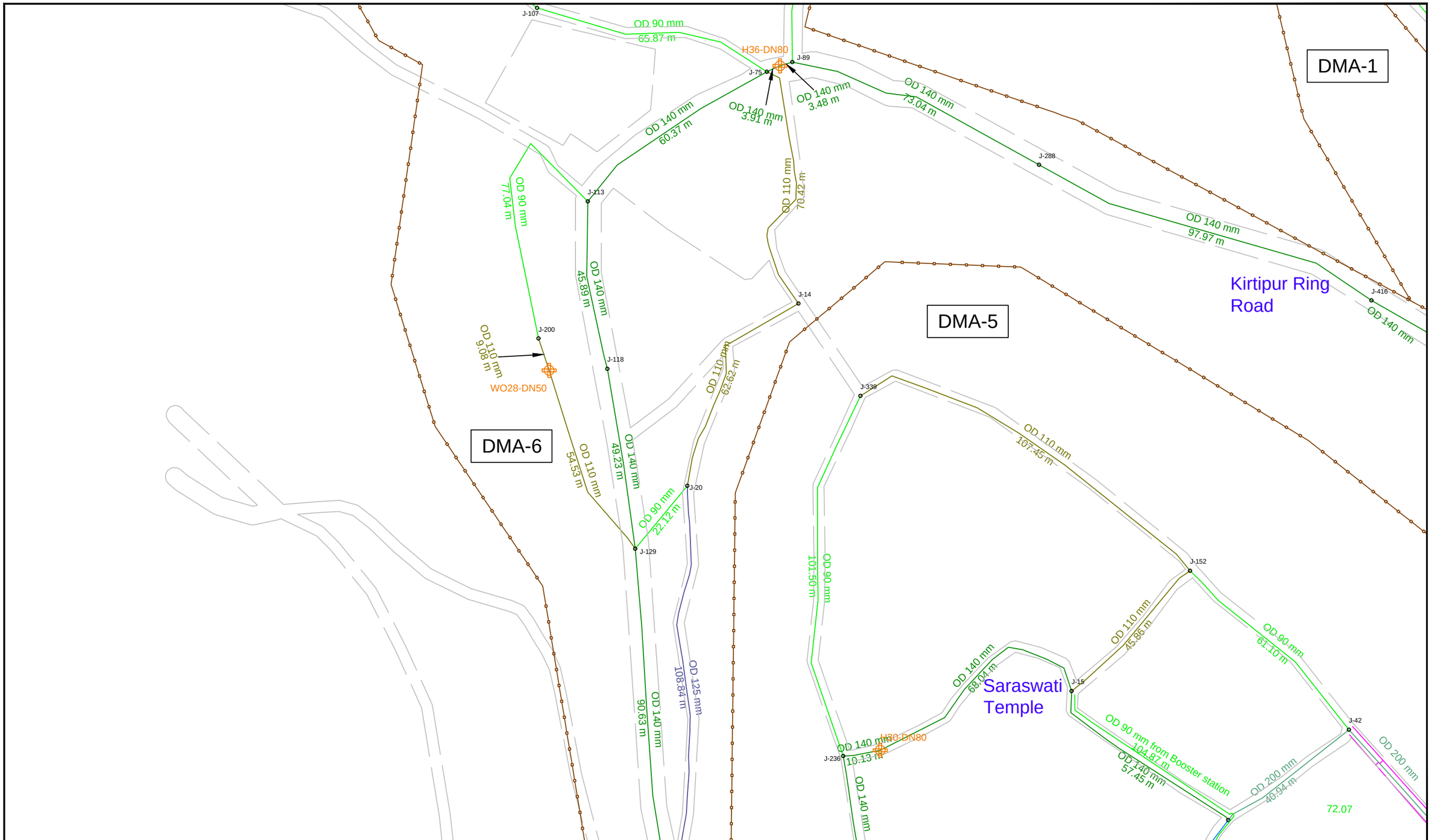
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

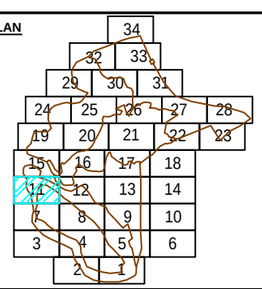
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

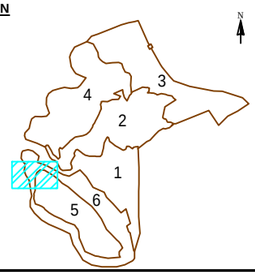
		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAYAS	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	10 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

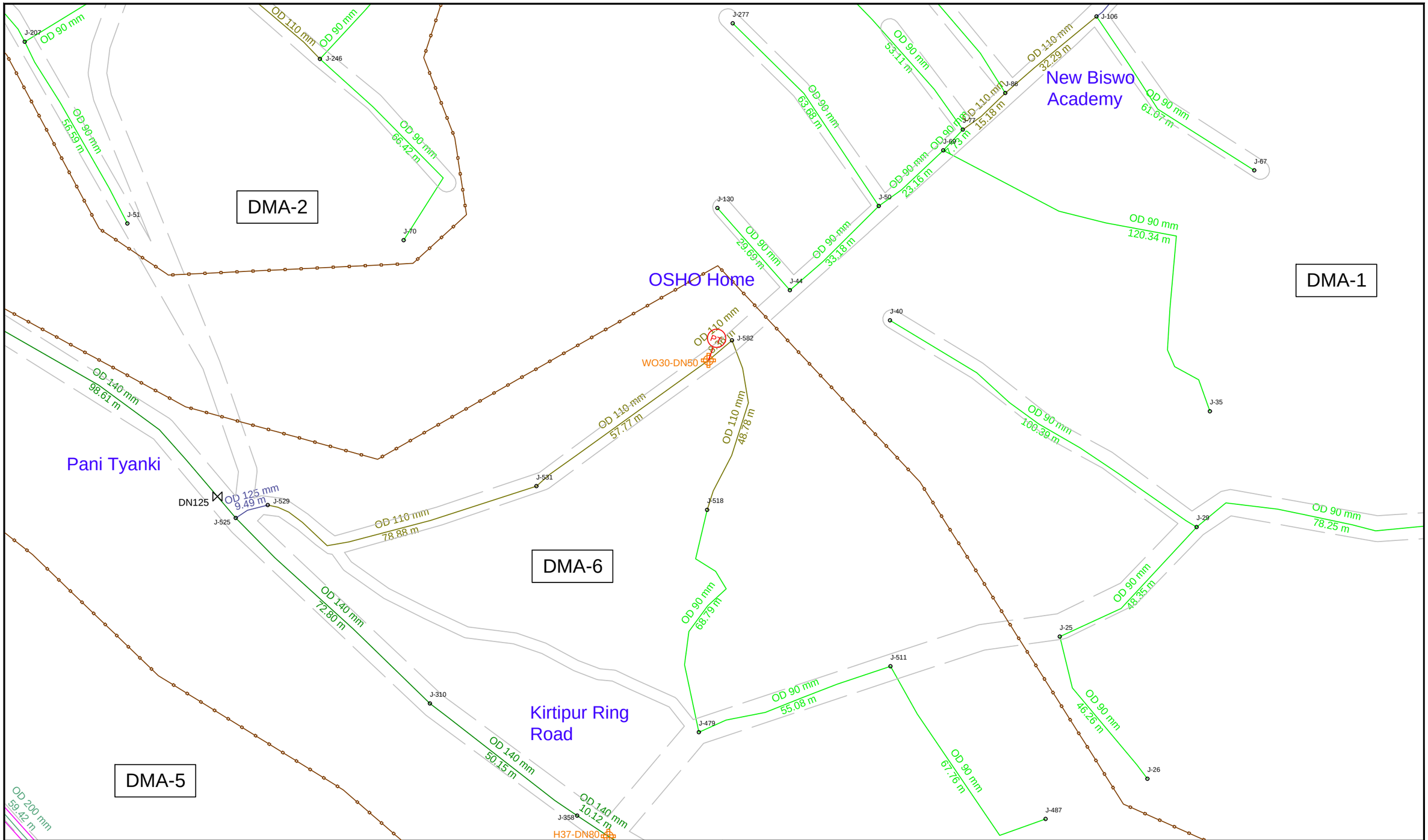
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

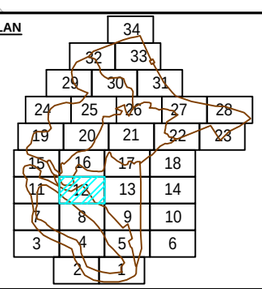
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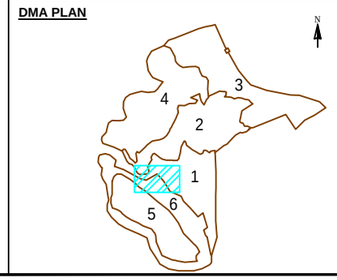
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	11 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	12 OF 34	5	

DMA-1

Ghingu Sekuwa Chey

Three Brothers Trade Center

Sahakarya Girl's Hostel

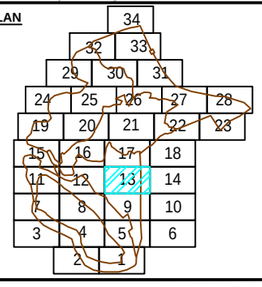
BIgmart

OD 125 mm 51.74 m
OD 90 mm 42.71 m
OD 125 mm
OD 125 mm 34.52 m
OD 90 mm 35.80 m
OD 125 mm 49.78 m
OD 125 mm 41.93 m
OD 125 mm 56.09 m
OD 125 mm 77.83 m
OD 250 mm 200.88 m
OD 90 mm 51.95 m
OD 90 mm 90.83 m
OD 90 mm 64.66 m
OD 125 mm 98.91 m
OD 90 mm 63.98 m
OD 140 mm 86.05 m
OD 125 mm 123.87 m
OD 125 mm 39.35 m
OD 140 mm 3.95 m
OD 140 mm 57.59 m
OD 90 mm 30.36 m
OD 90 mm 73.25 m
OD 110 mm 40.98 m
OD 140 mm 55.11 m
OD 140 mm 31.11 m
OD 160 mm 25.47 m
OD 160 mm 44.96 m
DI 350 mm 37.27 m
DI 350 mm 5.72 m
DI 350 mm
OD 90 mm 45.32 m
OD 90 mm 47.00 m
OD 90 mm 54.77 m
OD 90 mm 19.16 m
OD 90 mm 26.08 m
OD 90 mm 47.38 m
OD 90 mm 60.63 m
OD 90 mm
OD 200 mm 1.59 m

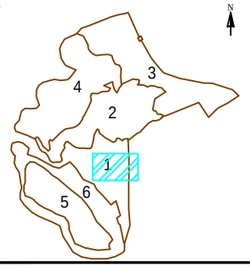
J-117 J-133 J-123 J-137 J-159 J-182 J-196 J-108 J-164 J-48 J-87 J-105 J-132 J-190 J-168 J-173 J-36 J-116 J-125 J-92 J-138 J-150 J-58 J-39 J-156 J-160 J-165

DN100 DN80 DN125 DN-100 H2-DN80 H40-DN100 OMU 1 DMA-1&DMA-2 EMFM DMA-2-OHT EMFM DMA-1-OHT

KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

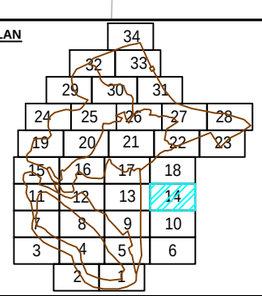
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

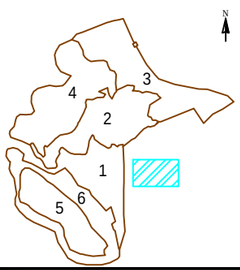
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	13 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

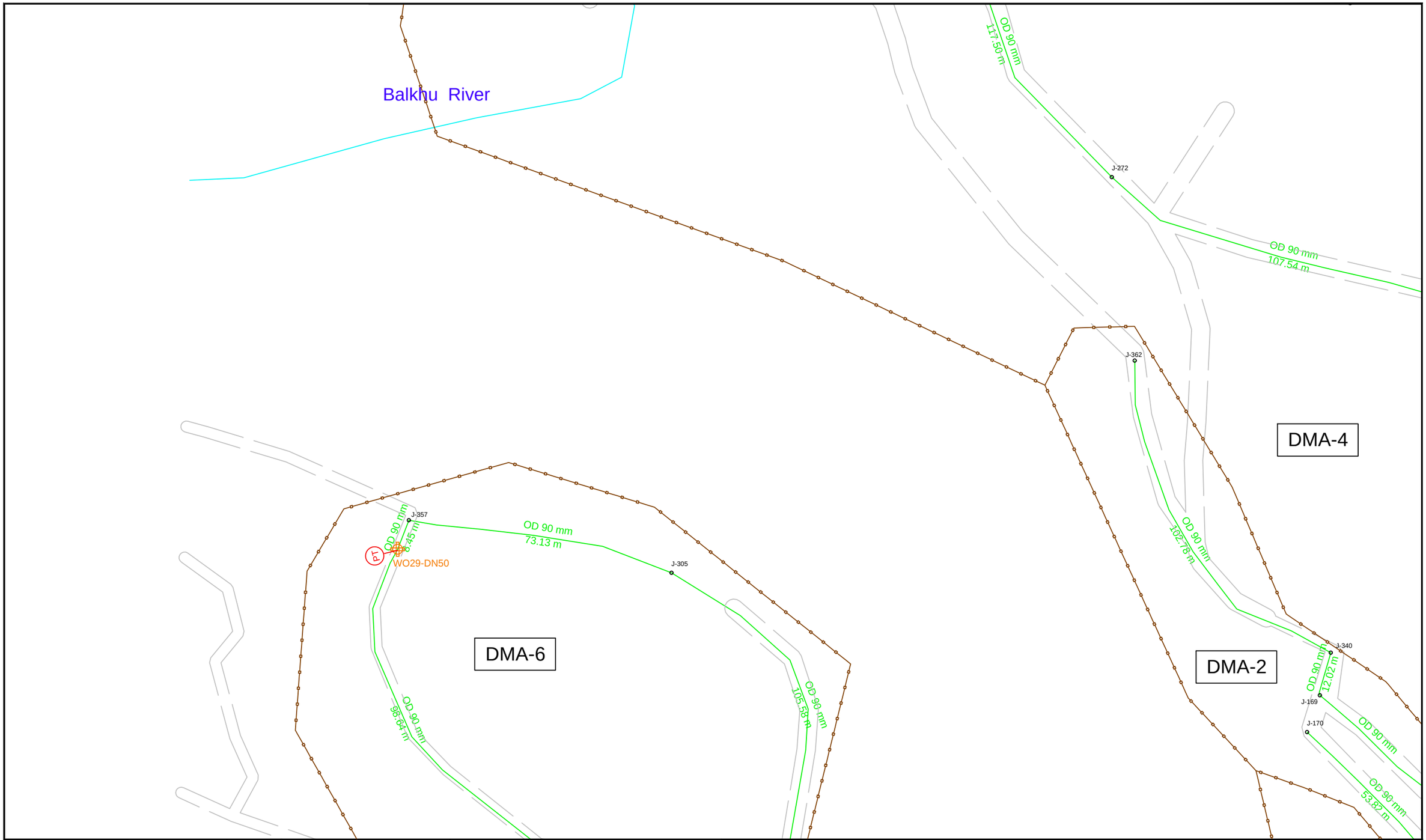
PROJECT TITLE: KIRTIPUR DISTRIBUTION NETWORK IMPROVEMENT WORKS

DISTRIBUTION NETWORK IMPROVEMENT WORKS

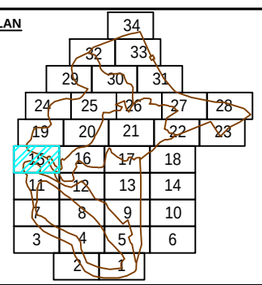
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

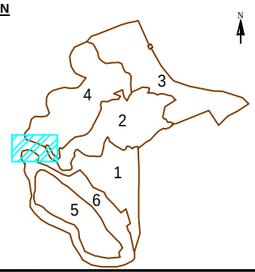
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DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	14 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

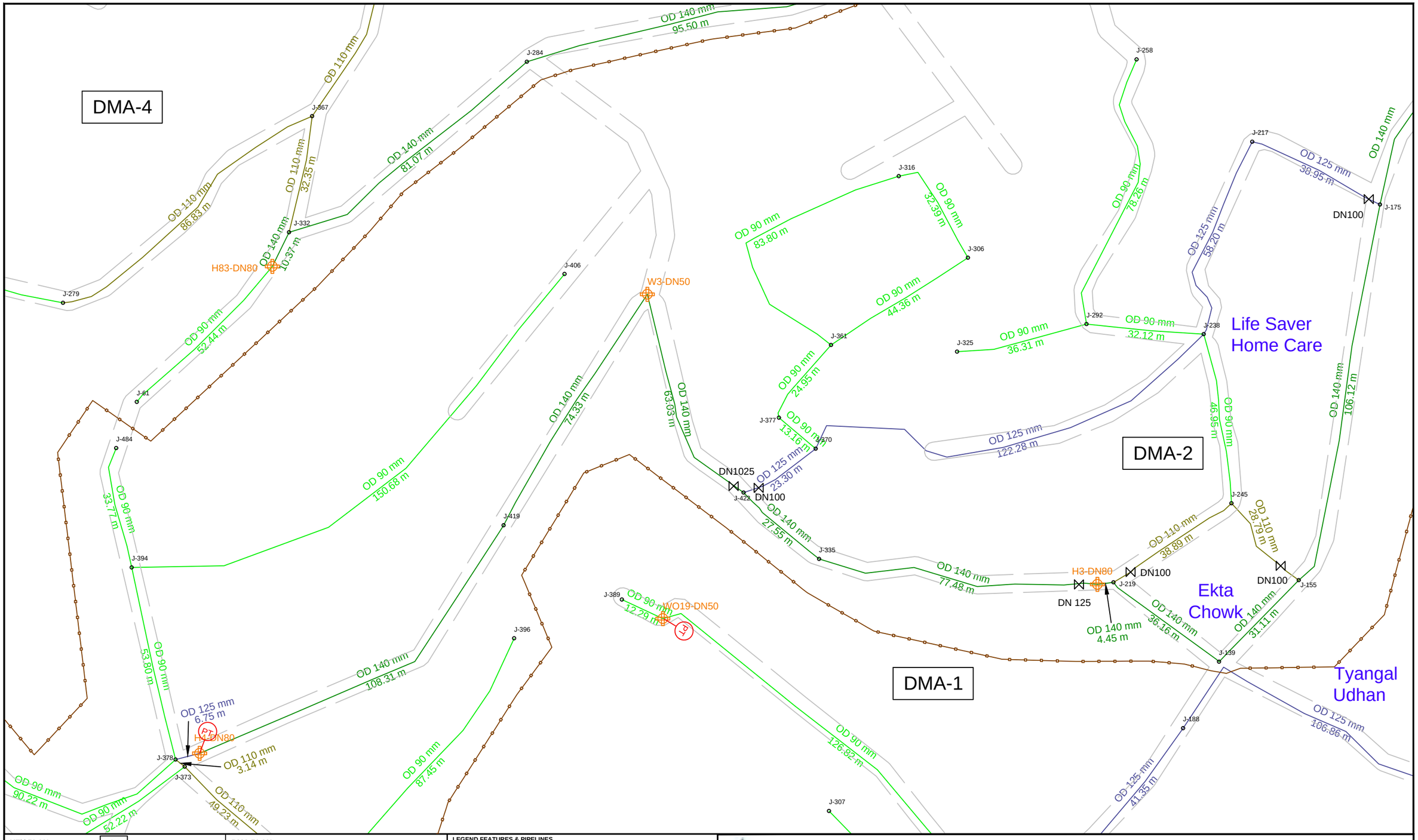
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

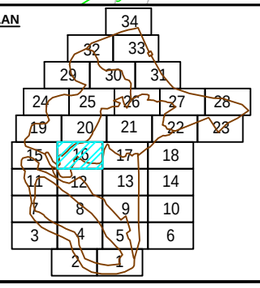
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DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

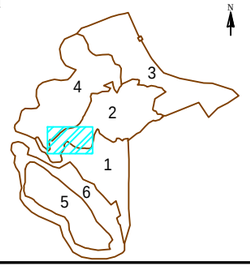
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	15 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

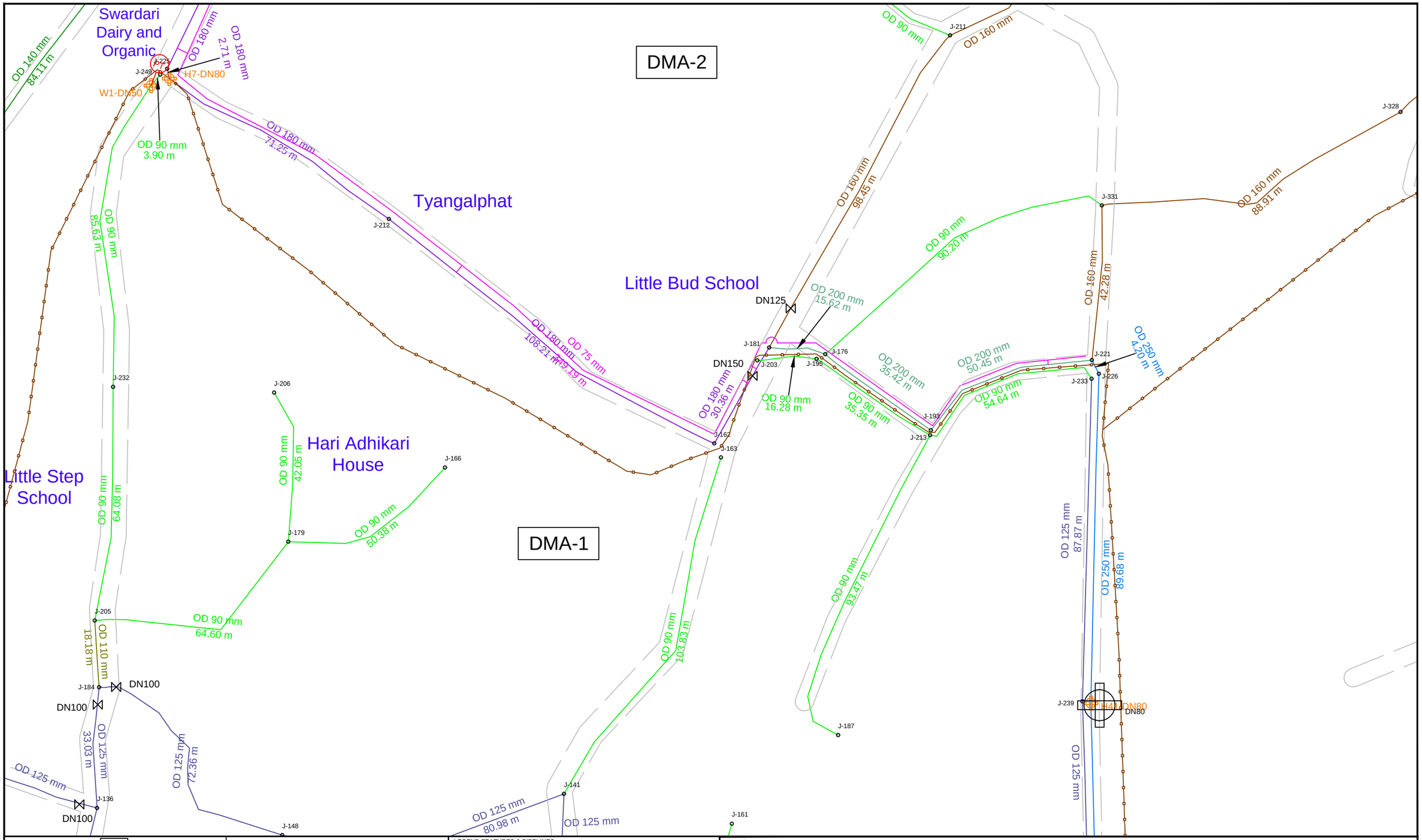
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

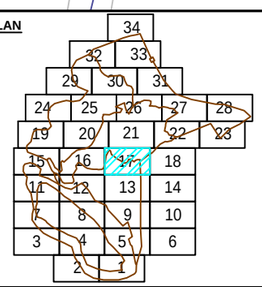
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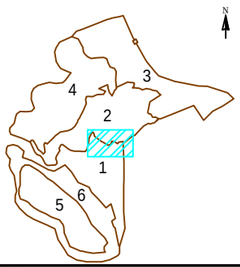
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRETE	1	
APPROVED:	M. BERMÚDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	16 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

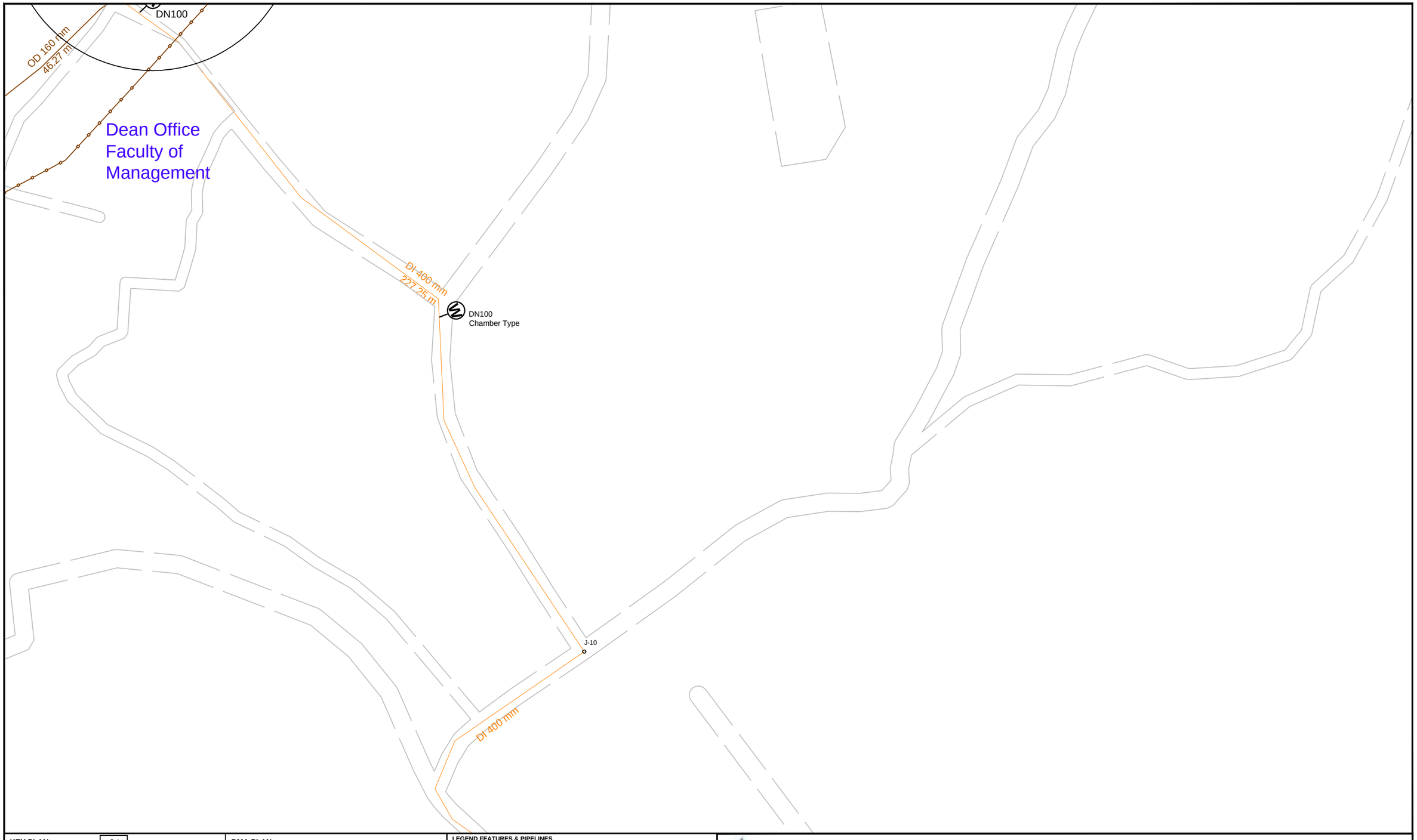
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

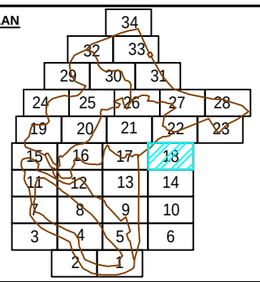
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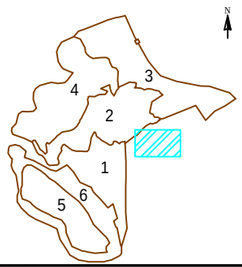
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	17 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	18 OF 34	5	

Balkhu River

Kanishka Marketing

DMA-4

J-400 OD 90 mm 25.61 m J-427 OD 90 mm 45.25 m J-472

OD 90 mm 45.62 m

OD 90 mm

OD 110 mm 63.36 m J-505

OD 90 mm 79.48 m

OD 90 mm 70.93 m

OD 140 mm 95.35 m

J-360 DN80 OD 90 mm 78.32 m J-354 OD 110 mm 23.22 m J-345 OD 110 mm 58.23 m J-475

J-342 OD 90 mm 94.91 m J-343 OD 90 mm 47.87 m

PT OD 90 mm 24.69 m

W07-DN50 RIVER TYPE

J-287 OD 90 mm 77.75 m

J-269 OD 90 mm 69.85 m OD 90 mm

OD 90 mm 122.04 m

OD 110 mm 69.69 m

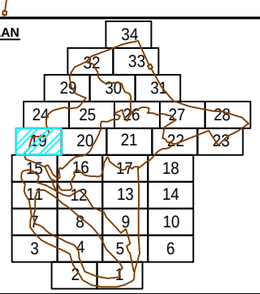
DN100 J-465

OD 110 mm 112.09 m

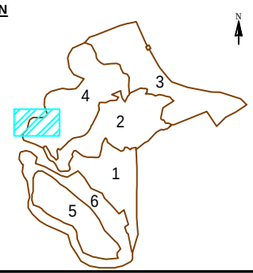
H19-DN50

OD 90 mm 13.28 m J-326

KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

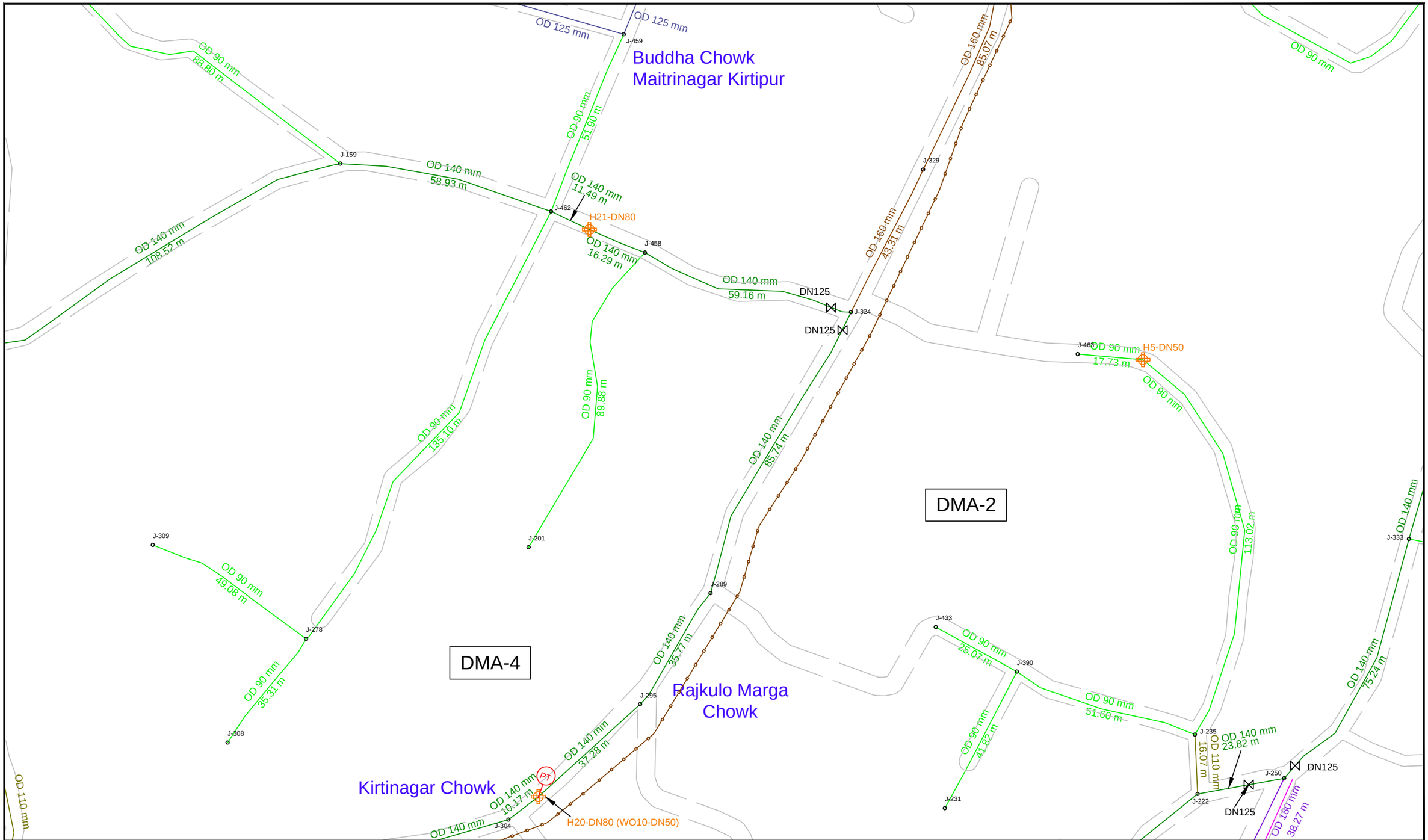
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

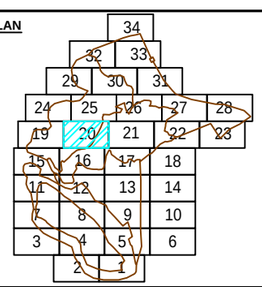
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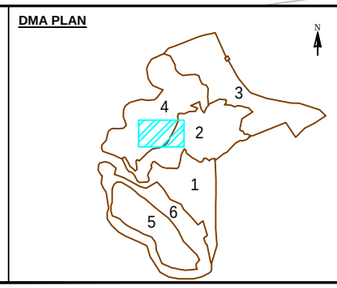
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DE	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	19 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

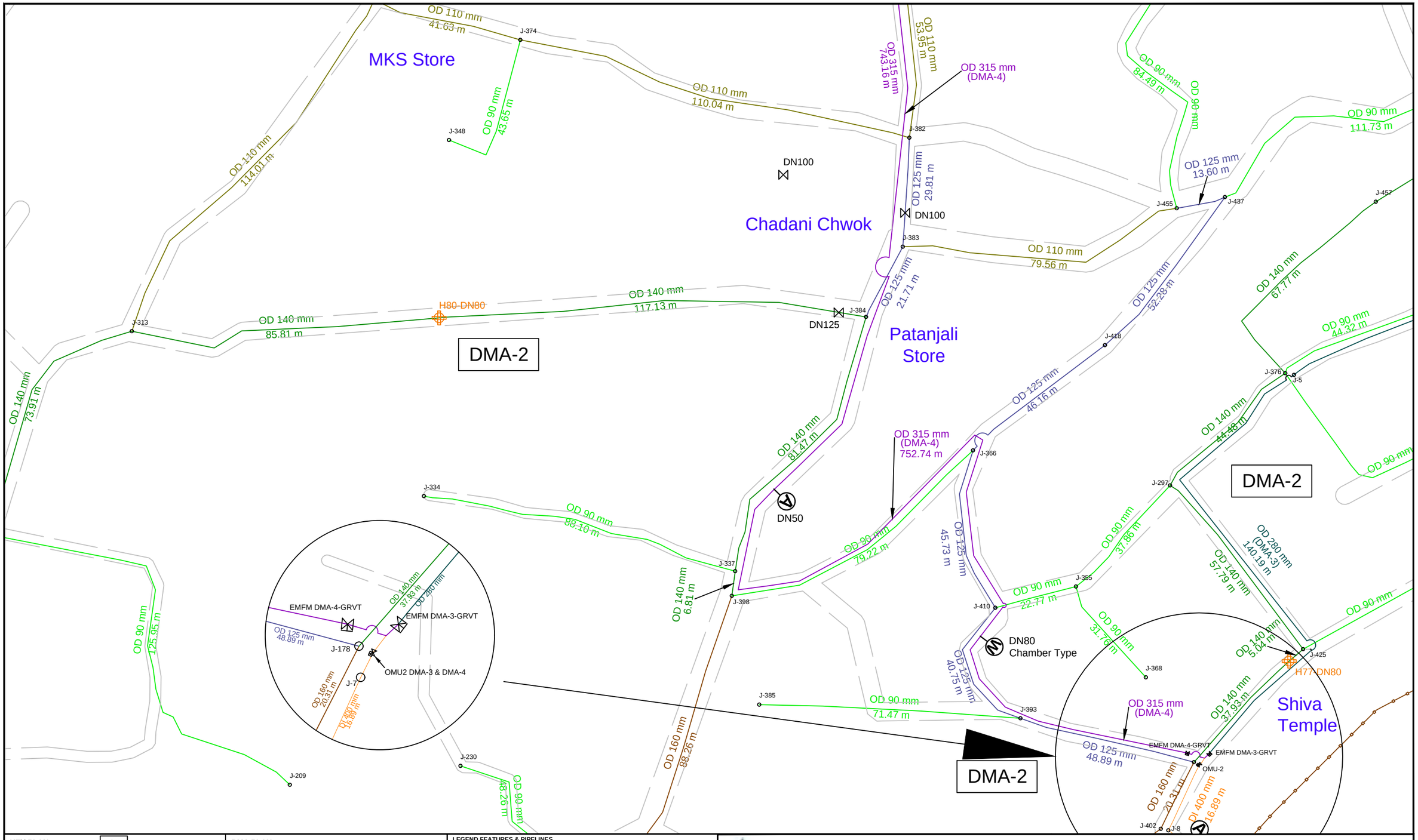
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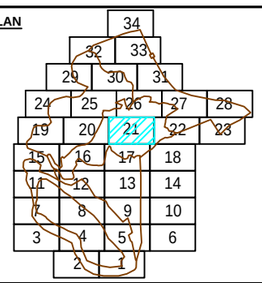
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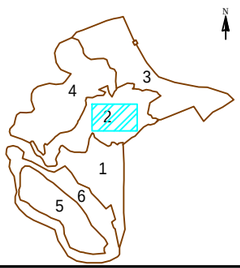
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APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	20 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

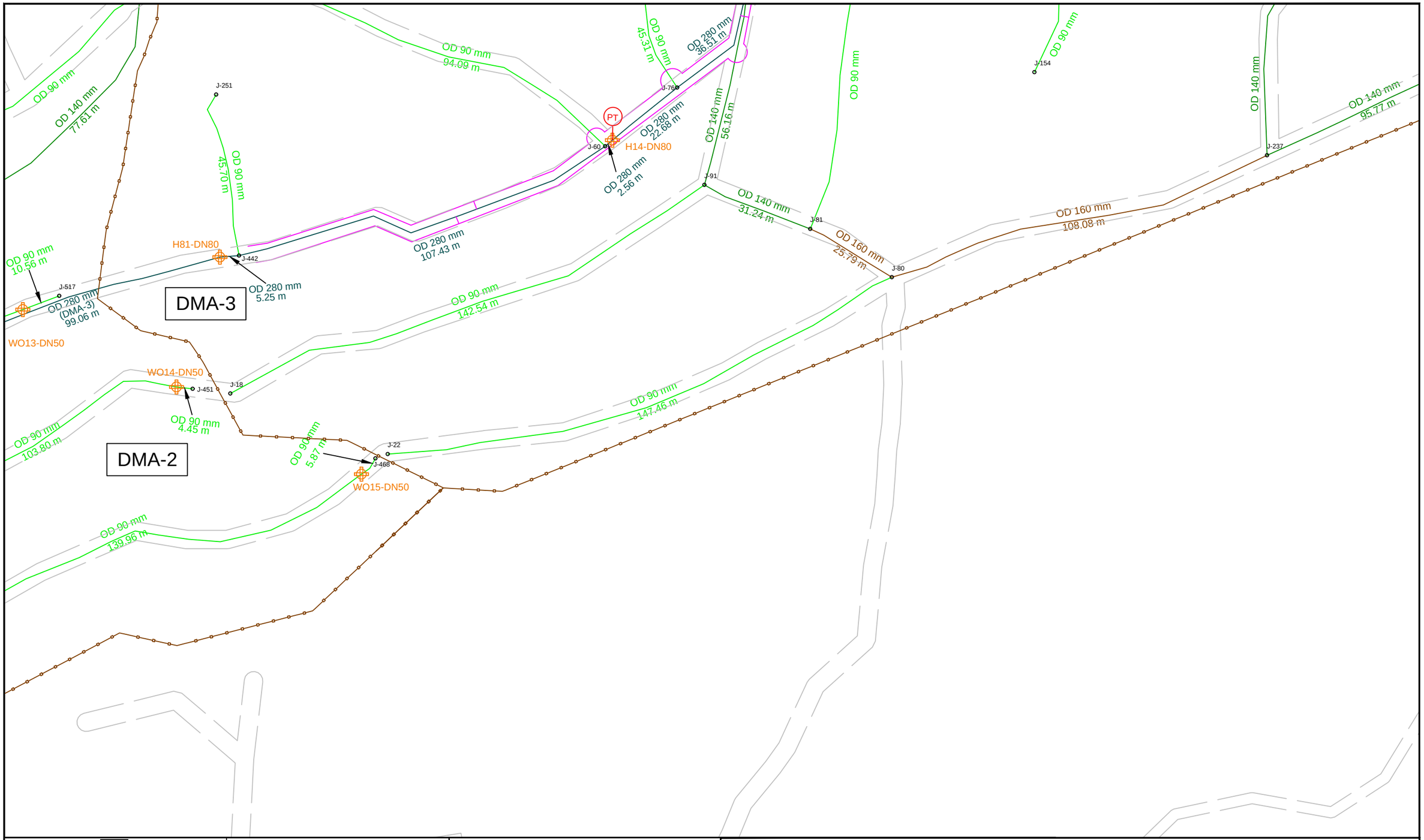
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

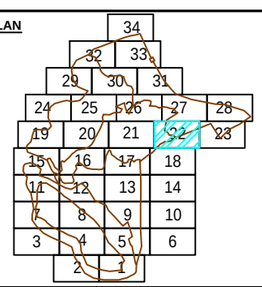
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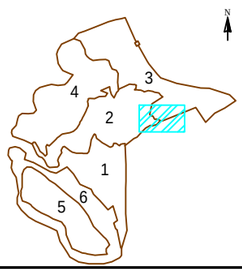
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DESIGNED:	J.M. NAVARRO	2	
APPROVED:	M. BENAVIDES	3	
DATE:	Jan-2024	4	
SCALE:	1:1000	5	
DRAWING No.	21 OF 34		



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

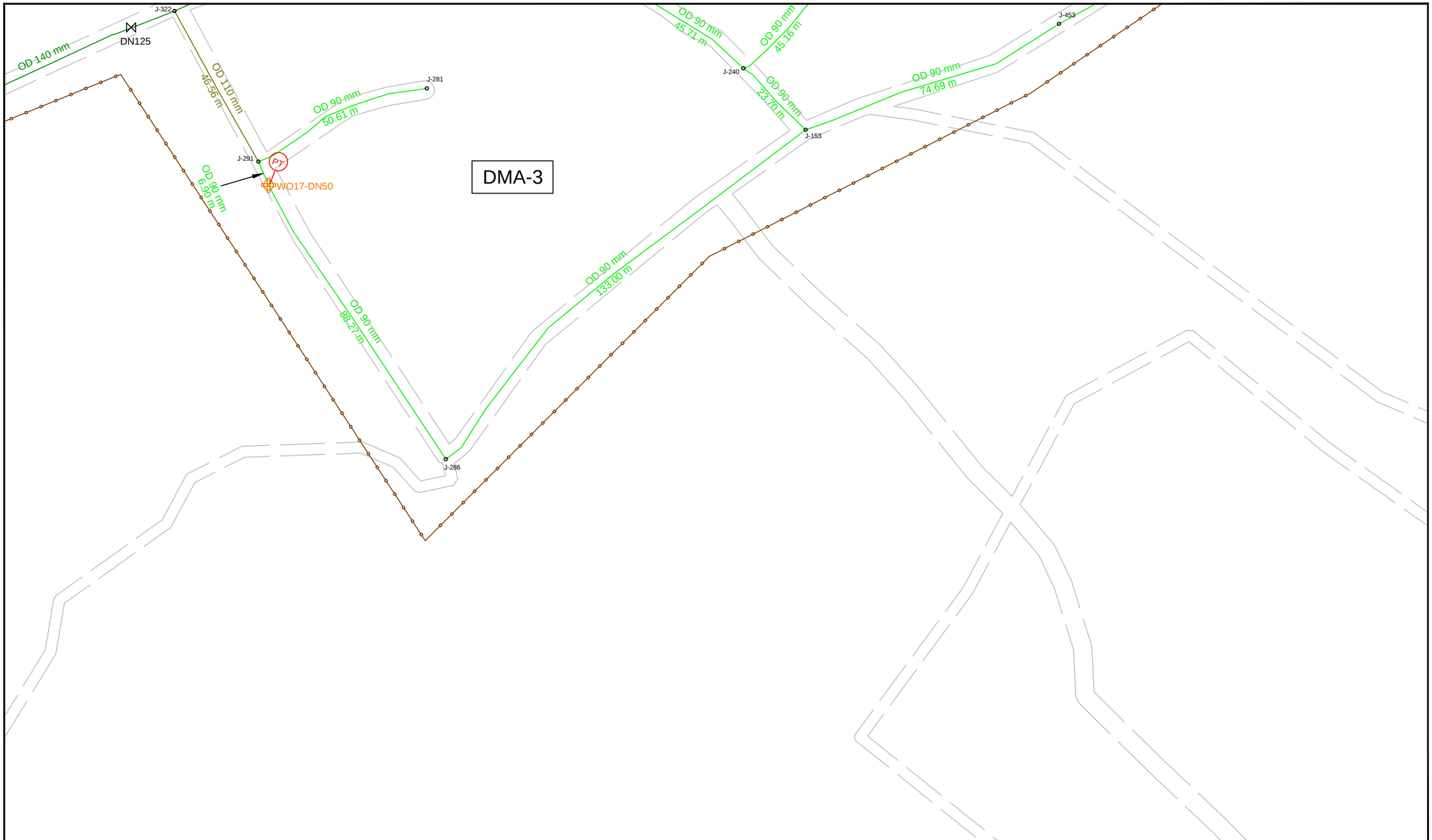
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

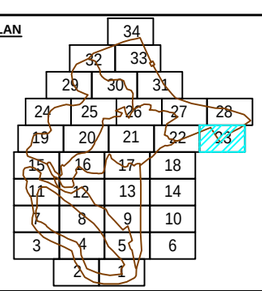
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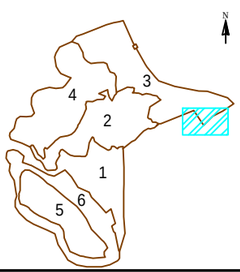
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DESIGNED:	J.M. NAVARRO	2	
APPROVED:	M. BENAVIDES	3	
DATE:	Jan-2024	4	
SCALE:	1:1000	5	
DRAWING No.	22 OF 34		



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
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- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

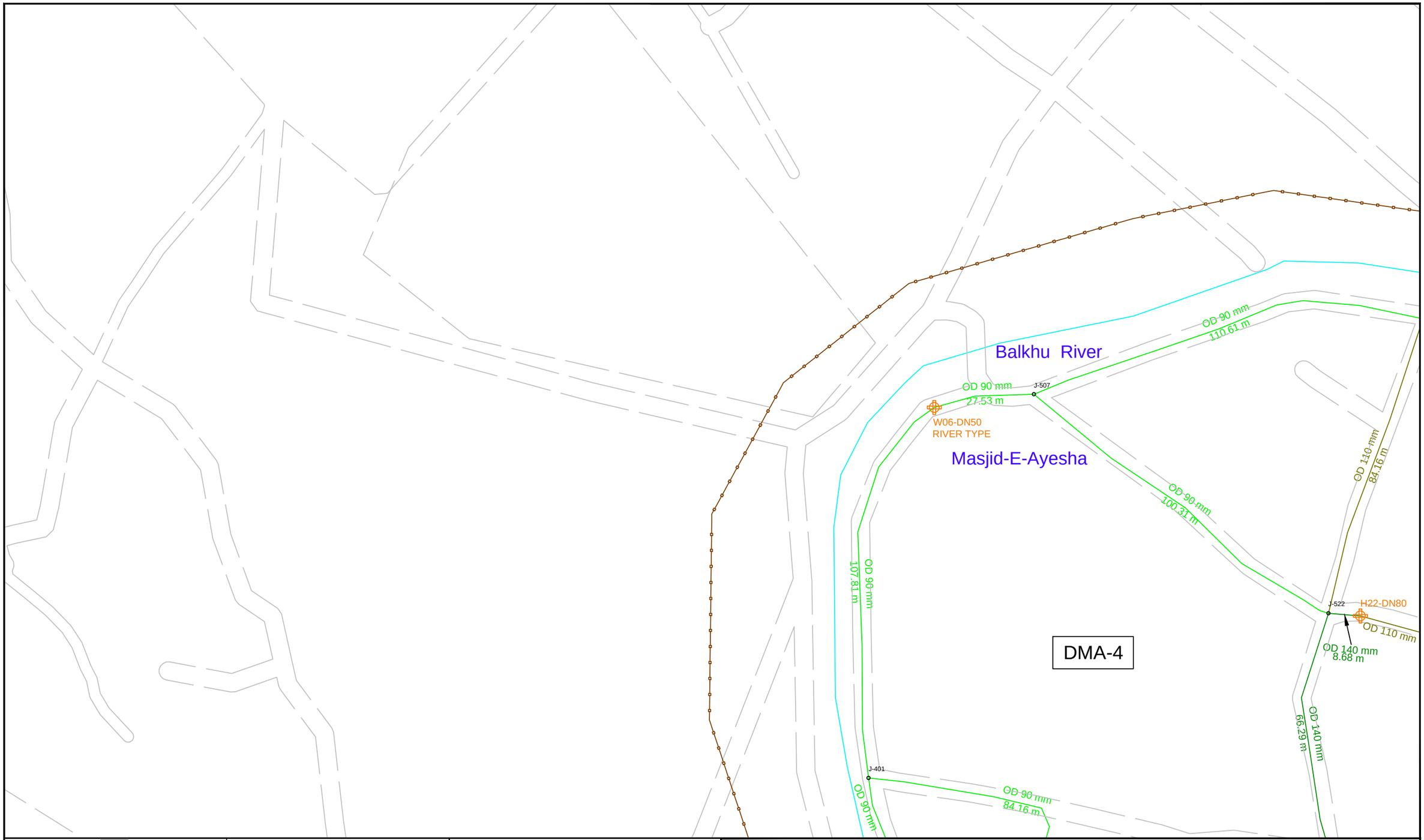
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

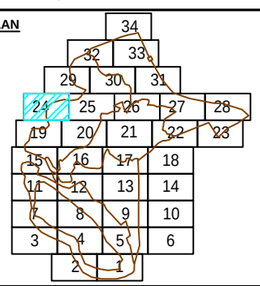
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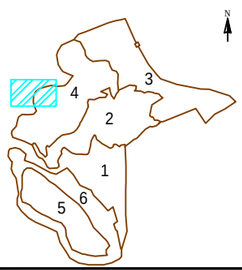
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APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	23 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
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- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

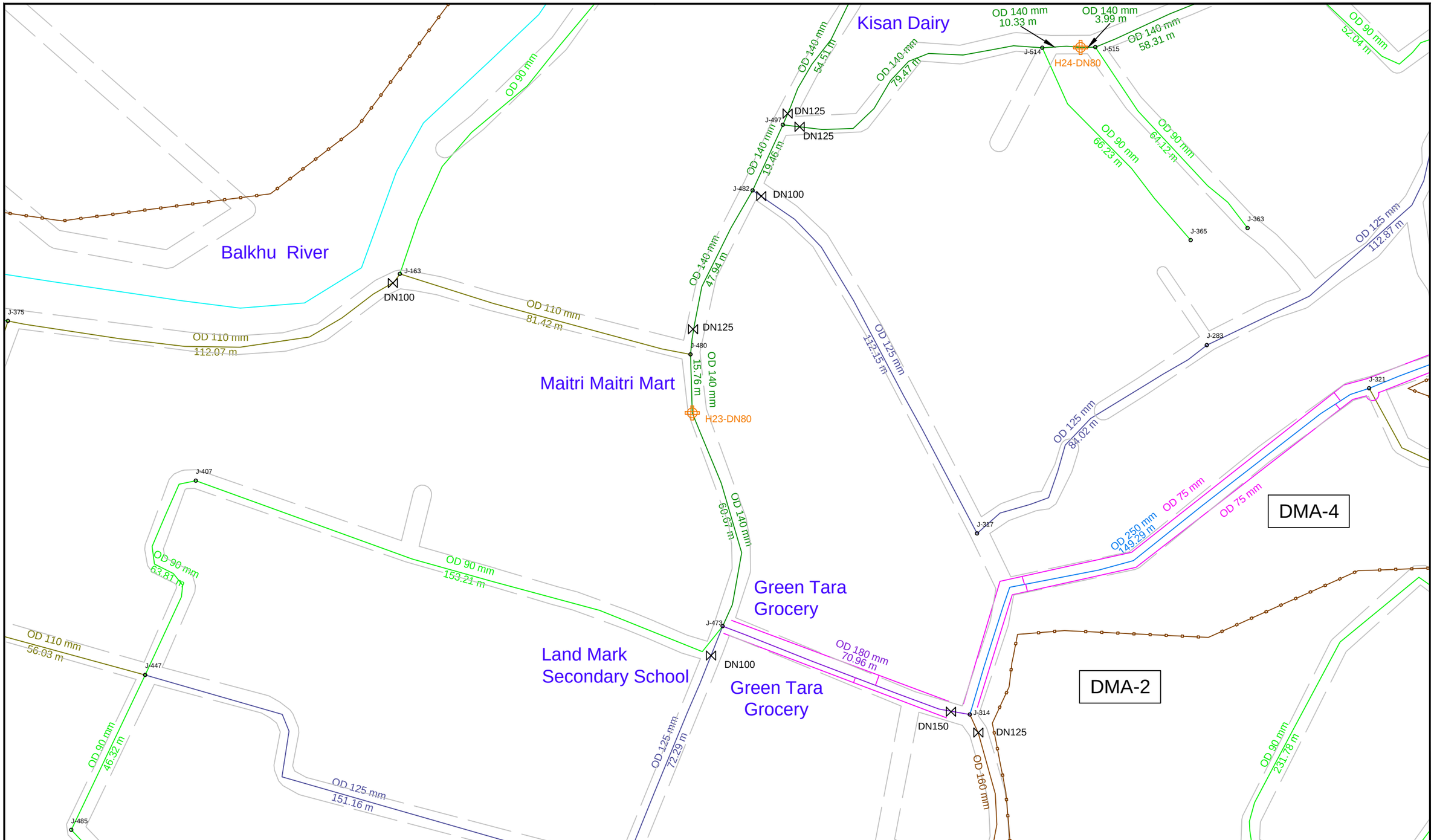
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

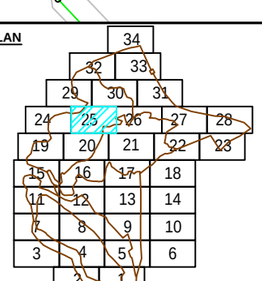
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DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

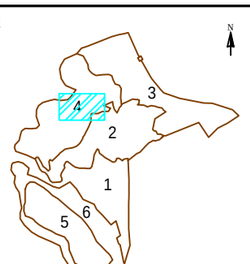
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO BES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	24 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

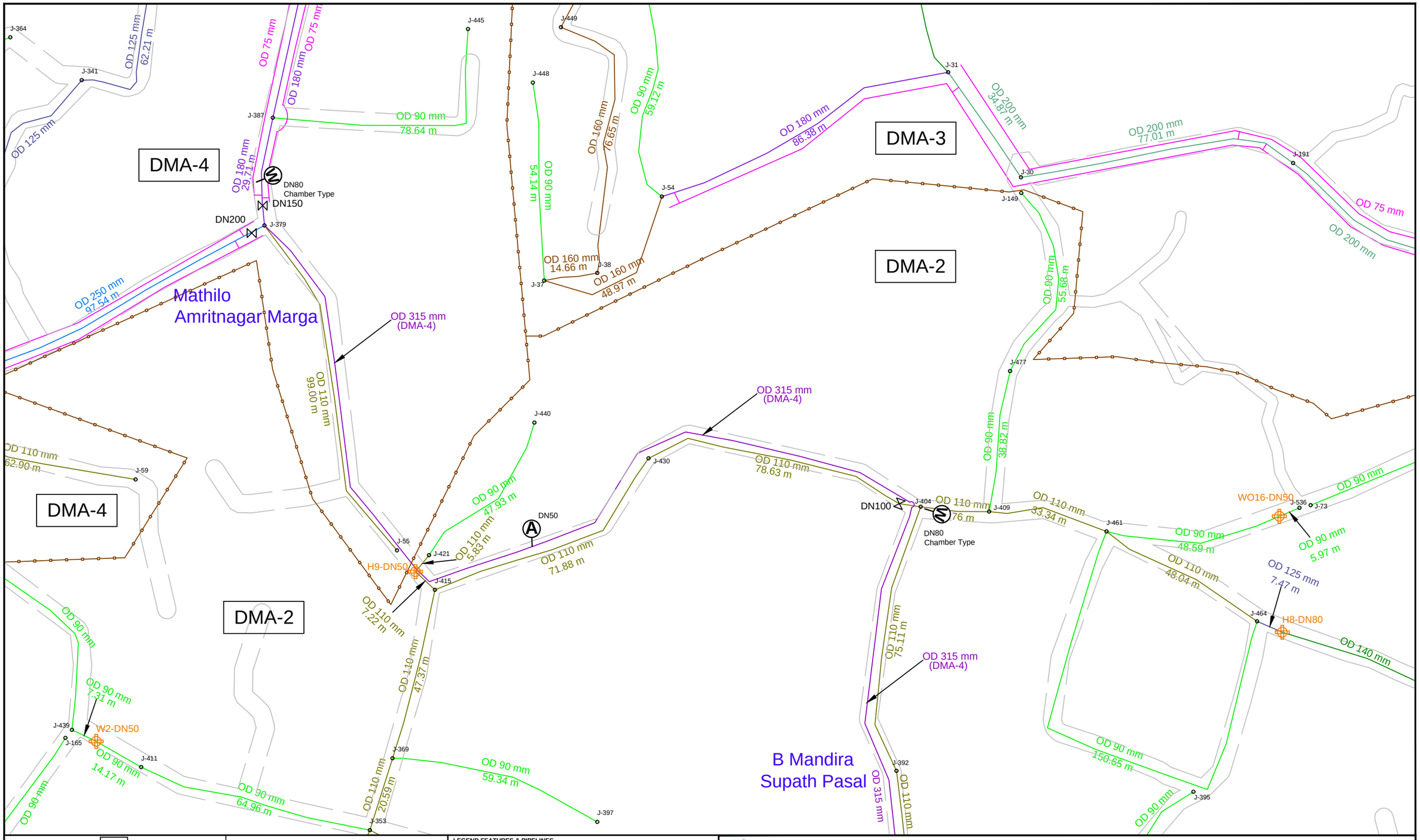
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

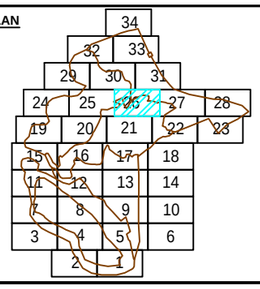
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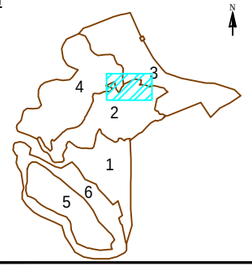
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	25 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

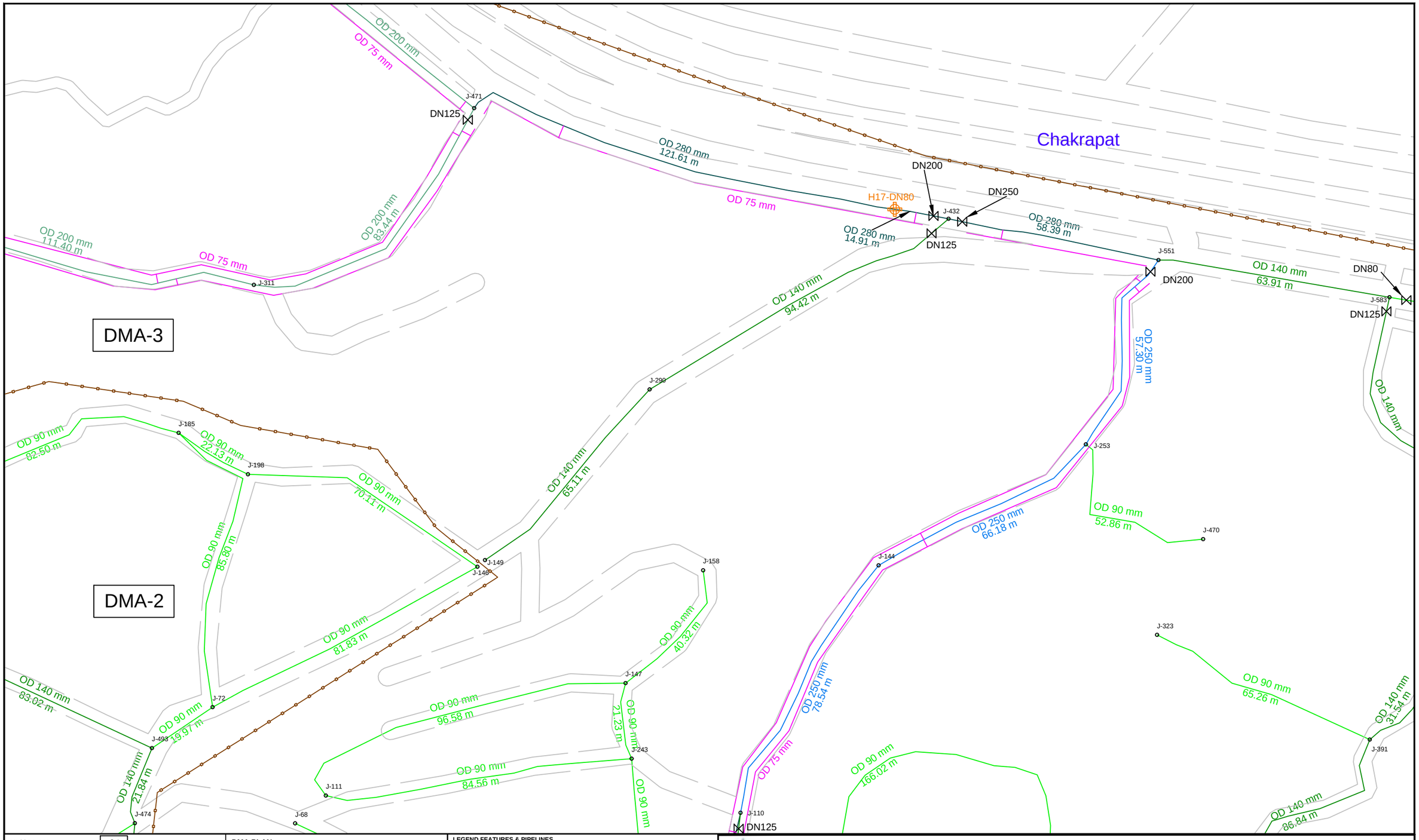
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

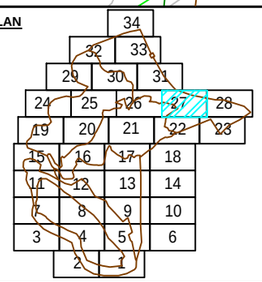
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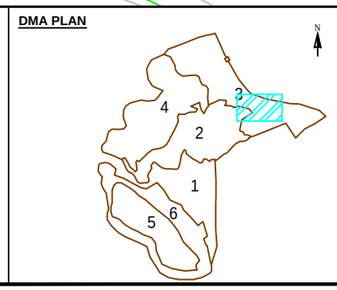
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DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	26 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 110 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 160 HDPE PN10
- OD 180 HDPE PN10
- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

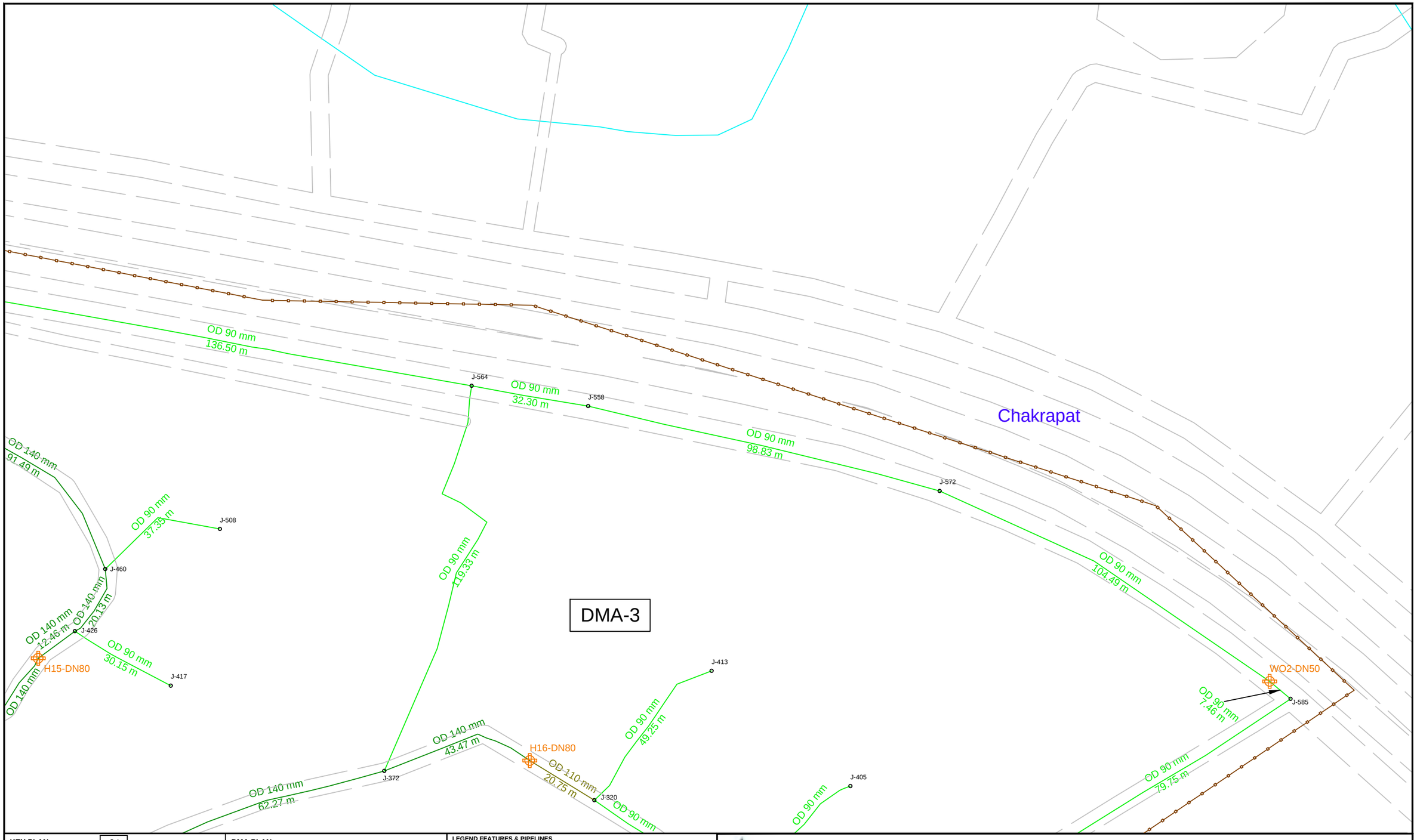
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

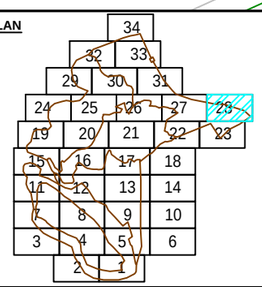
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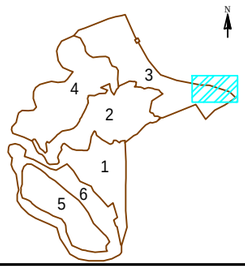
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DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES -	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	27 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
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- OD 140 HDPE PN10
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- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

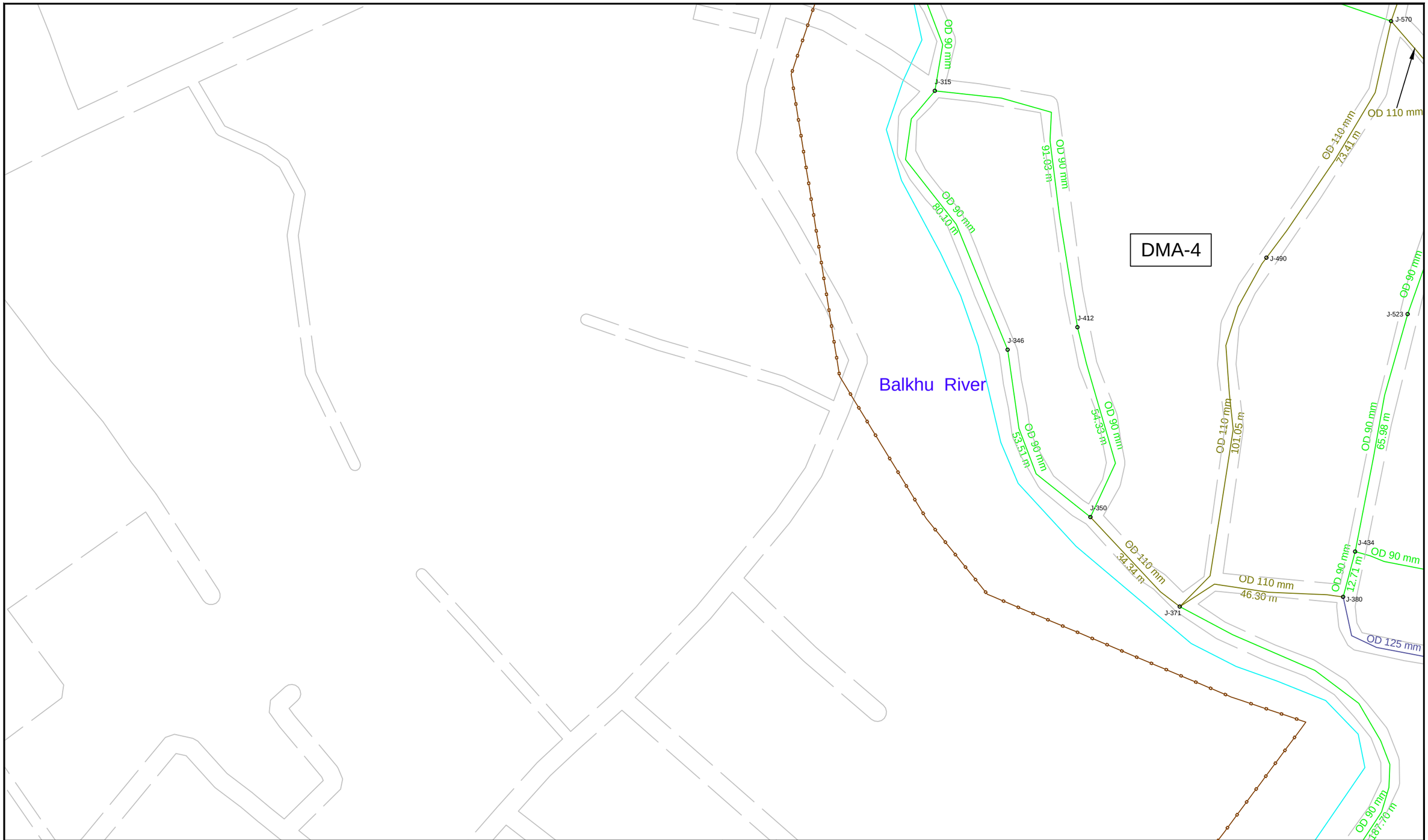
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

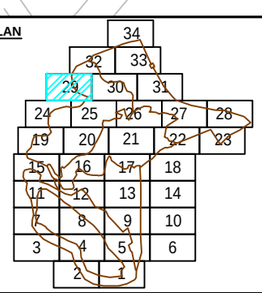
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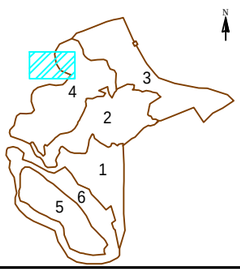
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	28 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
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- DMA BOUNDARY
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- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

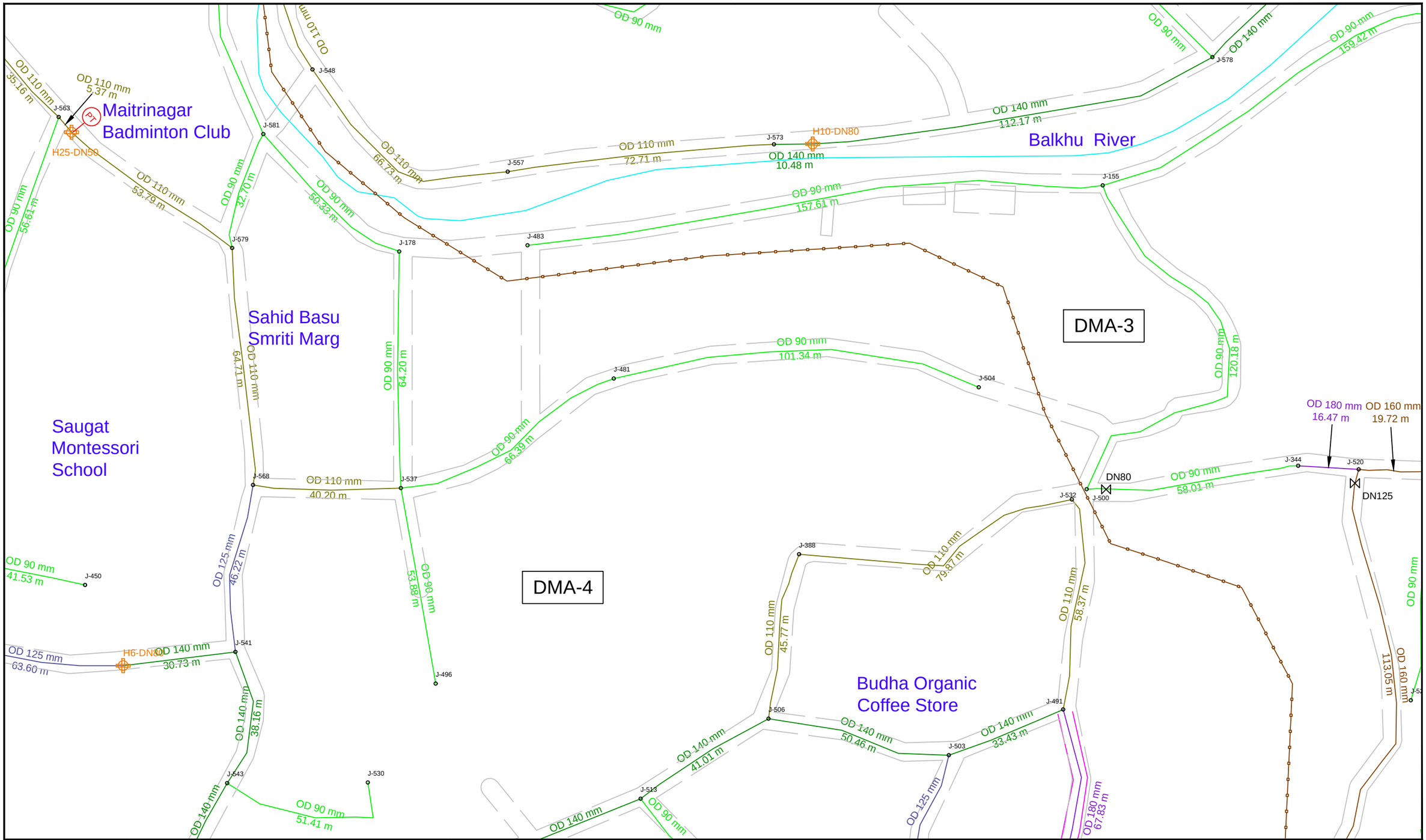
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

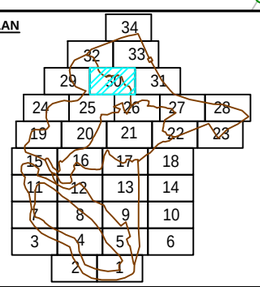
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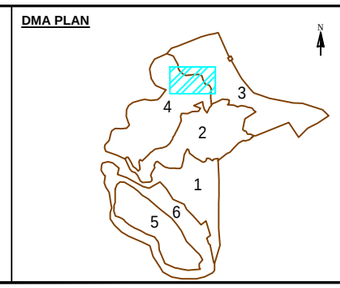
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DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO ES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	29 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
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5 0 10 20

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- OD 140 HDPE PN10
- OD 160 HDPE PN10
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- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

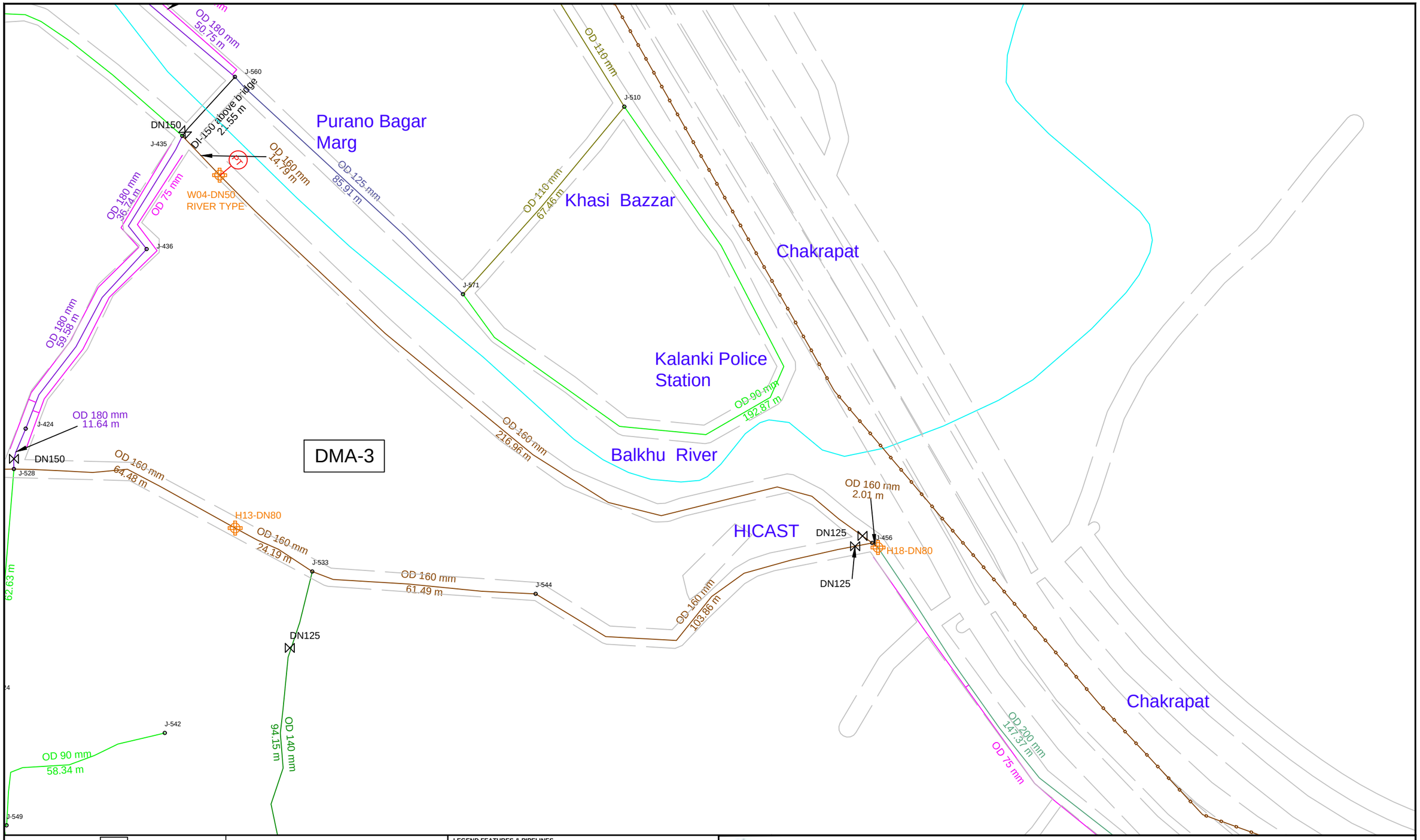
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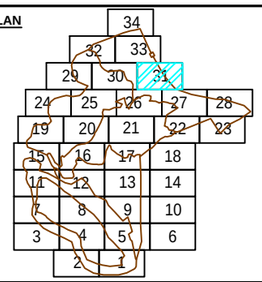
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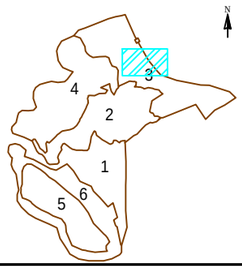
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DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BERMÚDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	30 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
- OD 90 HDPE PN10
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- OD 125 HDPE PN10
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- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
- DN 350 DI CLASS 30
- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

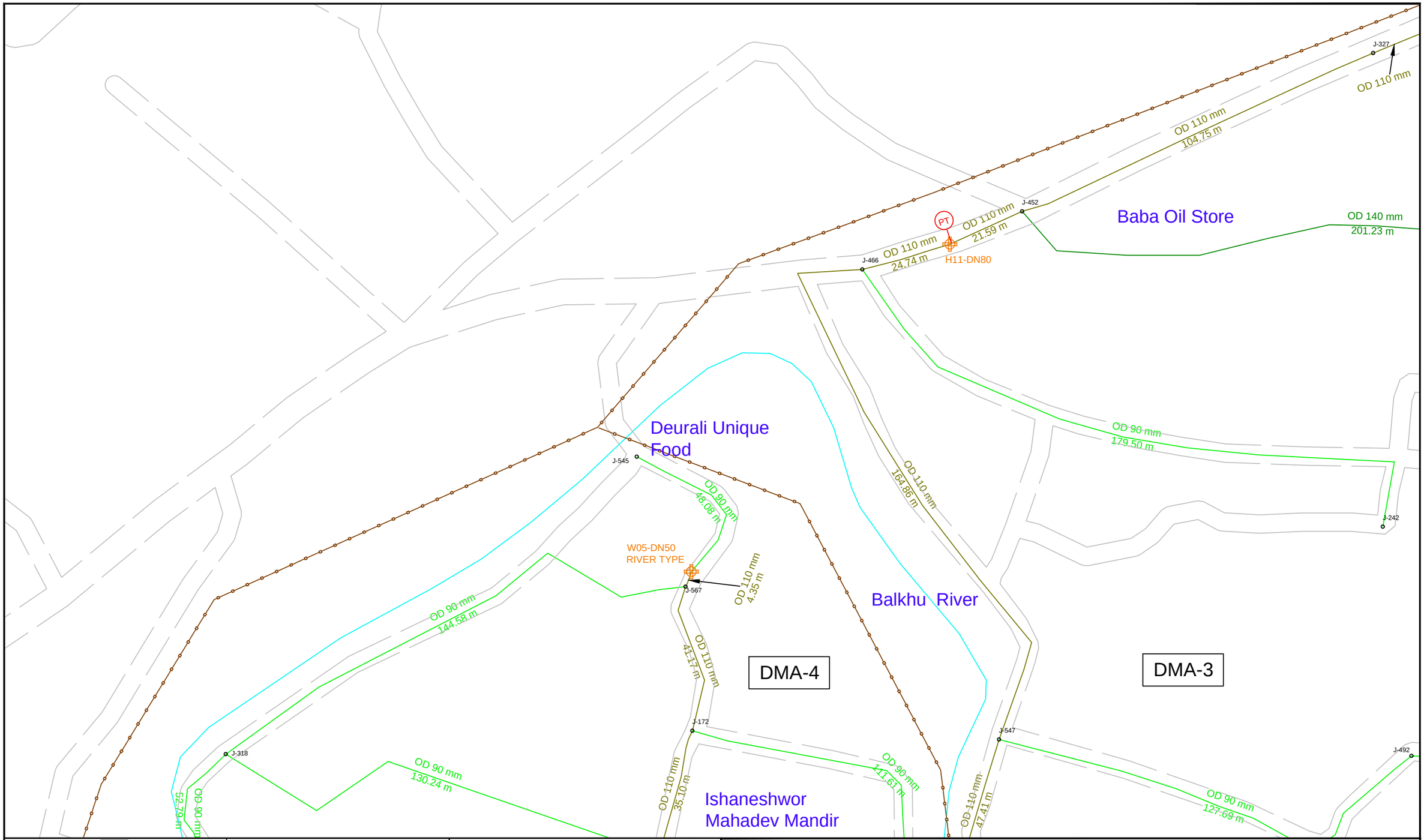
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

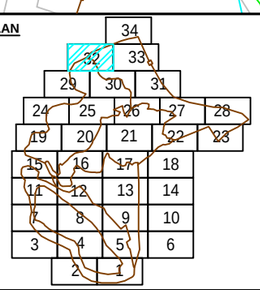
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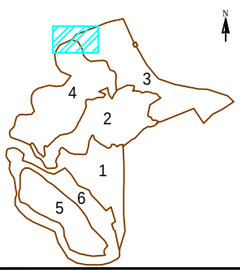
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APPROVED:	M. BRAVO-BES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	31 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
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- AIR RELEASE VALVE

5 0 10 20

- OD 75 HDPE PN10
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- OD 110 HDPE PN10
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- OD 140 HDPE PN10
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- OD 200 HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- OD 315 HDPE PN10
- DN 300 DI CLASS 40
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- DN 400 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

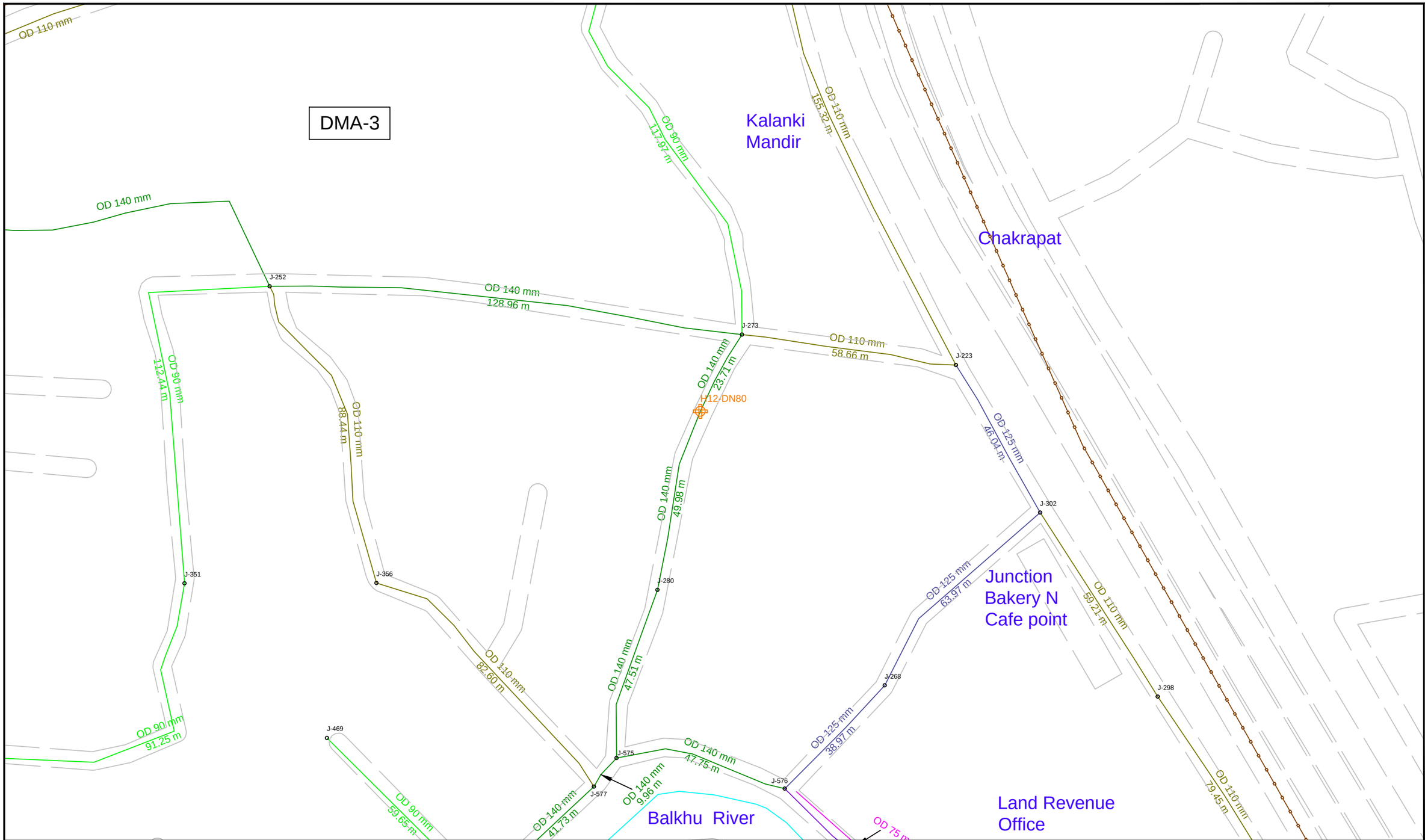
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

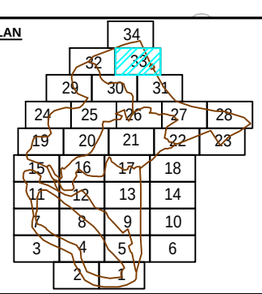
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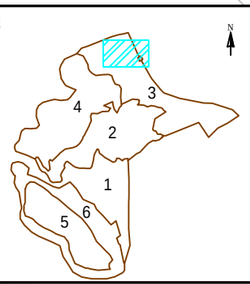
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DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BERMÚDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	32 OF 34	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
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5 0 10 20

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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

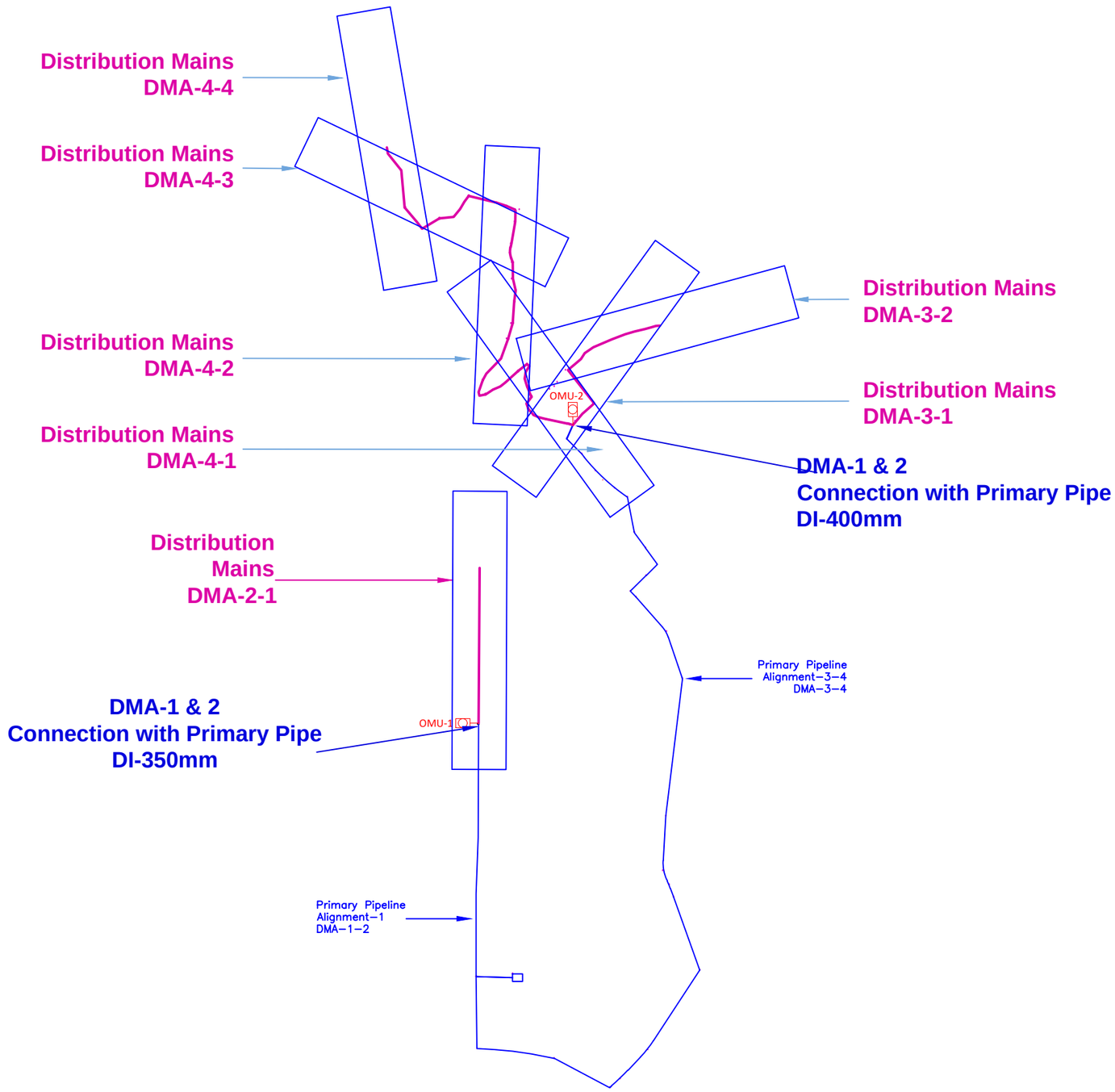
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:1000	4	
DRAWING No.	33 OF 34	5	



KEY PLAN
N.T.S

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LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

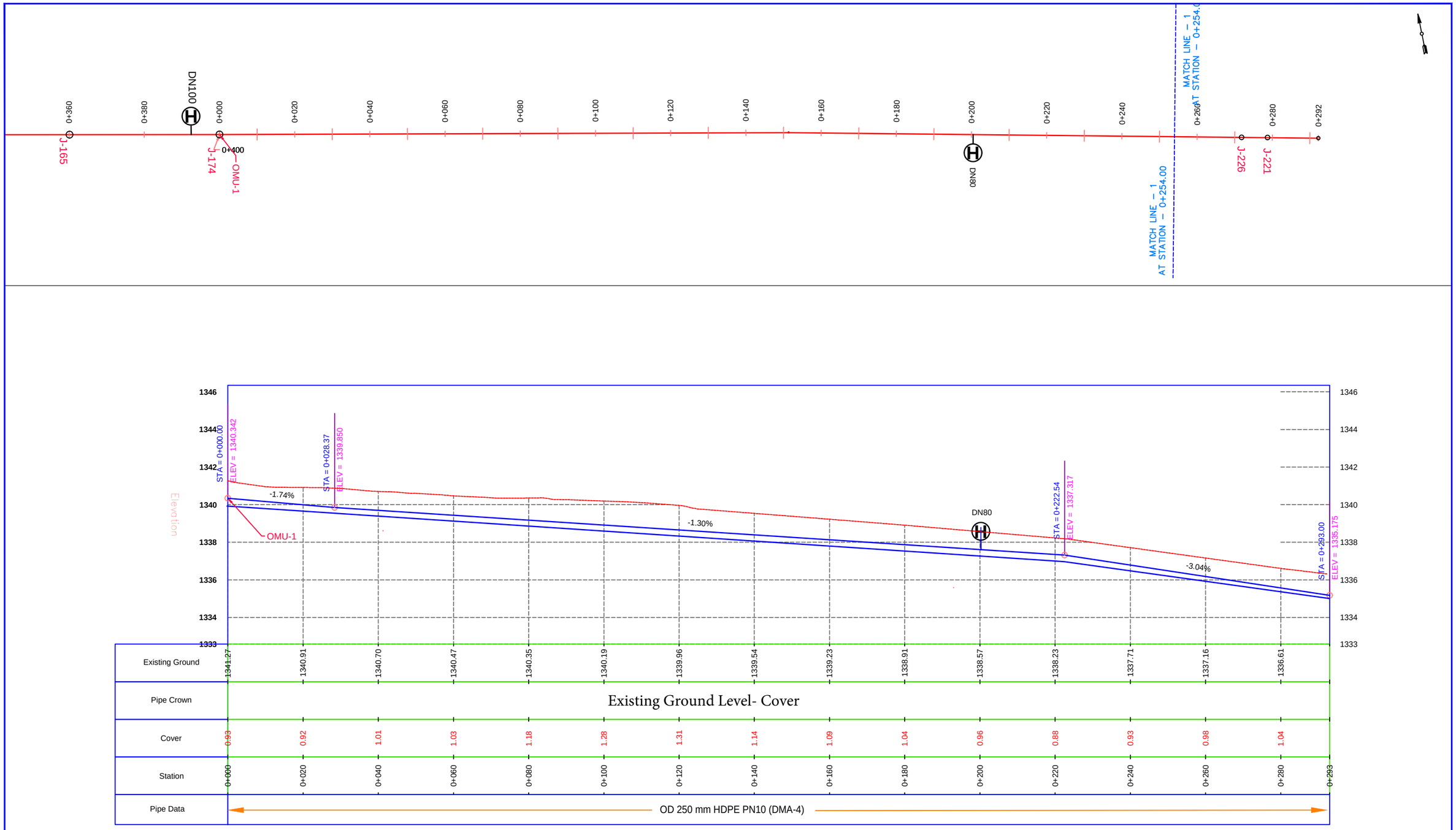
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE:
DISTRIBUTION NETWORK
Distribution Network Layout Plan

		Rev.	DATE
DRAWN:	S. PAUDEL		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	DPLP 1-0	5	



KEY PLAN
N.T.S

N

1

LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

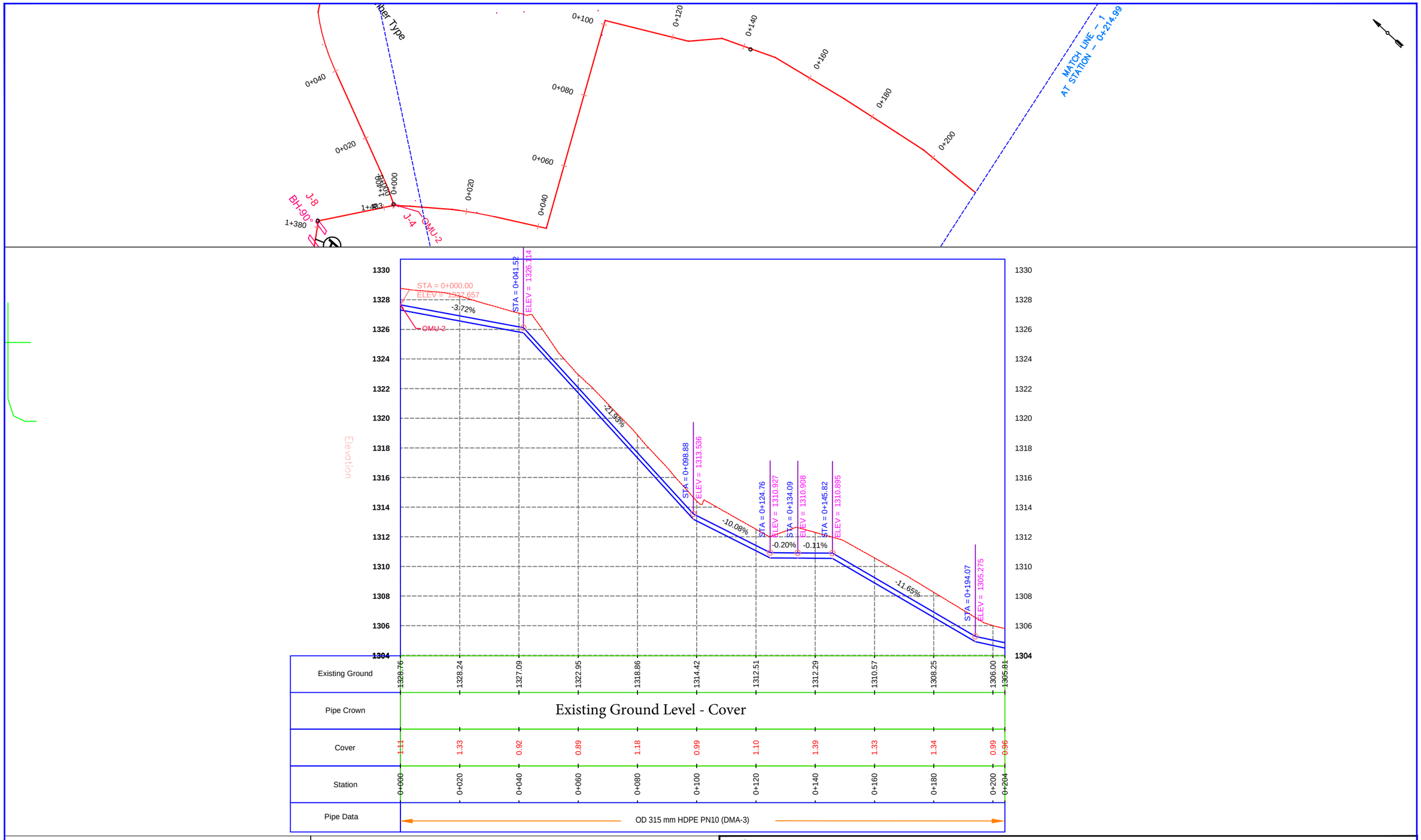
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

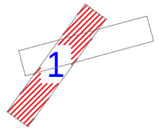
PACKAGE:
PID/SKV/DNI2-KIRTIPUR

DRAWING TITLE:
DISTRIBUTION NETWORK
Distribution Main Pipeline Longitudinal Profile
ALIGNMENT DMA-2

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BRAVARES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	DMA-2-1	5	



KEY PLAN
N.T.S



N

LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

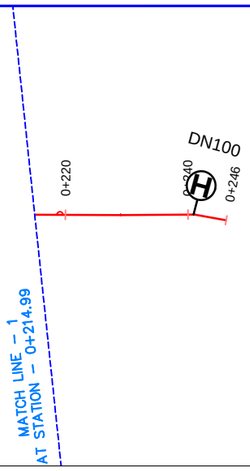
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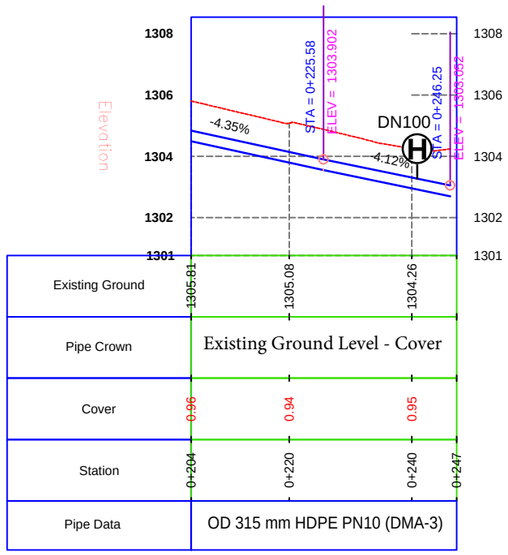
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2-KIRTIPUR

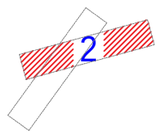
DRAWING TITLE:
DISTRIBUTION NETWORK
Distribution Main Pipeline Longitudinal Profile
ALIGNMENT DMA-3

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BRAVARES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	DMA-3- 1	5	





KEY PLAN
N.T.S



LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

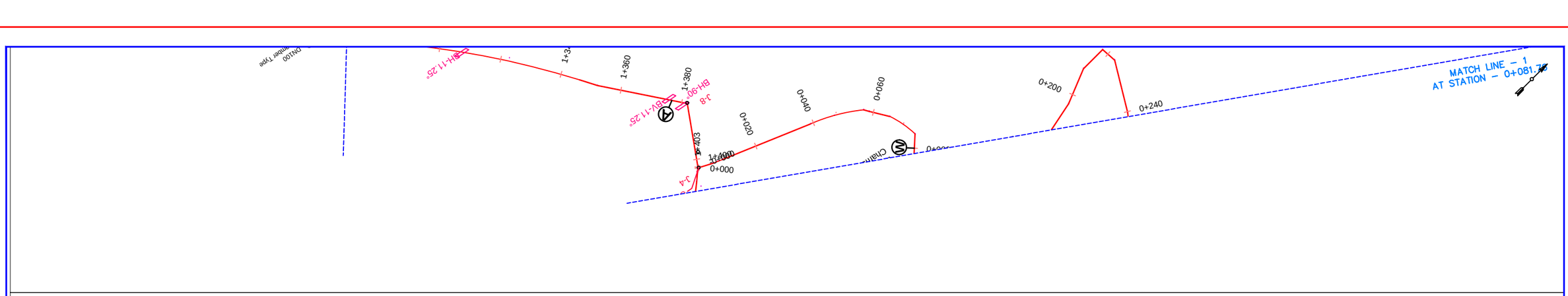
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

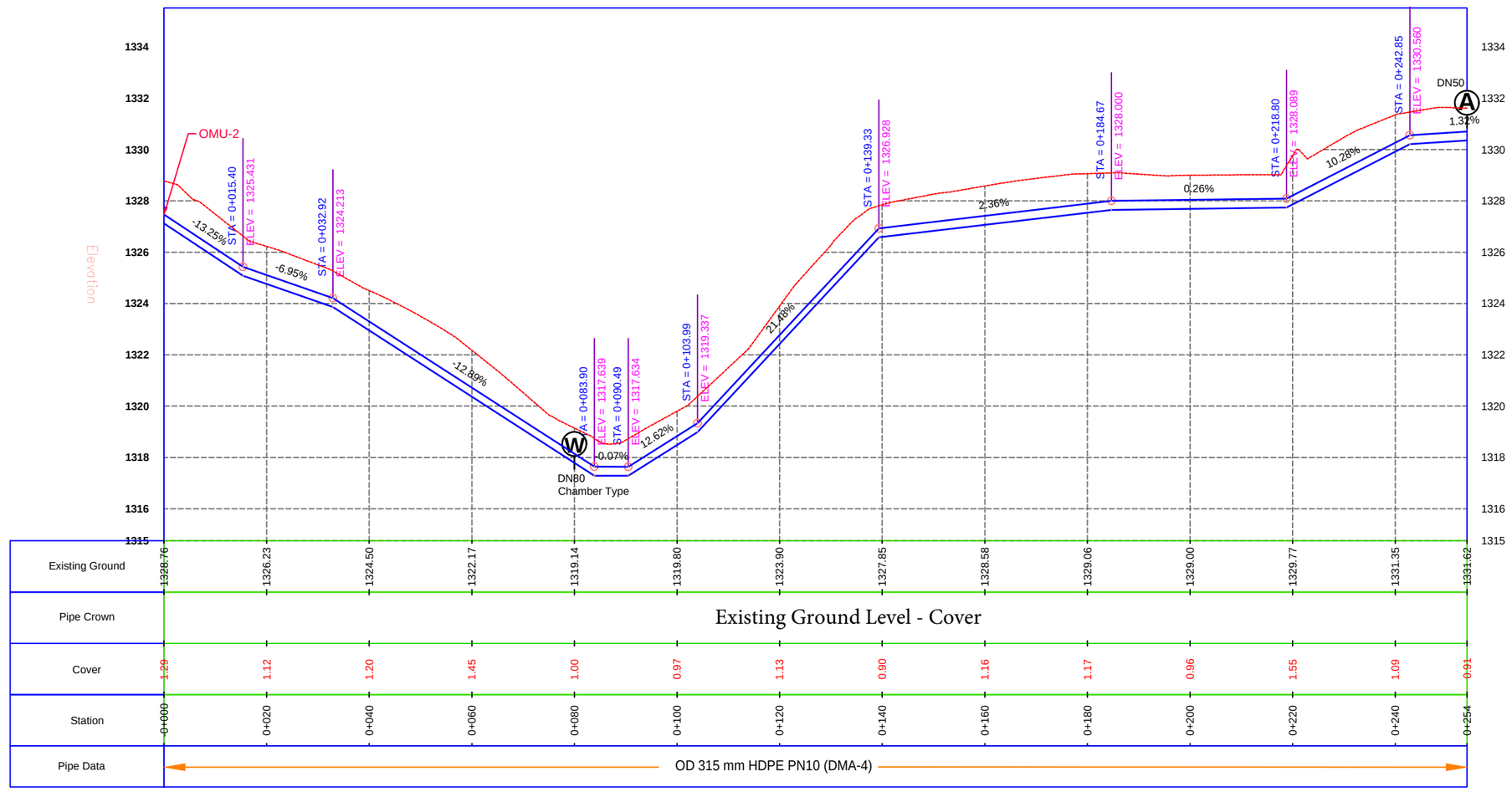
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DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2-KIRTIPUR

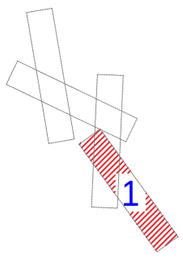
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DISTRIBUTION NETWORK
Distribution Main Pipeline Longitudinal Profile
ALIGNMENT DMA-3

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAYAS	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	DMA-3- 2	5	





KEY PLAN
N.T.S



LEGENDS:

Benchmark	Air Valve	Electric Pole
Transformer	Washout	Manhole
Chamber	Road	Bend
Slab	Hydrant	Culvert
Footpath	OMU	Drain
Pipe	Butterfly Valve	River

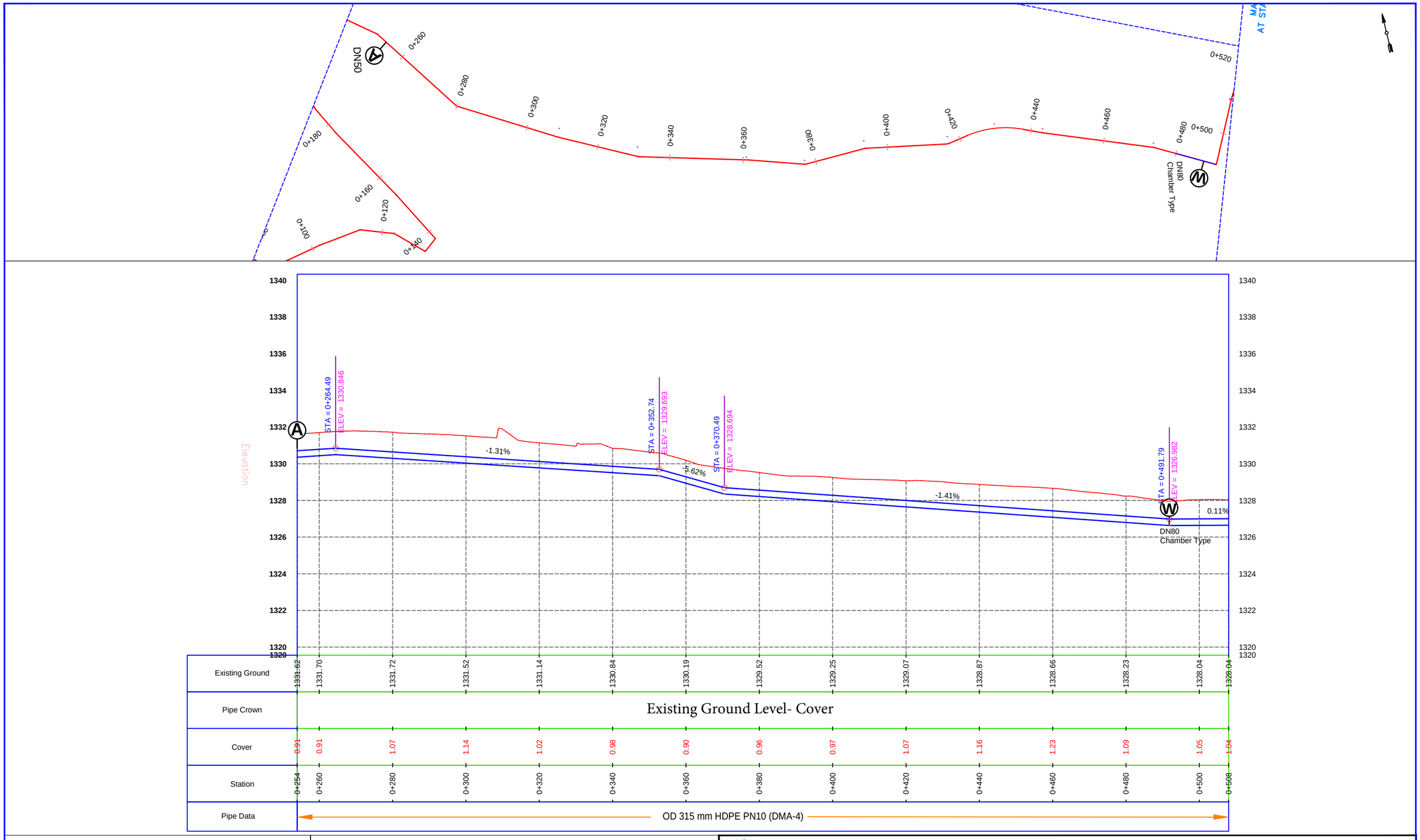
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

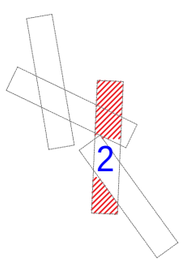
IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2-KIRTIPUR
DRAWING TITLE: DISTRIBUTION NETWORK
Distribution Main Pipeline Longitudinal Profile
ALIGNMENT DMA-4

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	DMA-4-1	5	



KEY PLAN
N.T.S



LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

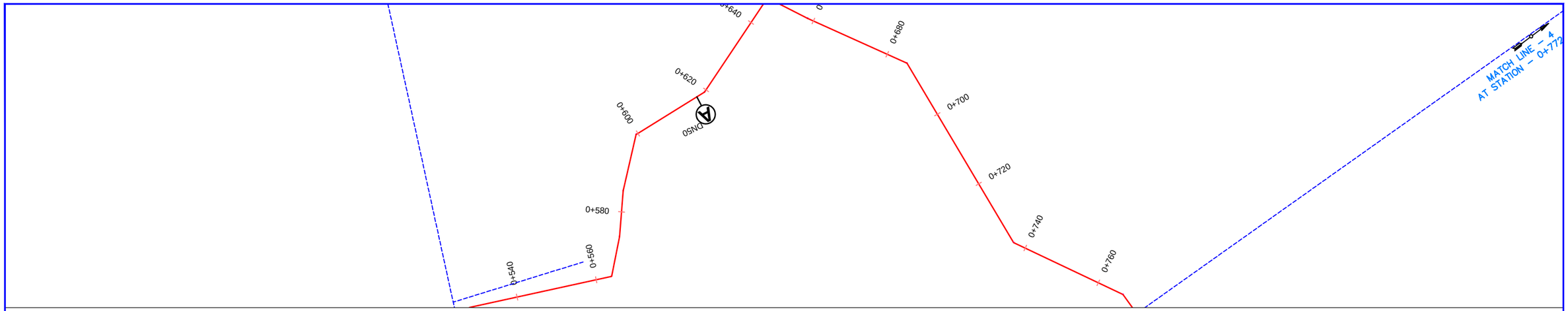
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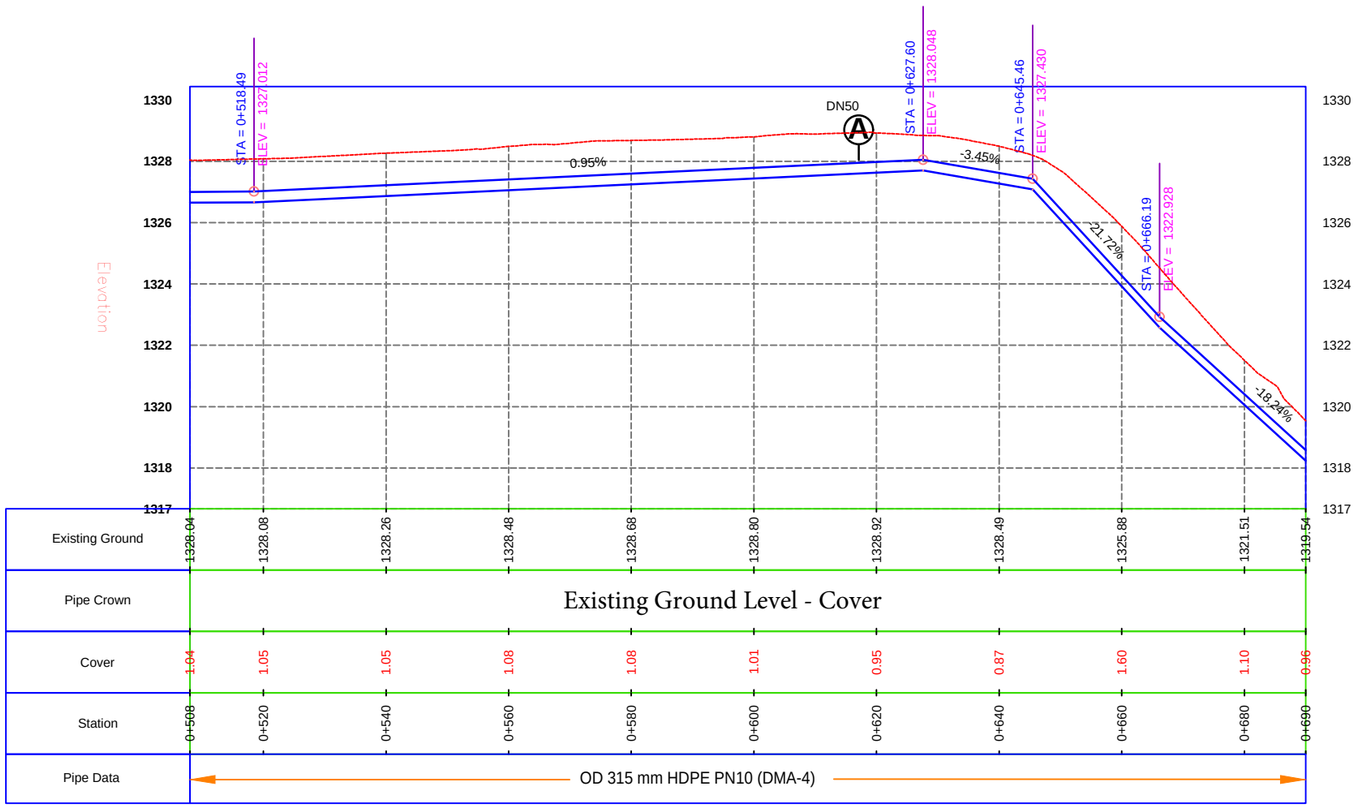
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2-KIRTIPUR

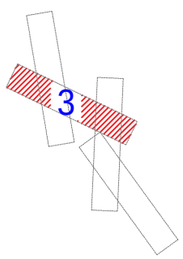
DRAWING TITLE: DISTRIBUTION NETWORK
Distribution Main Pipeline Longitudinal Profile
ALIGNMENT DMA-4

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	DMA-4-2	5	





KEY PLAN
N.T.S



LEGENDS:

Benchmark	Air Valve	Electric Pole
Transformer	Washout	Manhole
Chamber	Road	Bend
Slab	Hydrant	Culvert
Footpath	OMU	Drain
Pipe	Butterfly Valve	River

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

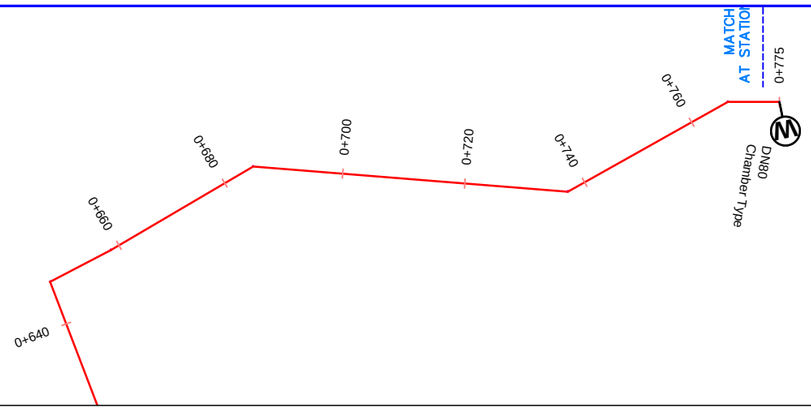
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

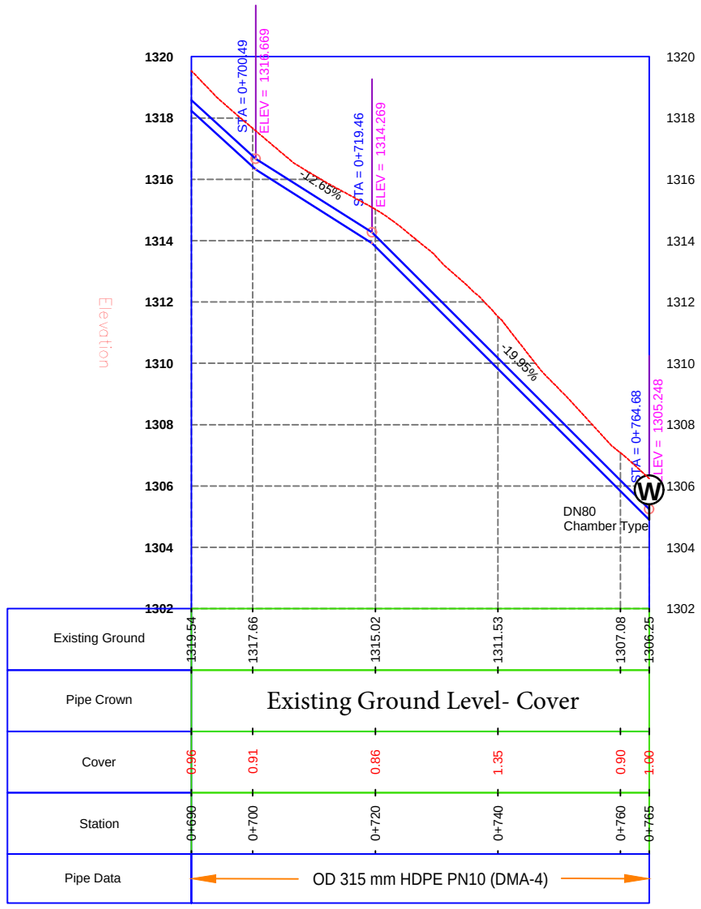
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DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2-KIRTIPUR

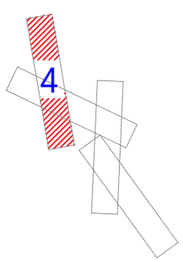
DRAWING TITLE:
DISTRIBUTION NETWORK
Distribution Main Pipeline Longitudinal Profile
ALIGNMENT DMA-4

		Rev.	DATE
DRAWN:	R. Maharjan	1	
DESIGNED:	J.M. NAVARRO	2	
APPROVED:	M.BENAYAS	3	
DATE:	Jan-2024	4	
SCALE:	H 1;1000 V1;200	5	
DRAWING No.	DMA-4-3		





KEY PLAN
N.T.S



LEGENDS:

Benchmark		Air Valve	A	Electric Pole	
Transformer		Washout	W	Manhole	
Chamber		Road		Bend	
Slab		Hydrant	H	Culvert	
Footpath		OMU		Drain	
Pipe		Butterfly Valve		River	

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2-KIRTIPUR

DRAWING TITLE:
DISTRIBUTION NETWORK
Distribution Main Pipeline Longitudinal Profile
ALIGNMENT DMA-4

		Rev.	DATE
DRAWN:	R. Maharjan		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	H 1;1000 V1;200	4	
DRAWING No.	DMA-4-4	5	





OMU-1

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: OMU-1 PHOTO LAYOUT
OMU & DMA LOCATION
DISTRIBUTION NETWORK

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M, NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-24	3	
SCALE:	-	4	
DRAWING No.	OMU-1	5	







OMU-2

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: OMU-2 PHOTO LAYOUT
OMU & DMA LOCATION
DISTRIBUTION NETWORK

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M, NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-24	3	
SCALE:	-	4	
DRAWING No.	OMU-2	5	



OMU-3

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: OMU-3 PHOTO LAYOUT
OMU & DMA LOCATION
DISTRIBUTION NETWORK

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M, NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-24	3	
SCALE:	-	4	
DRAWING No.	OMU-3	5	





OMU-4

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

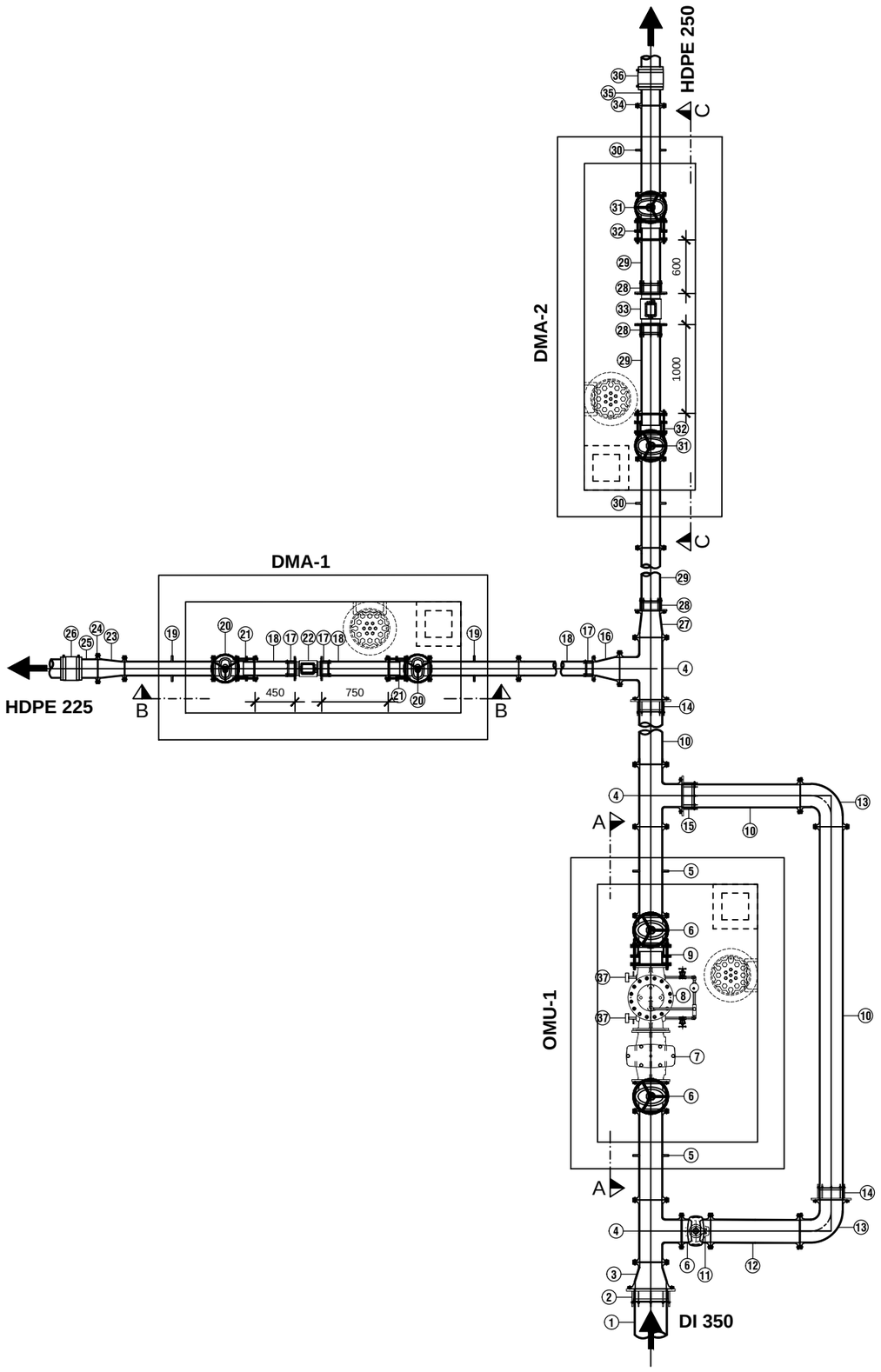
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: OMU-4 PHOTO LAYOUT
OMU & DMA LOCATION
DISTRIBUTION NETWORK

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M, NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-24	3	
SCALE:	-	4	
DRAWING No.	OMU-4	5	



ITEM	DESIGNATION	PN	DN	QTY	LENGTH
1	SOCKET SPIGOT STANDARD DI	16	350	1	-
2	FLANGED ADAPTER UNRESTRAINED	16	350	1	-
3	FLANGED REDUCER-DI	16	350/250	1	300
4	FLANGED EQUALITER-D	16	250	5	750/350
5	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	16	250	3	1000
6	GATE VALVE-DI	16	250	5	250
7	STRAINER	16	250	1	580
8	CONTROL VALVE (PSV+PRV)	16	350	1	730
9	SELF RESTRAINING DISMANTLING JOINT-DI	16	250	1	250
10	SINGLE FLANGED PIPE-DI	16	250	5	VARIABLE
11	SURFACE BOX-CI	-	-	1	-
12	DOUBLE FLANGED PIPE	16	250	1	1000
13	FLANGED 90° BEND-DI	16	250	3	350
14	FLANGED ADAPTER UNRESTRAINED	16	250	3	-
15	FLANGED ADAPTER RESTRAINED	16	250	1	-
16	FLANGED REDUCER-DI	16	250/150	1	300
17	FLANGED ADAPTER UNRESTRAINED	16	150	3	-
18	SINGLE FLANGED PIPE-DI	16	150	3	VARIABLE
19	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	16	150	3	1000
20	GATE VALVE-DI	16	150	3	210
21	SELF RESTRAINING DISMANTLING JOINT-DI	16	150	3	200
22	ELECTRO-MAGNETIC FLOWMETER	16	150	1	300
23	FLANGED REDUCER-DI	16	200/150	1	300
24	Ductile Iron Backing ring	16	200	1	-
25	HDPE STUB END	16	200	1	-
26	ELECTRO-FUSION COUPLING	16	200	1	-
27	FLANGED REDUCER-DI	16	250/200	1	300
28	FLANGED ADAPTER UNRESTRAINED	16	200	3	-
29	SINGLE FLANGED PIPE-DI	16	200	3	VARIABLE
30	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	16	200	3	1000
31	GATE VALVE-DI	16	200	2	210
32	SELF RESTRAINING DISMANTLING JOINT-DI	16	200	2	220
33	ELECTRO-MAGNETIC FLOWMETER	16	200	1	350
34	Ductile Iron Backing ring	16	200	1	-
35	HDPE STUB END	16	200	1	-
36	ELECTRO-FUSION COUPLING	16	200	1	-
37	PRESSURE SENSOR WITH PRESSURE GAUGE	-	-	3	-

NOTE :
Electro- Magnetic flowmeter must have Earthing System.

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

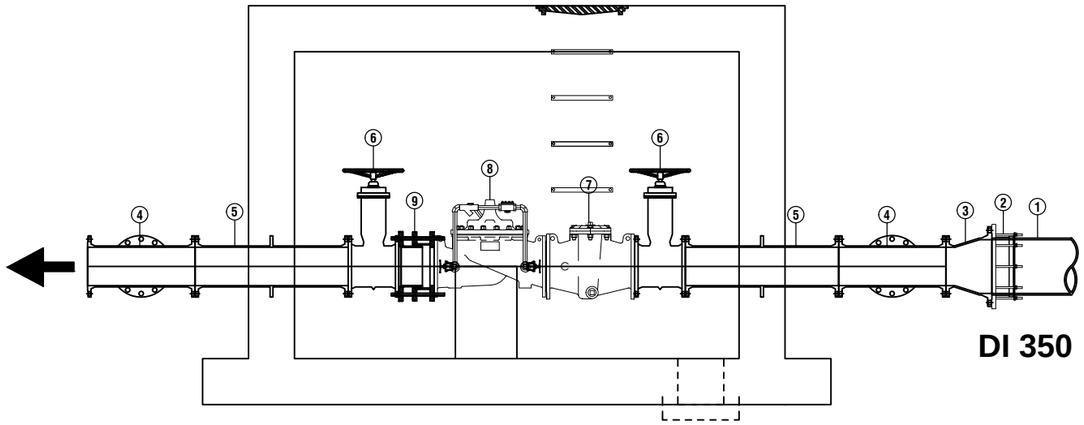
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

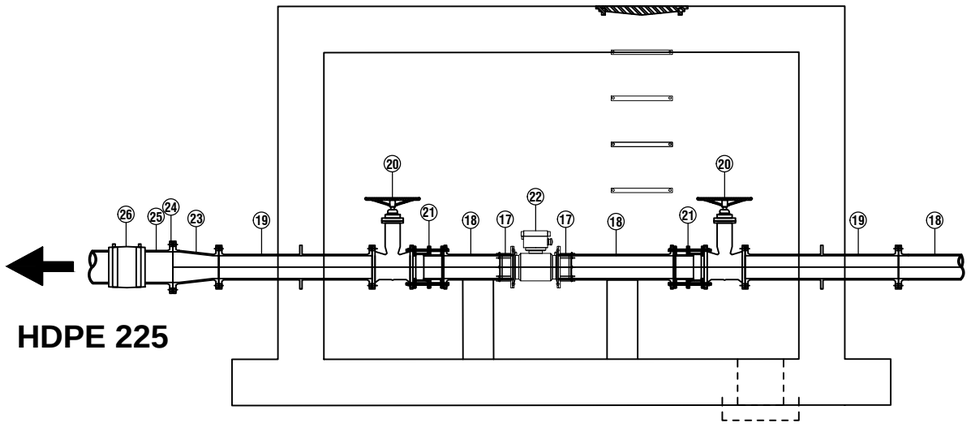
PACKAGE:
PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE:
OMU & DMA ASSEMBLY
DISTRIBUTION NETWORK
OMU -1

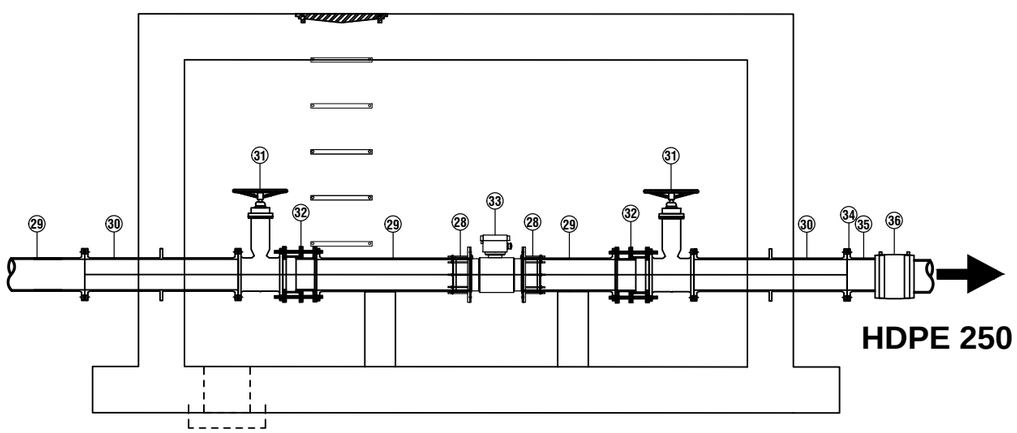
		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRETE	1	
APPROVED:	M. BERMÚDEZ	2	
DATE:	Jan-2024	3	
SCALE:	1:60	4	
DRAWING No.	OMU-1a	5	



SECTION THROUGH A-A



SECTION THROUGH B-B



SECTION THROUGH C-C

ITEM	DESIGNATION	PN	DN	QTY	LENGTH
1	SOCKET SPIGOT STANDARD DI	16	350	1	-
2	FLANGED ADAPTER UNRESTRAINED	16	350	1	-
3	FLANGED REDUCER DI	16	350/250	1	300
4	FLANGED EQUAL TEE DI	16	250	5	250/250
5	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	16	250	7	1000
6	GATE VALVE DI	16	250	5	250
7	STRAINER	16	250	1	550
8	CONTROL VALVE (ESV+PRV)	16	250	1	730
9	SELF RESTRAINING DISMANTLING JOINT DI	16	250	1	250
10	SINGLE FLANGED PIPE DI	16	250	5	VARIABLE
11	SURFACE BOX DI			1	
12	DOUBLE FLANGED PIPE	16	250	1	1000
13	FLANGED 90° BEND DI	16	250	2	450
14	FLANGED ADAPTER UNRESTRAINED	16	250	7	
15	FLANGED ADAPTER RESTRAINED	16	250	1	
16	FLANGED REDUCER DI	16	250/150	1	300
17	FLANGED ADAPTER UNRESTRAINED	16	150	8	
18	SINGLE FLANGED PIPE DI	16	150	8	VARIABLE
19	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	16	150	2	1000
20	GATE VALVE DI	16	150	2	210
21	SELF RESTRAINING DISMANTLING JOINT DI	16	150	2	200
22	ELECTRO-MAGNETIC FLOWMETER	16	150	1	300
23	FLANGED REDUCER DI	16	200/150	1	300
24	Ductile Iron Backing ring	16	200	1	
25	HDPE STUB END	16	200	1	-
26	ELECTRO-FUSION COUPLING	16	200	1	-
27	FLANGED REDUCER DI	16	250/200	1	300
28	FLANGED ADAPTER UNRESTRAINED	16	200	3	-
29	SINGLE FLANGED PIPE DI	16	200	3	VARIABLE
30	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	16	200	2	1000
31	GATE VALVE DI	16	200	2	230
32	SELF RESTRAINING DISMANTLING JOINT DI	16	200	2	220
33	ELECTRO-MAGNETIC FLOWMETER	16	200	1	350
34	Ductile Iron Backing ring	16	200	1	-
35	HDPE STUB END	16	200	1	-
36	ELECTRO-FUSION COUPLING	16	200	1	-
37	PRESSURE SENSOR WITH PRESSURE GAUGE	-	-	2	-

NOTE :
Electro- Magnetic flowmeter must have Earthing System.

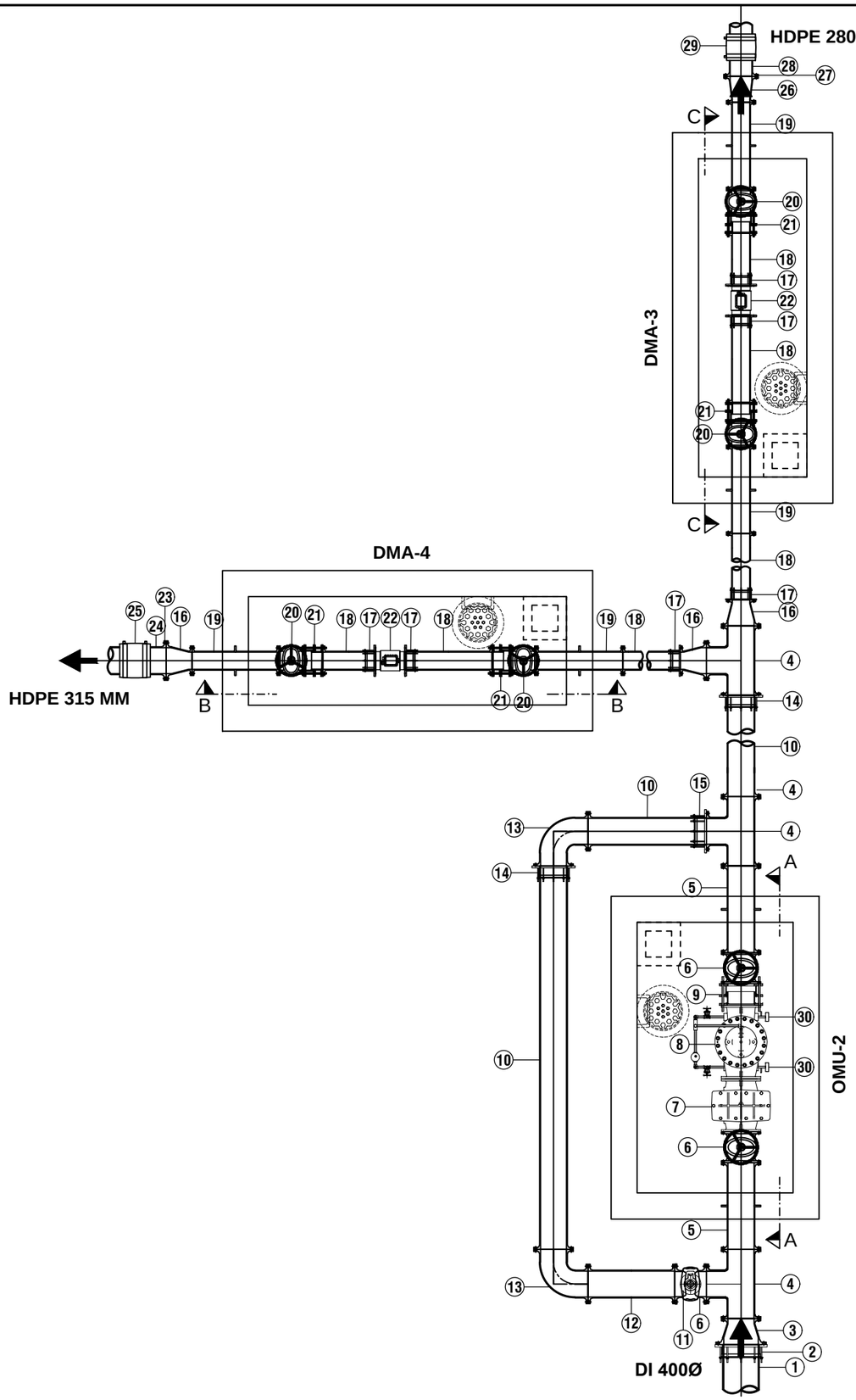
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: OMU & DMA ASSEMBLY DISTRIBUTION NETWORK OMU -1

		Rev.	DATE
DRAWN:	SAJ	1	
DESIGNED:	J. M. NAVARRETE	2	
APPROVED:	M. BENAVIDES	3	
DATE:	Jan-2024	4	
SCALE:	1:40	5	
DRAWING No.	OMU-1b		



ITEM	DESIGNATION	PN	DN	QTY	LENGTH
1	SOCKET SPIGOT STANDARD	16	400	1	
2	FLANGED ADAPTER UNRESTRAINED	16	400	1	-
3	FLANGED REDUCER-DI	16	400/300	1	500
4	FLANGED EQUAL TEE-DI	16	300	3	630/450
5	COUPLE FLANGED PIPE WITH DUCTILE FLANGE LENGTH	16	300	2	1300
6	GATE VALVE-DI	16	300	3	270
7	STRAINER	16	300	1	510
8	CONTRO. VALVE (PSV+PRV)	16	300	1	350
9	SELF RESTRAINING DISMANTLING JOINT-DI	16	300	1	250
10	SINGLE FLANGED PIPE-DI	16	300	3	VARIABLE
11	SURFACE BOX-C	-		1	-
12	COUPLE FLANGED PIPE	16	300	1	1300
13	FLANGED 90° BEND-C	16	300	2	480
14	FLANGED ADAPTER UNRESTRAINED	16	300	2	
15	FLANGED ADAPTER RESTRAINED	16	300	1	
16	FLANGED REDUCER-DI	16	300/200	3	500
17	FLANGED ADAPTER UNRESTRAINED	16	200	5	
18	SINGLE FLANGED PIPE-DI	16	200	6	VARIABLE
19	COUPLE FLANGED PIPE WITH DUCTILE FLANGE LENGTH	16	200	4	1300
20	GATE VALVE-DI	16	200	4	230
21	SELF RESTRAINING DISMANTLING JOINT-DI	16	200	4	220
22	ELECTRO MAGNETIC FLOWMETER	16	200	2	350
23	DUCTILE IRON BACKING RING	16	300	1	
24	HDPE STUB END	16	300	1	-
25	ELECTRO FUSION COUPLING	16	300	1	
26	FLANGED REDUCER-DI	16	300/200	1	500
27	DUCTILE IRON BACKING RING	16	250	1	
28	HDPE STUB END	16	250	1	-
29	ELECTRO FUSION COUPLING	16	250	1	-
30	PRESSURE SENSOR WITH PRESSURE GAUGE	-		2	-

NOTE :
Electro- Magnetic flowmeter must have Earthing System.

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

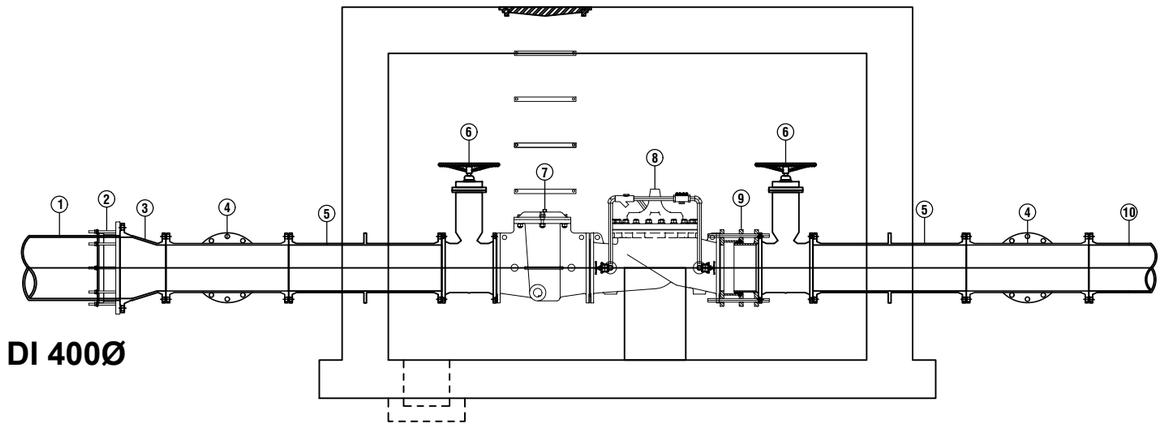
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

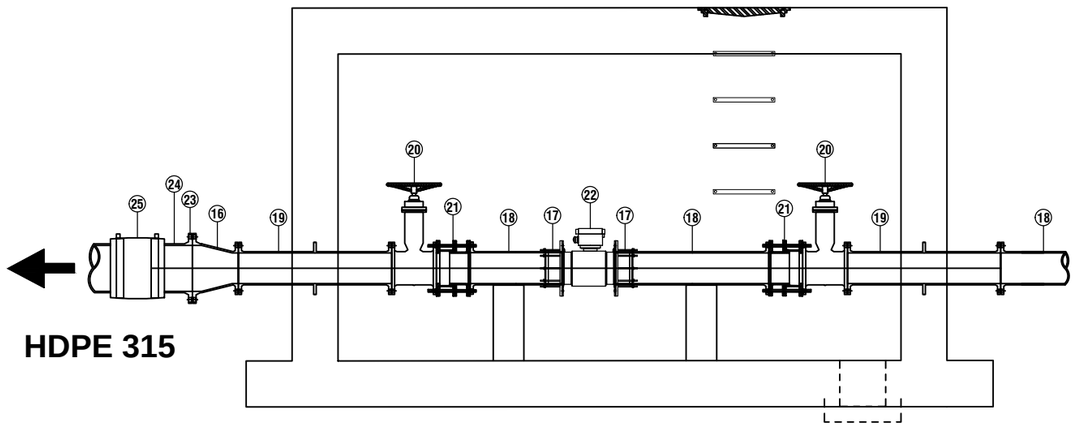
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: OMU & DMA ASSEMBLY DISTRIBUTION NETWORK OMU -2

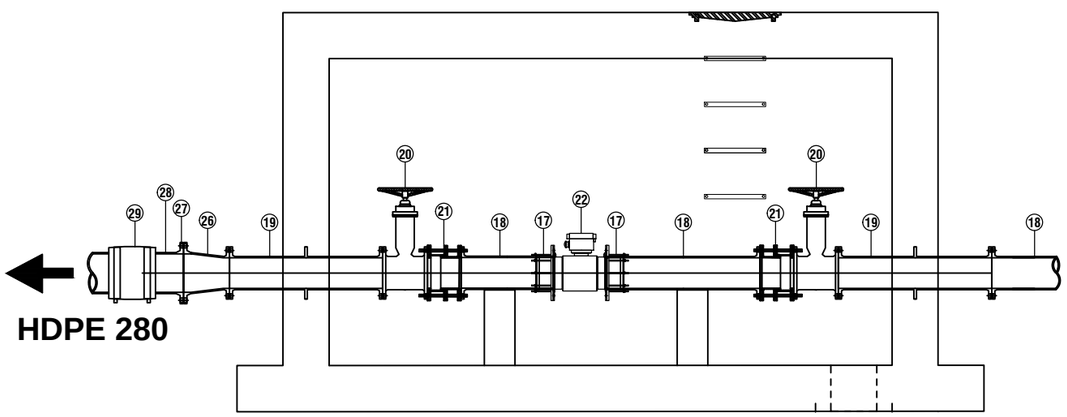
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DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRAVO BES	2	
DATE:	Jan-2024	3	
SCALE:	1:60	4	
DRAWING No.	OMU-2a	5	



SECTION THROUGH A-A



SECTION THROUGH B-B



SECTION THROUGH C-C

ITEM	DESIGNATION	PN	DN	QTY	LENGTH
1	SOCKET SPIGOT STANDARD DI	16	400	1	-
2	FLANGED ADAPTER UNRESTRAINED	16	400	1	-
3	FLANGED REDUCER-D	16	400/300	1	300
4	FLANGED EQUAL TEE-DI	16	300	3	800/400
5	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	10	300	2	1000
6	GATE VALVE-DI	10	300	2	270
7	STRAINER	10	300	1	610
8	CONTROL VALVE (PSV+PRV)	10	300	1	650
9	SELF RESTRAINING DISMANTLING JOINT DI	10	300	1	250
10	SINGLE FLANGED PIPE DI	16	300	5	VARIABLE
11	SURFACE BOX CI			1	
12	DOUBLE FLANGED PIPE	16	300	1	1000
13	FLANGED 90° BEND-DI	16	300	2	400
14	FLANGED ADAPTER UNRESTRAINED	16	300	2	
15	FLANGED ADAPTER RESTRAINED	16	300	1	
16	FLANGED REDUCER-D	16	300/200	5	500
17	FLANGED ADAPTER UNRESTRAINED	16	200	6	
18	SINGLE FLANGED PIPE-DI	16	200	6	VARIABLE
19	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	16	200	4	1000
20	GATE VALVE-DI	10	200	4	230
21	SELF RESTRAINING DISMANTLING JOINT-DI	10	200	4	220
22	ELECTRO-MAGNETIC FLOWMETER	10	200	2	350
23	DUCTILE IRON BACKING RING	10	300	1	-
24	HDPE STUB END	10	300	1	
25	ELECTRO-FUSION COUPLING	10	300	1	-
26	FLANGED REDUCER-D	10	250/200	1	350
27	DUCTILE IRON BACKING RING	10	250	1	
28	HDPE STUB END	16	250	1	-
29	ELECTRO-FUSION COUPLING	16	250	1	-
30	PRESSURE SENSOR WITH PRESSURE GAUGE	-	-	2	-

NOTE :
Electro- Magnetic flowmeter must have Earthing System.

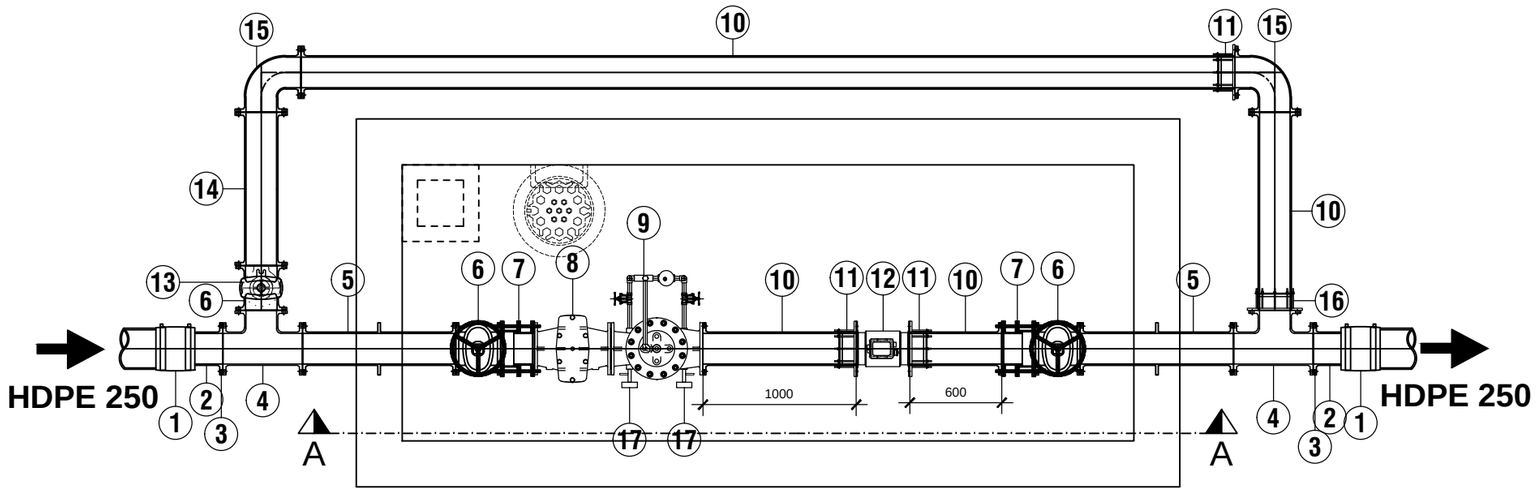
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: OMU & DMA ASSEMBLY DISTRIBUTION NETWORK OMU -2

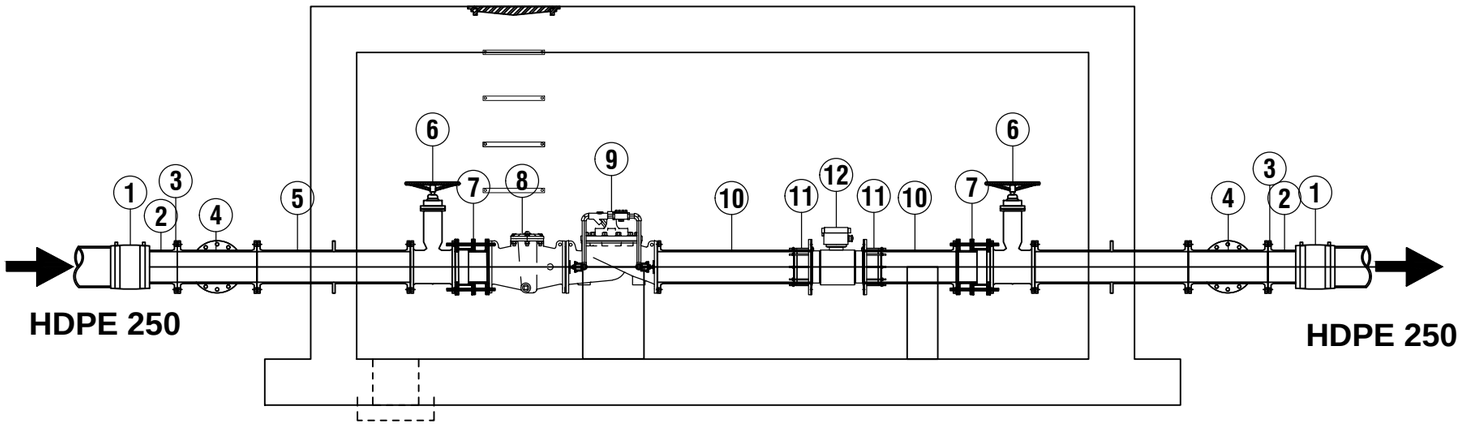
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DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRAVO DES -	2	
DATE:	Jan-2024	3	
SCALE:	1:40	4	
DRAWING No.	OMU-2b	5	



OMU-3 (DMA-5)

ITEM	DESIGNATION	PN	DN	QTY	LENGTH
1	ELECTRO-FUSION COUPLING	16	250	2	-
2	HDPE STUB END	16	250	2	-
3	DUCTILE IRON BACKING RING	16	250	2	-
4	FLANGED EQUAL TEE-DI	16	250	2	520/260
5	DOUBLE FLANGED PIPE WITH PADDLE FLANGE LENGTH	16	250	2	1000
6	GATE VALVE-DI	16	250	3	230
7	SELF RESTRAINING DISMANTLING JOINT-DI	16	250	2	230
8	STRAINER	16	250	L	500
9	CONTROL VALVE(PSV-FRV)	16	250	L	
10	SINGLE FLANGED PIPE-DI	16	250	4	VARIABLE
11	FLANGED ADAPTER UNRESTRAINED	16	250	3	-
12	ELECTRO-MAGNETIC FLOWMETER	16	250	L	350
13	SURFACE BOX-CI	-	-	L	-
14	DOUBLE FLANGED PIPE	16	250	1	1000
15	FLANGED 90° BEND-DI	16	250	2	260
16	FLANGED ADAPTER RESTRAINED	16	250	L	-
17	PRESSURE SENSOR WITH PRESSURE GAUGE	-	-	2	-

NOTE :
Electro- Magnetic flowmeter must have Earthing System.



SECTION THROUGH A-A

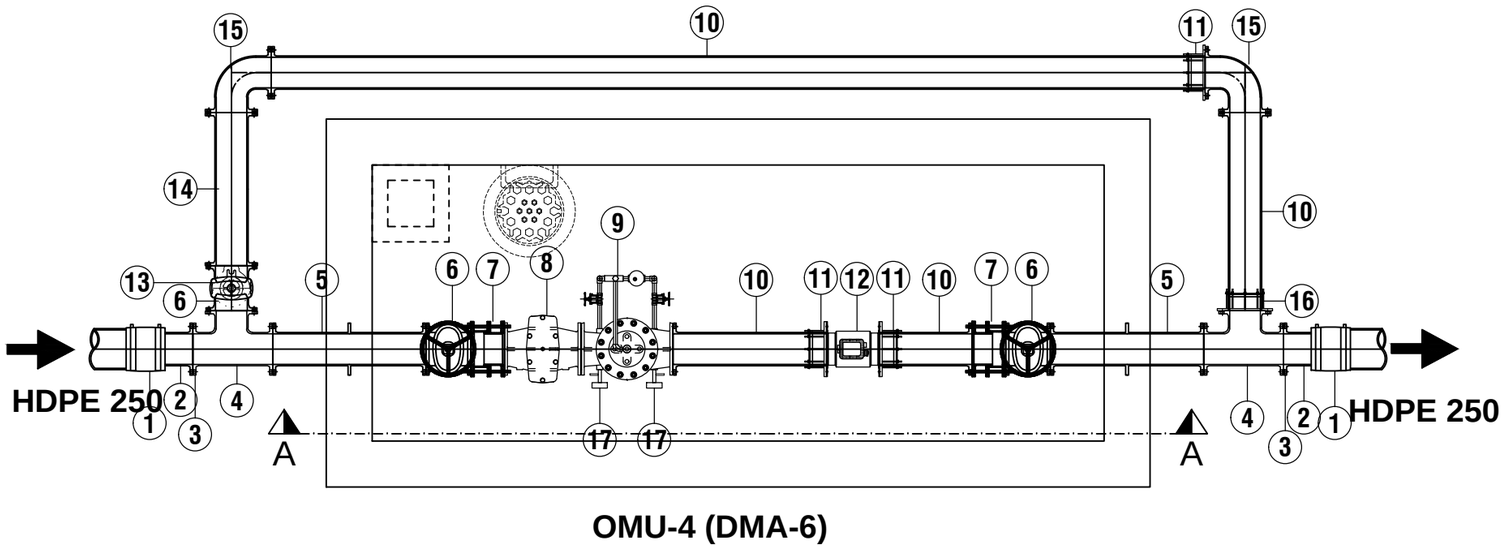
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: OMU & DMA ASSEMBLY DISTRIBUTION NETWORK OMU -3

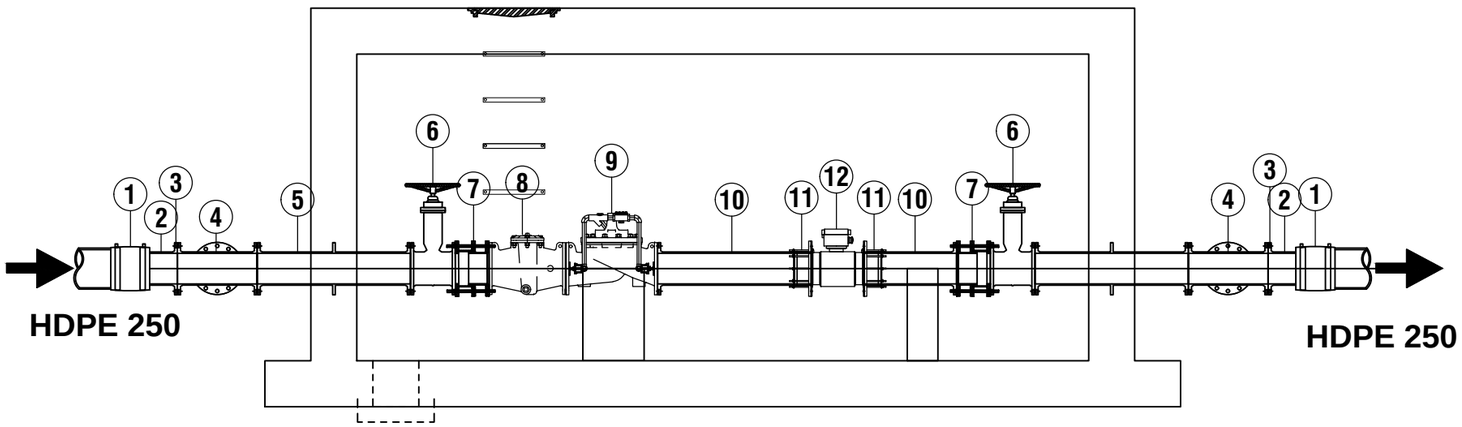
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DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:40	4	
DRAWING No.	OMU-3	5	



OMU-4 (DMA-6)

ITEM	DESIGNATION	PN	DN	QTY	LENGTH
1	ELECTRO FUSION COUPLING	16	250	2	
2	HDPE STUB END	16	250	2	
3	DUCTILE IRON BACKING RING	16	250	2	-
4	FLANGED ADAPTER DI	16	200	2	250/200
5	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	16	200	2	1000
6	GATE VALVE DI	16	200	3	230
7	SELF RESTRAINING DISMANTLING JOINT DI	16	200	2	230
8	STRAINER	16	200	1	500
9	CONTROL VALVE (PSV AND PRV)	16	200	1	
10	SINGLE FLANGED PIPE DI	16	200	4	VARIABLE
11	FLANGED ADAPTER UNRESTRAINED	16	200	4	
12	ELECTRO MAGNETIC FLOWMETER	16	200	1	450
13	SCADA BOX-DI	-	-	1	-
14	DOUBLE FLANGED PIPE	16	200	1	1000
15	FLANGED 90° BEND DI	16	200	2	200
16	FLANGED ADAPTER RESTRAINED	16	200	1	-
17	PRESSURE SENSOR WITH PRESSURE GAUGE	-	-	2	-

NOTE :
Electro- Magnetic flowmeter must have Earthing System.



SECTION THROUGH A-A

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

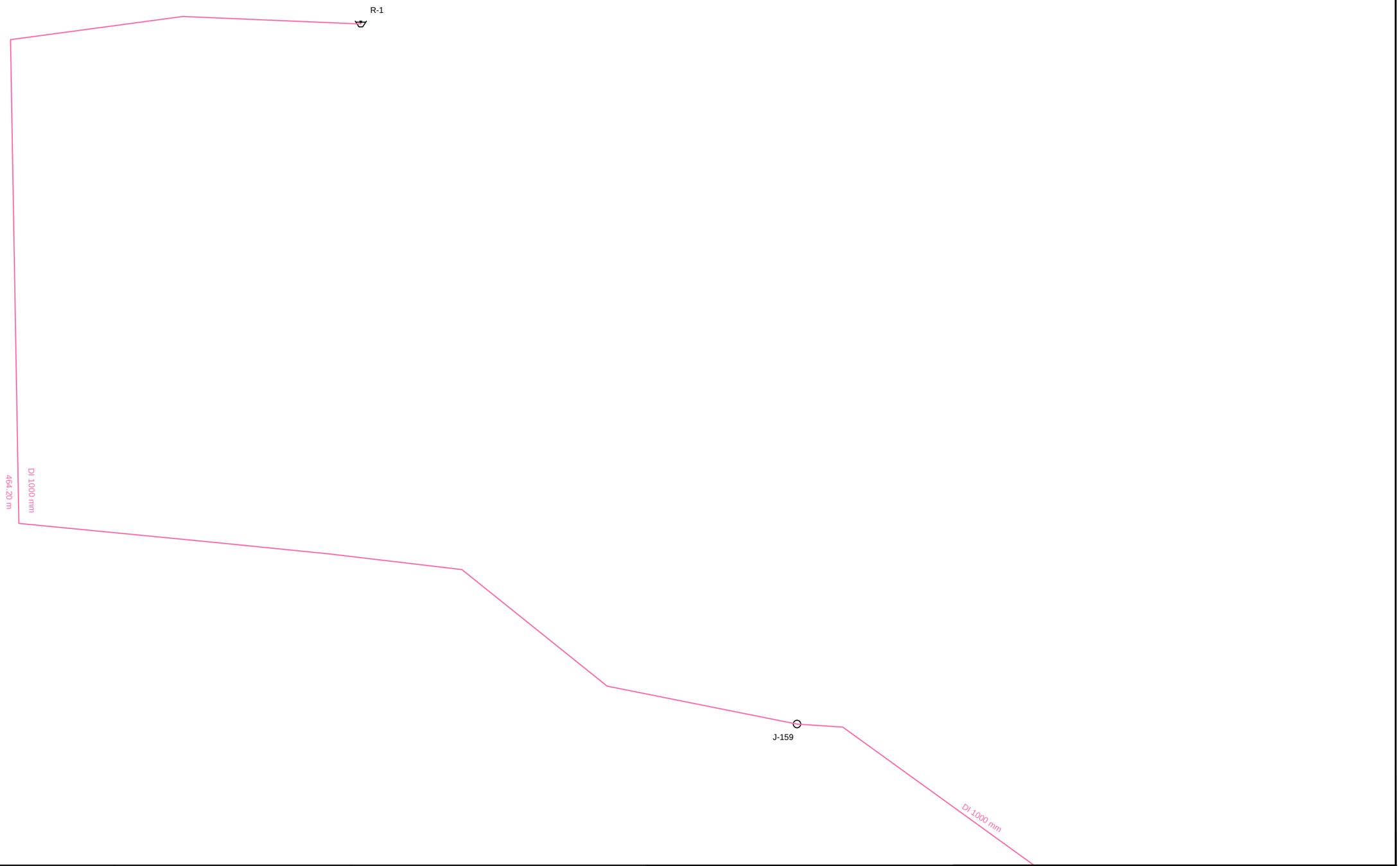
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: OMU & DMA ASSEMBLY DISTRIBUTION NETWORK OMU -4

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
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DRAWING No.	OMU-4	5	

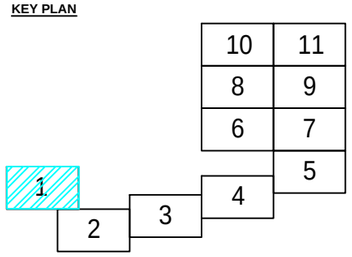
DISTRIBUTION NETWORK IMPROVEMENT WORKS IN KIRTIPUR

CONTRACT No.: PID/SKV/DNI2-KIRTIPUR

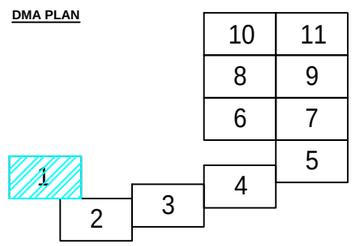
DISTRIBUTION NETWORK
KUMARICLUB



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 180 HDPE PN10
- OD 225HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- DN 150 DI CLASS 40
- DN 250 DI CLASS 30
- DN 1000 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

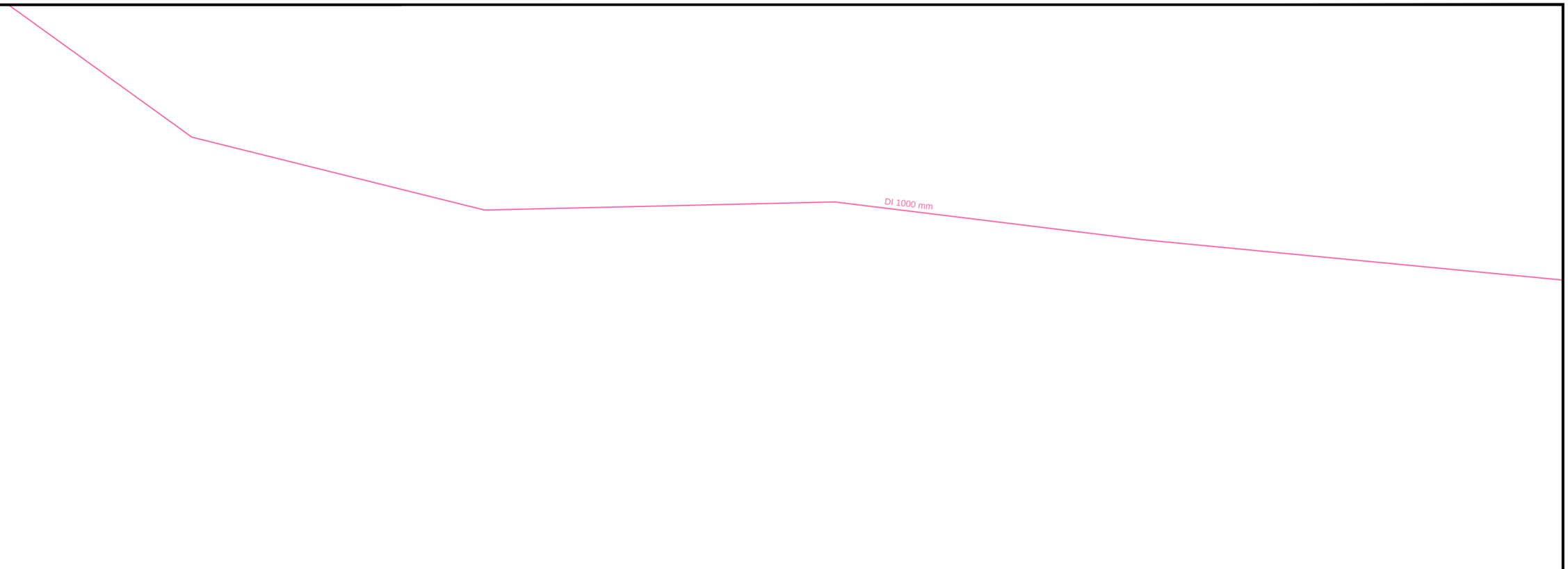
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

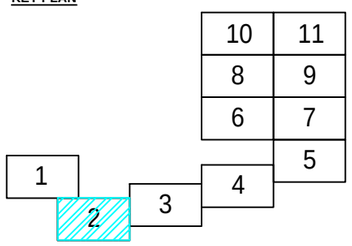
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DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS / KUMARICLUB

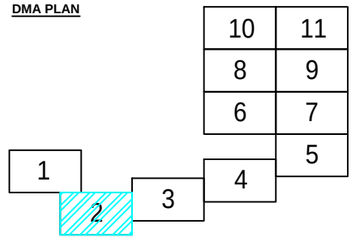
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DRAWN:	SAJ		
DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	1	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 180 HDPE PN10
- OD 225HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- DN 150 DI CLASS 40
- DN 250 DI CLASS 30
- DN 1000 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

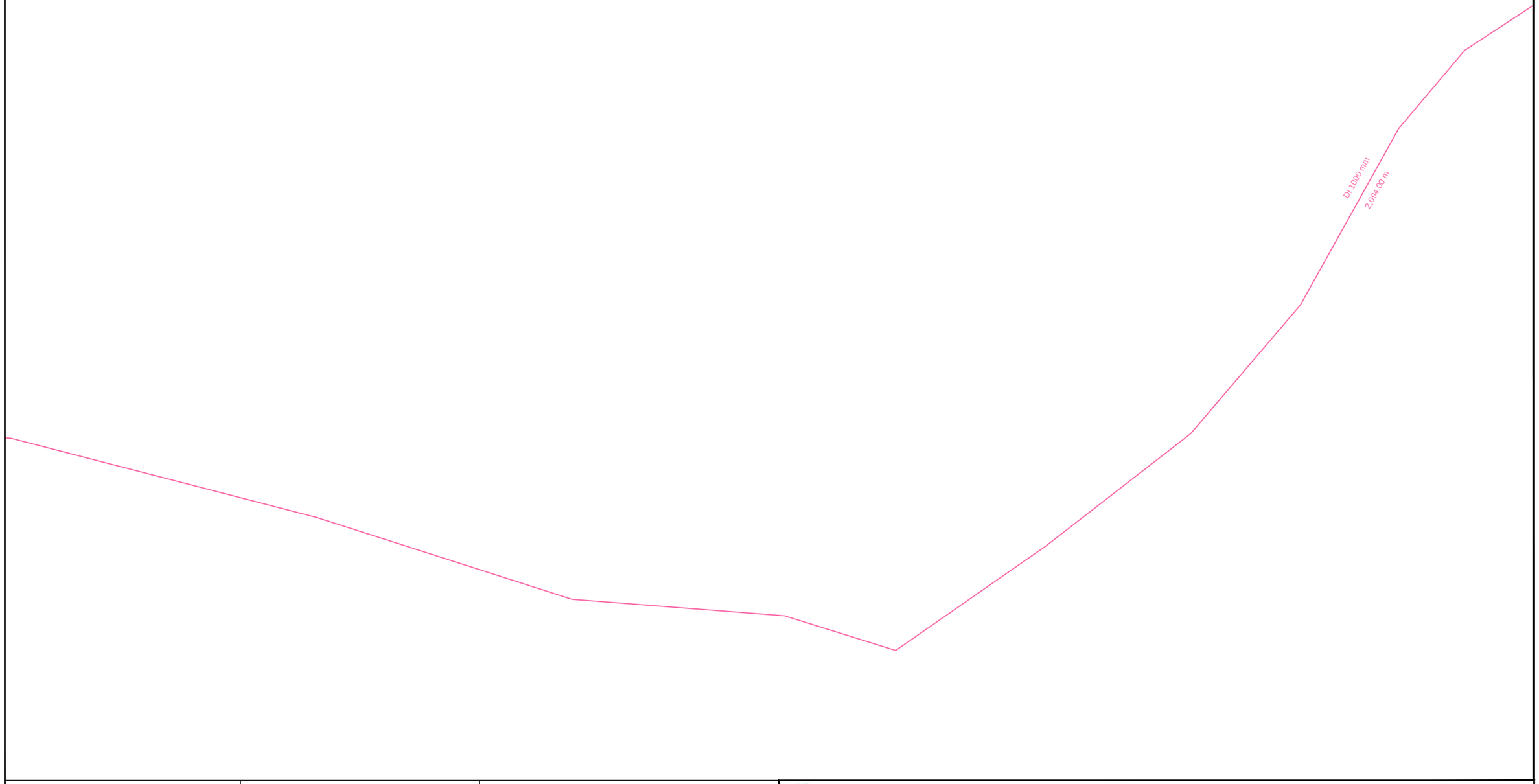
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

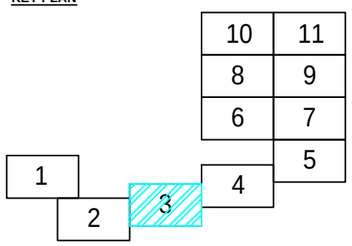
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DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS / KUMARICLUB

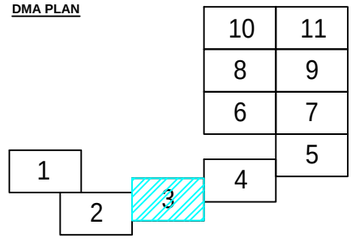
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DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
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DRAWING No.	2	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 180 HDPE PN10
- OD 225HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- DN 150 DI CLASS 40
- DN 250 DI CLASS 30
- DN 1000 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

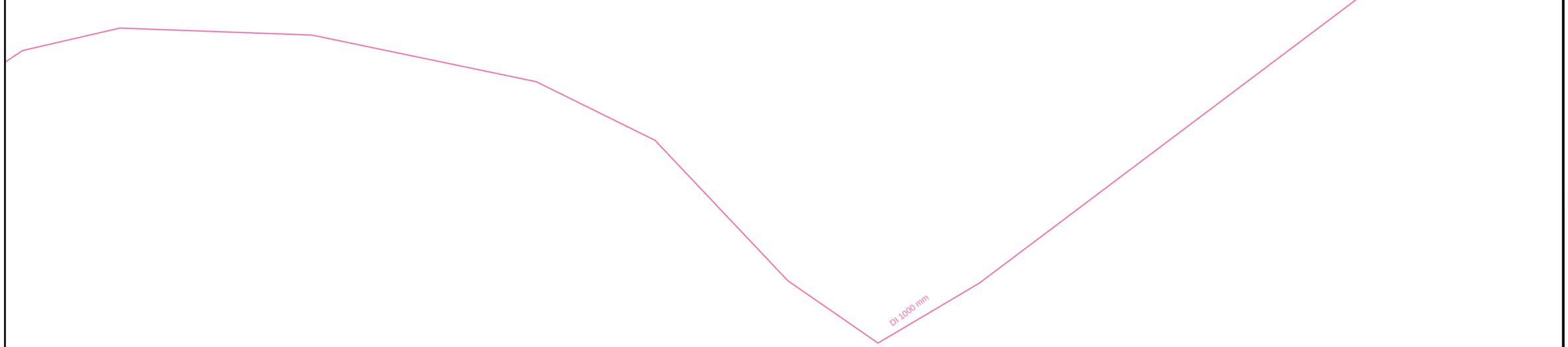
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

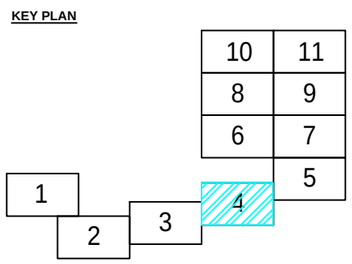
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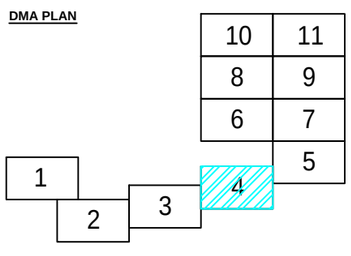
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DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	3	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
- DMA BOUNDARY
- AIR RELEASE VALVE

- OD 75 HDPE PN10
- OD 90 HDPE PN10
- OD 125 HDPE PN10
- OD 140 HDPE PN10
- OD 180 HDPE PN10
- OD 225HDPE PN10
- OD 250 HDPE PN10
- OD 280 HDPE PN10
- DN 150 DI CLASS 40
- DN 250 DI CLASS 30
- DN 1000 DI CLASS 30
- ROAD

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

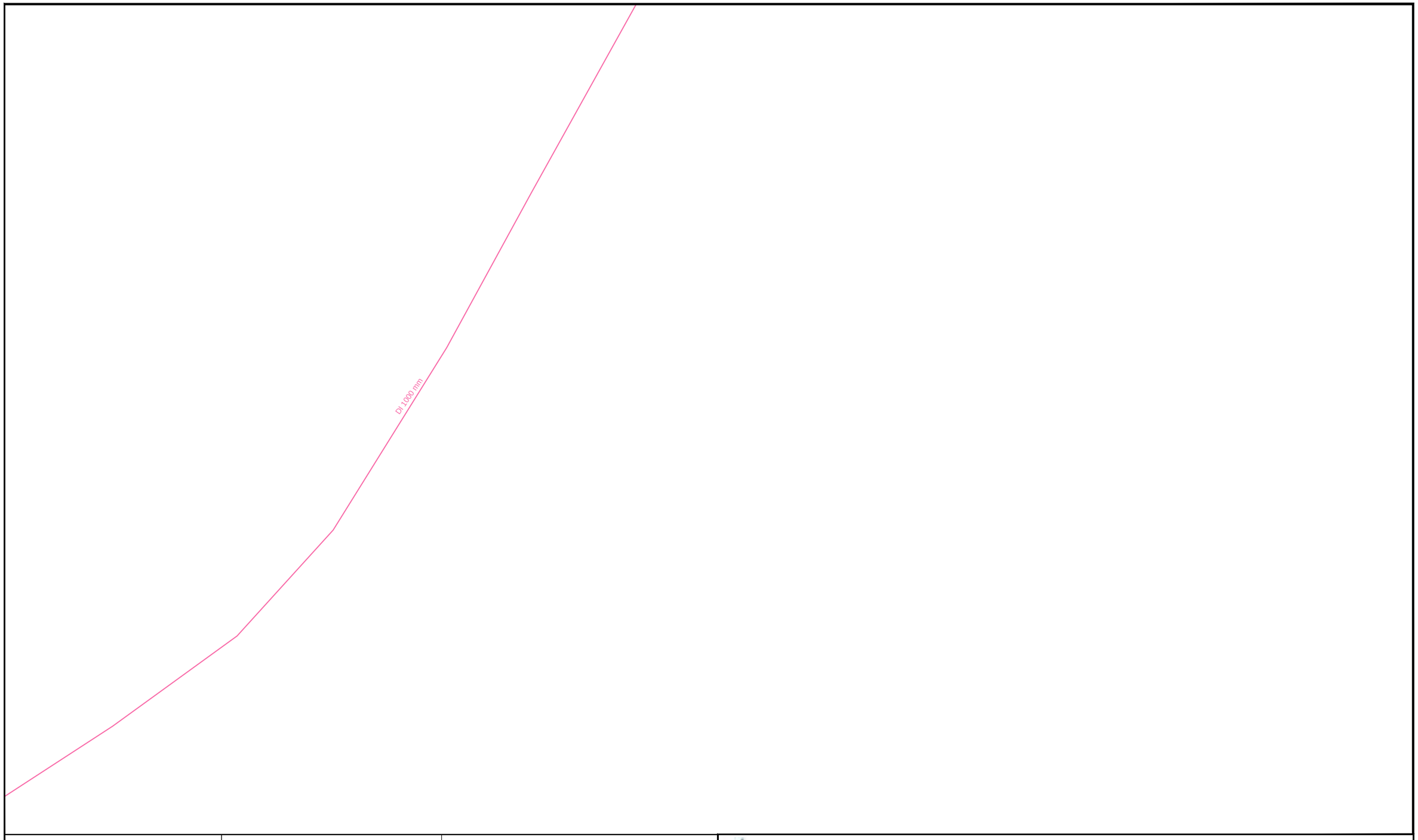
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

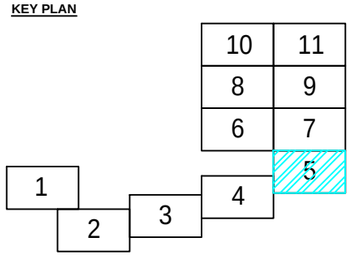
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DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS / KUMARICLUB

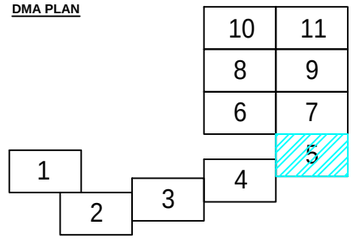
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DRAWN:	SAJ		
DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	4	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
- HYDRANT / WASHOUT
- PRESSURE REDUCING VALVE
- GATE VALVE
- BUTTERFLY VALVE
- PRESSURE TEST POINT
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- AIR RELEASE VALVE

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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

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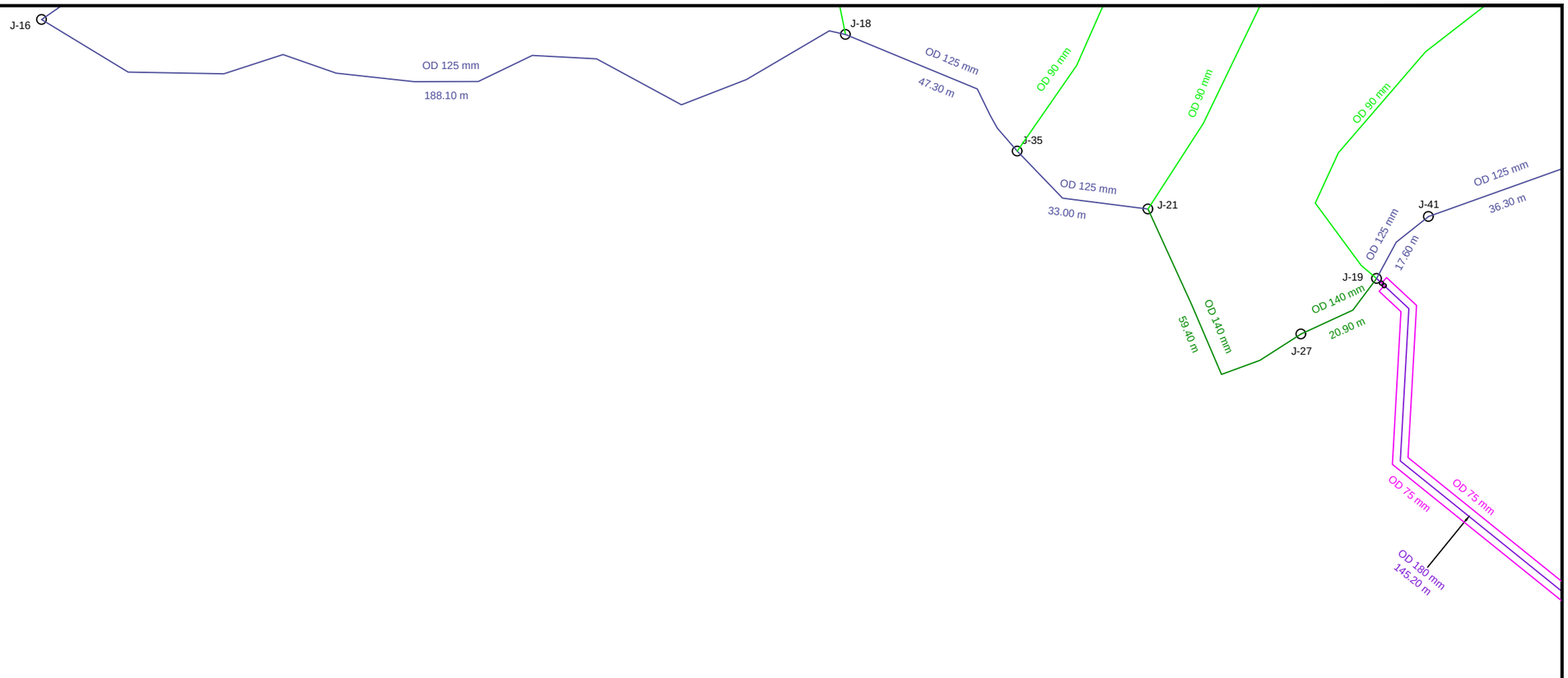
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

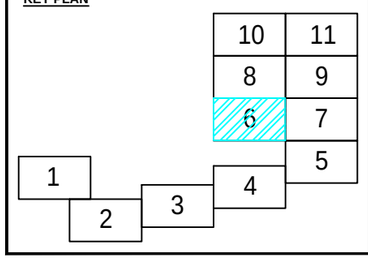
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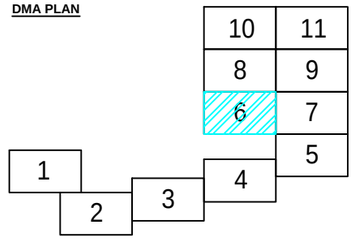
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DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	5	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

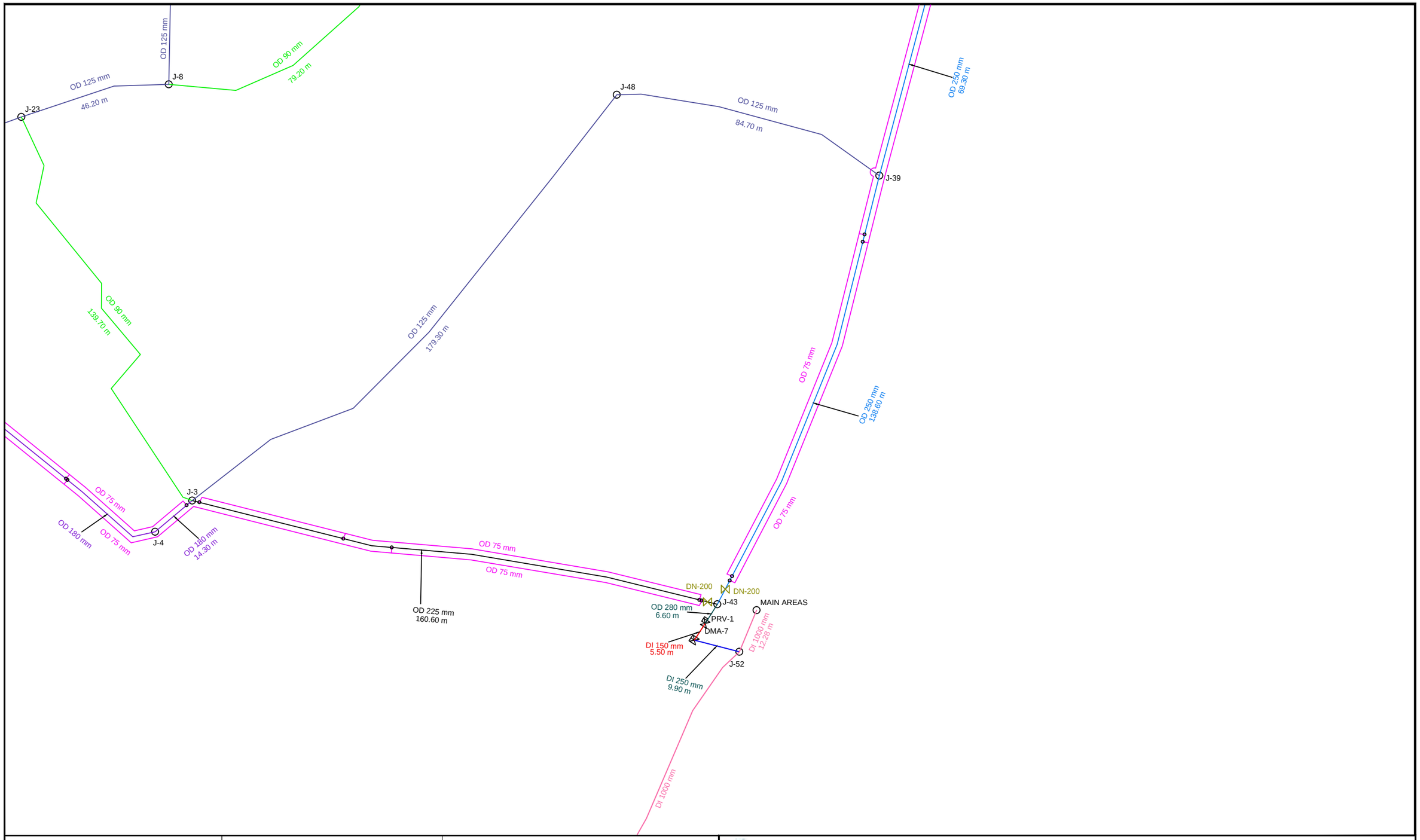
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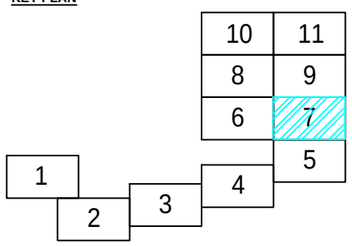
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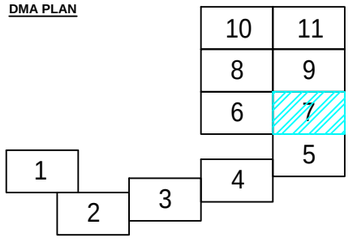
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DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	6	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

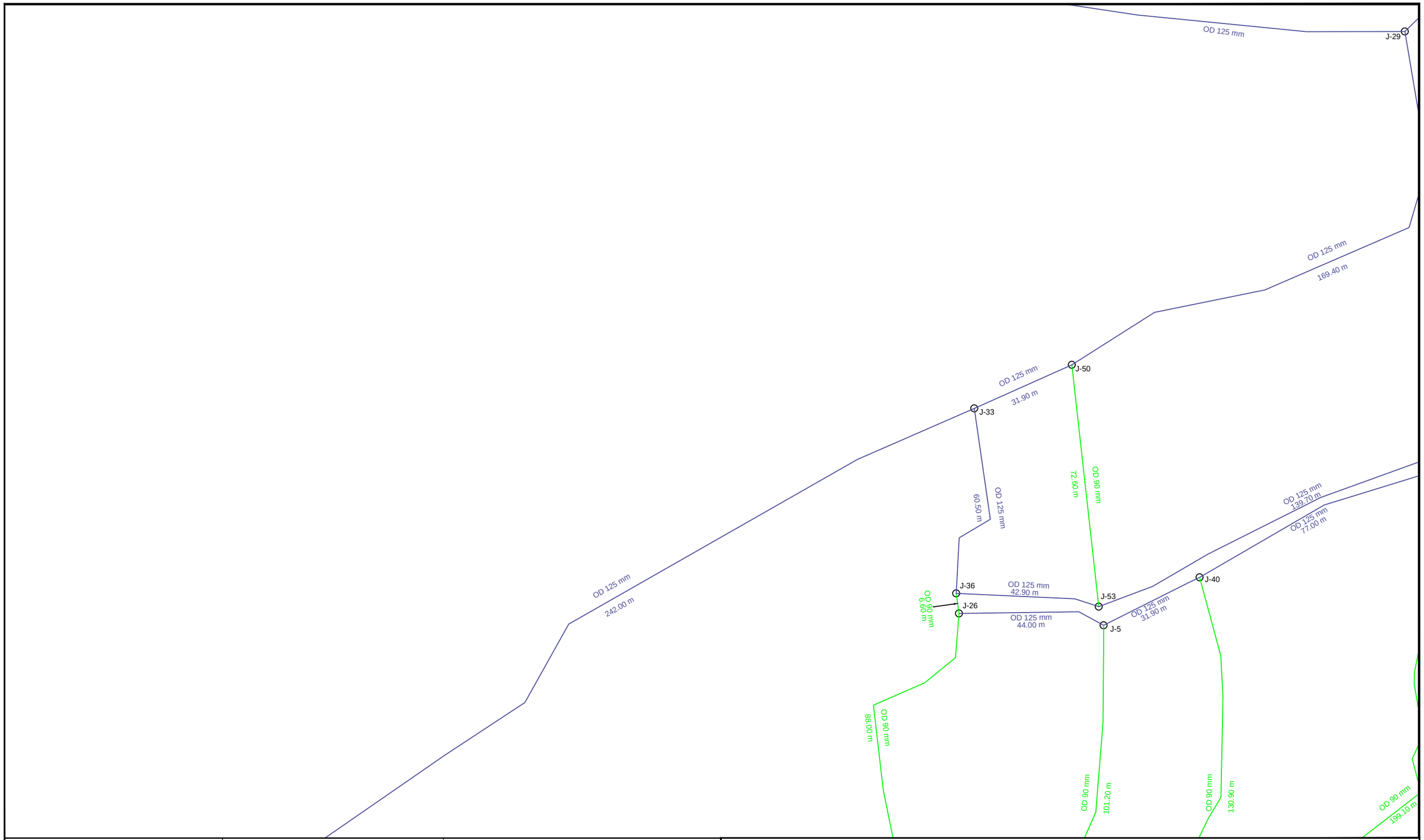
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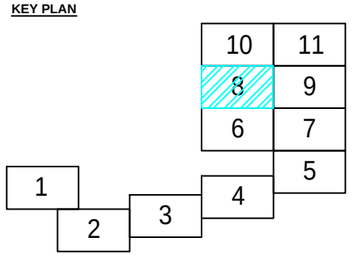
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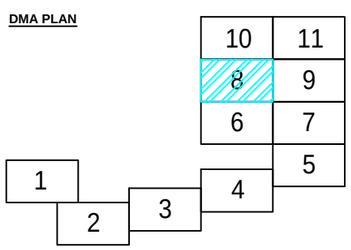
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DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	7	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

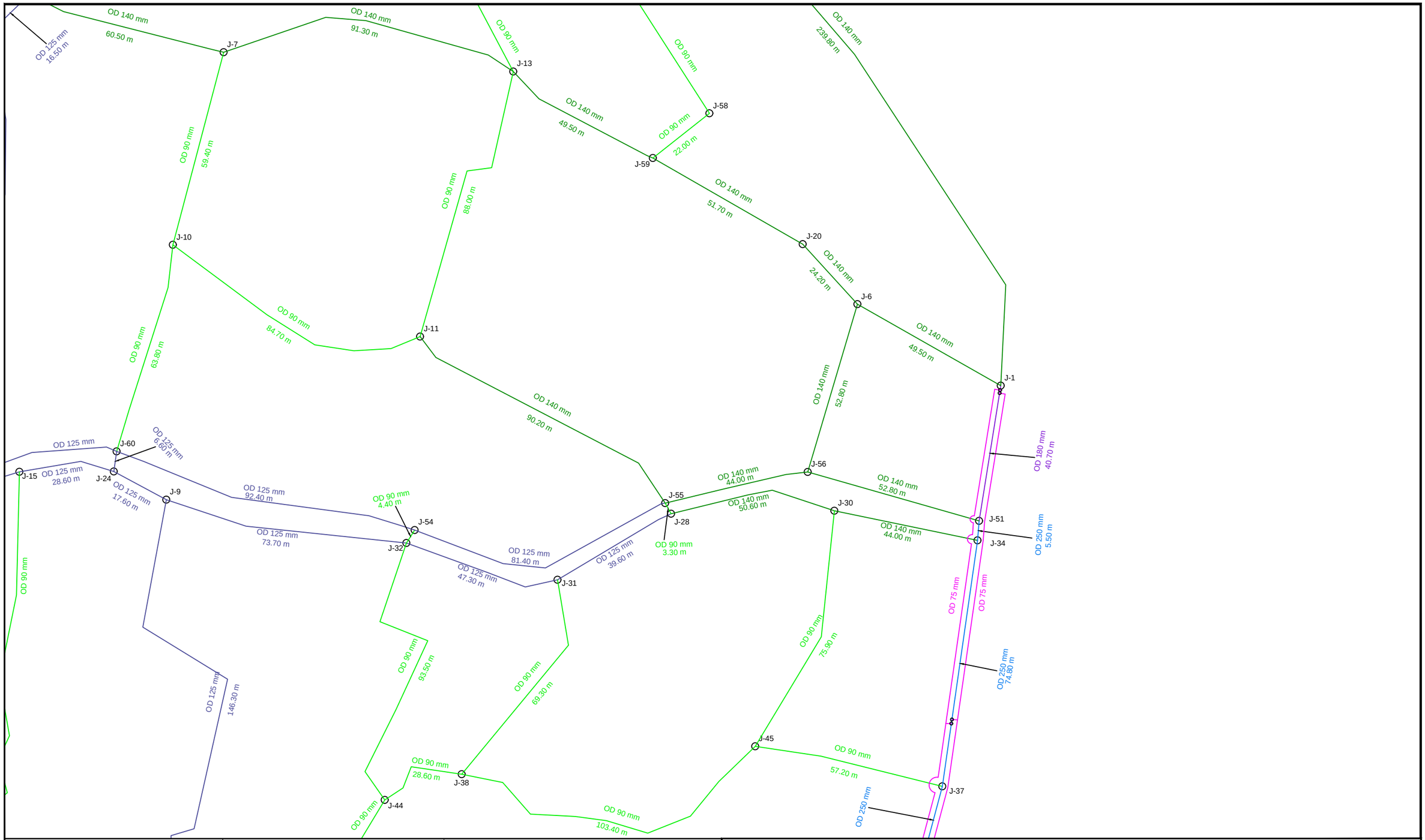
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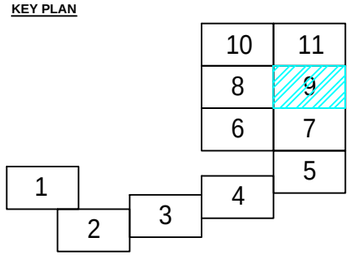
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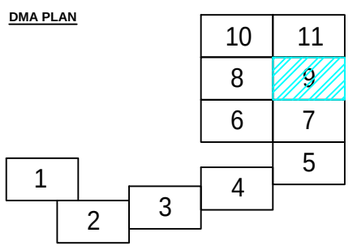
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DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	8	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

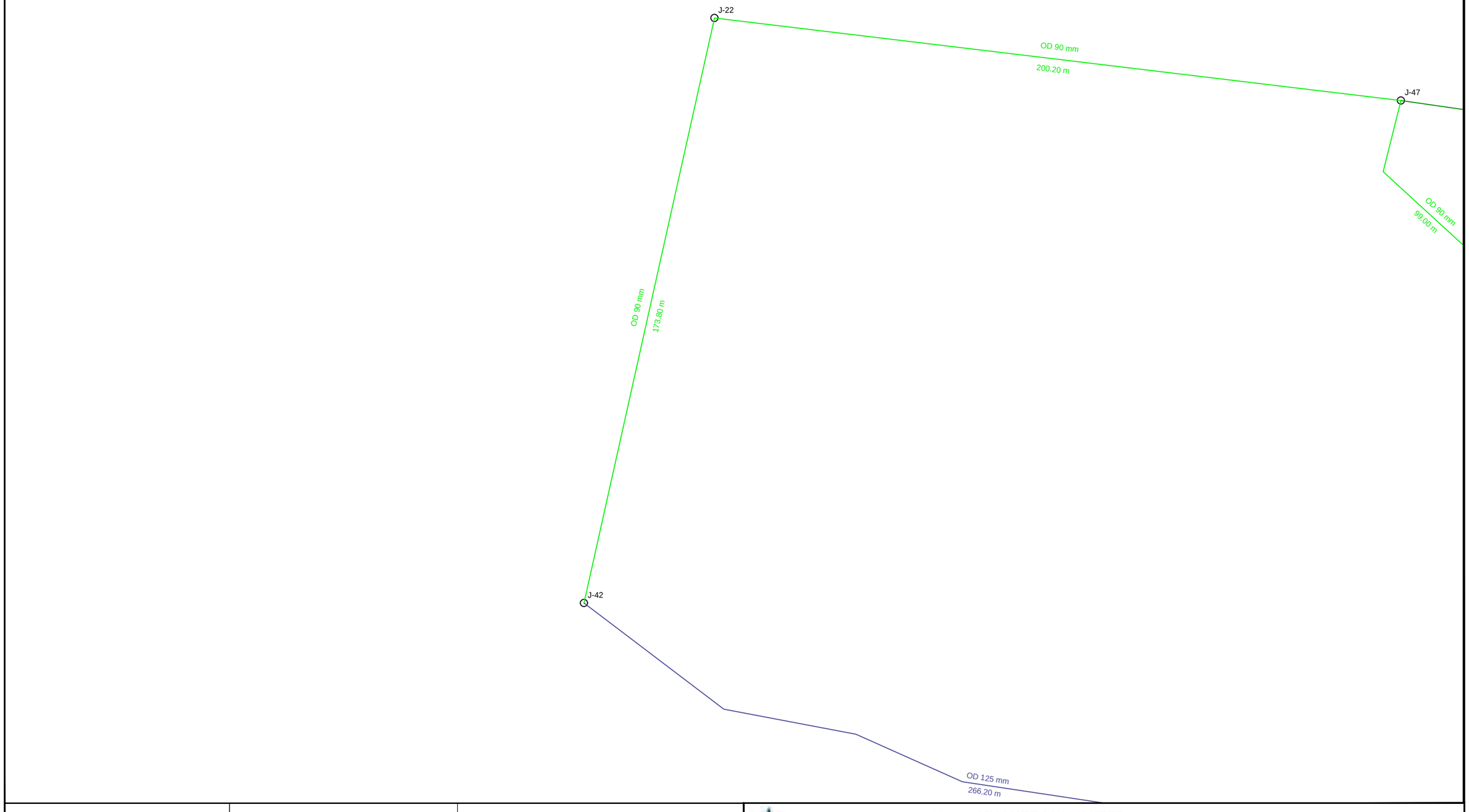
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PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

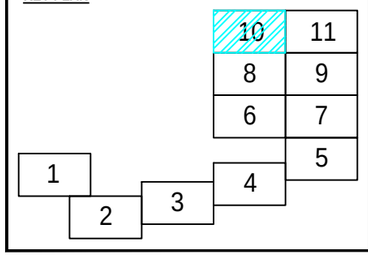
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DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS / KUMARICLUB

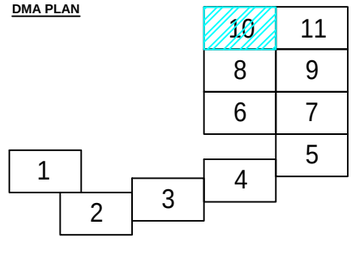
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DRAWN:	SAJ		
DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	9	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

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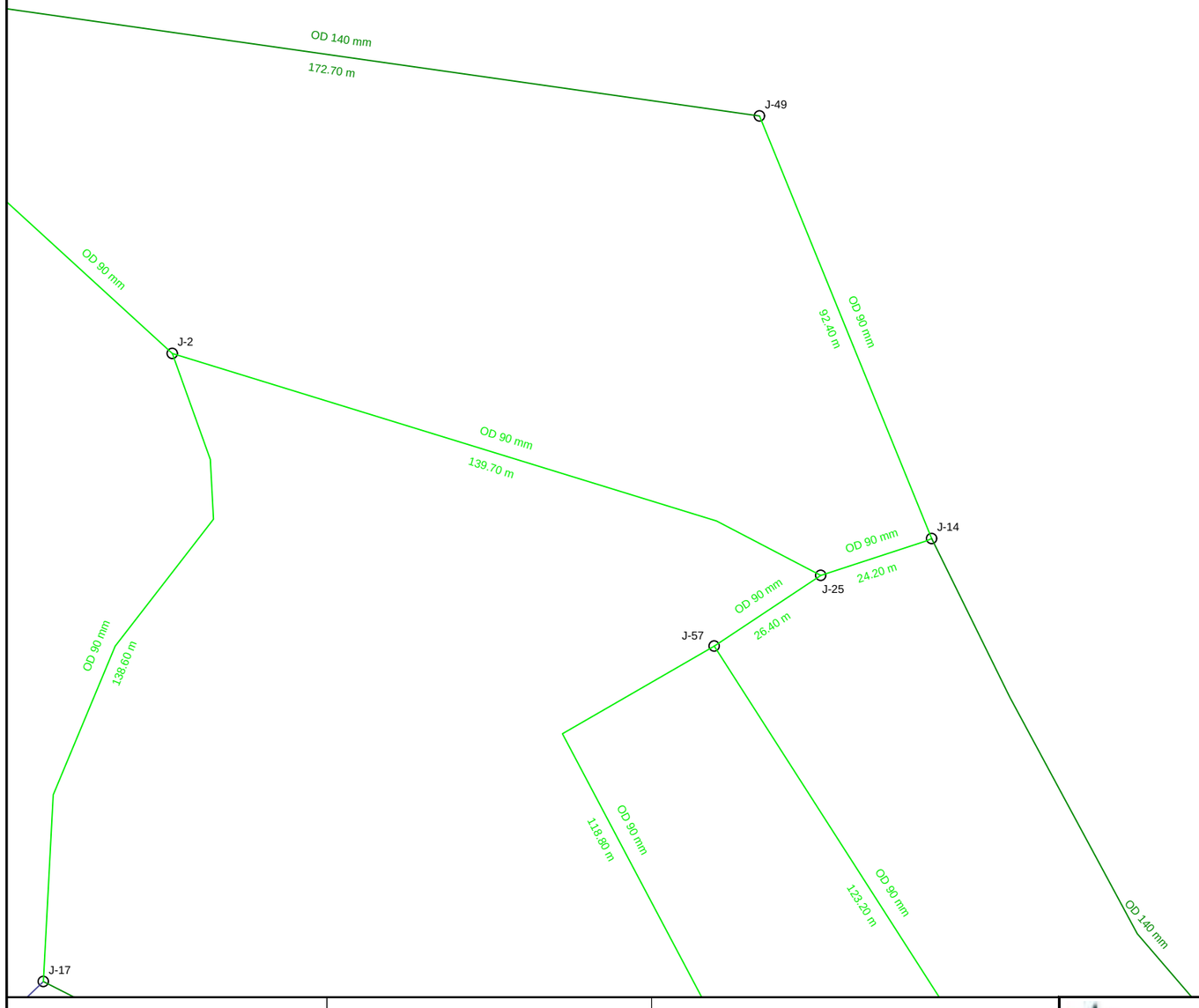
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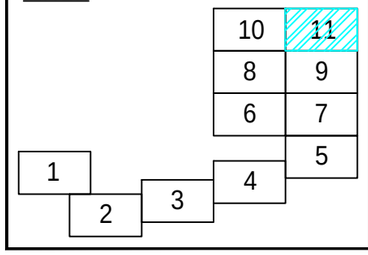
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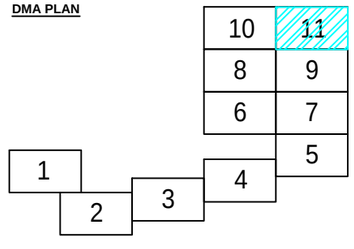
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DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	10	5	



KEY PLAN



DMA PLAN



LEGEND FEATURES & PIPELINES

- BULK FLOW METER
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

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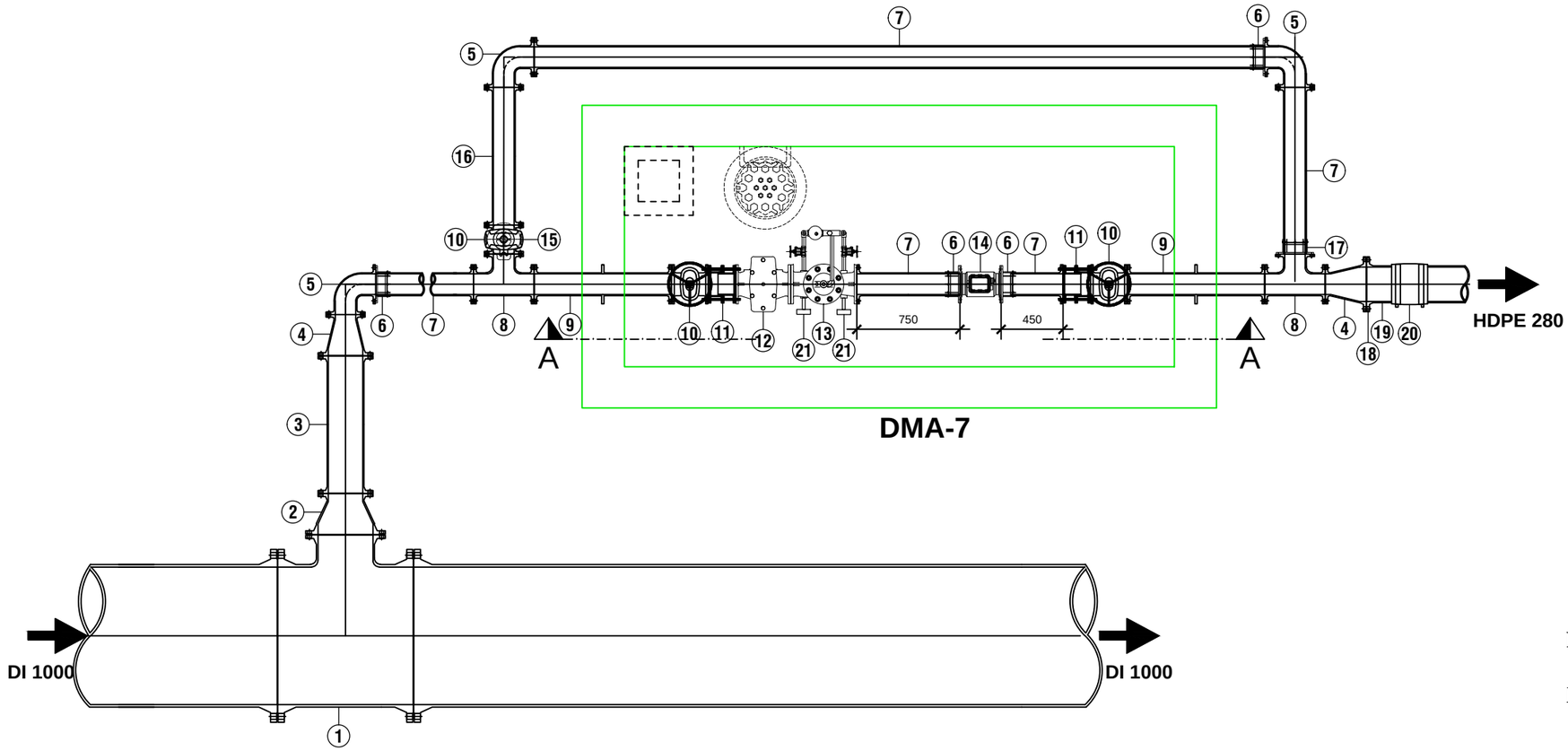
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KRITIPUR

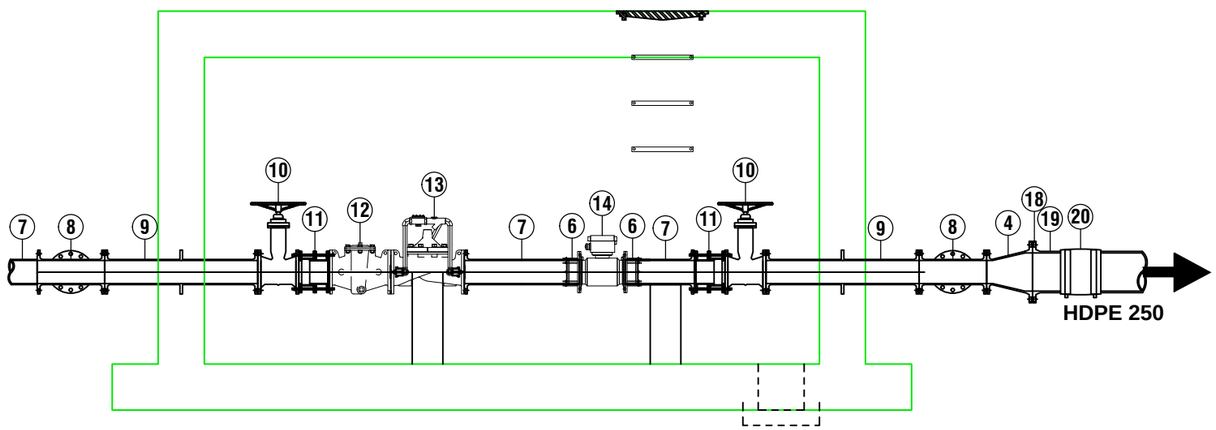
DRAWING TITLE: DISTRIBUTION NETWORK DRAWINGS / KUMARICLUB

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:1000	4	
DRAWING No.	11	5	



ITEM	DESIGNATION	PN	DN	QTY	LENGTH
1	FLANGED UNEQUAL TEE-DI	16	1000/400	1	950/335
2	FLANGED REDUCER-DI	16	400/250	1	300
3	DOUBLE FLAGED PIPE DI	16	250	1	1000
4	FLANGED REDUCER DI	16	250/150	2	300
5	FLANGED 90° BEND-DI	16	150	3	220
6	FLANGED ADAPTER UNRESTRAINED	16	150	2	-
7	SINGLE FLANGED PIPE DI	16	150	5	VARIABLE
8	FLANGED EQUAL TEE DI	16	150	2	440/220
9	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE LENGTH	16	150	2	1000
10	GATE VALVE-DI	16	150	3	210
11	SELF RESTRAINING MECHANICAL JOINT DI	16	150	2	200
12	STRAINER	16	150	1	400
13	CONTROL VALVE 4WAY & PIPE	16	150	1	600
14	ELECTROMAGNETIC FLOW METER	16	150	1	300
15	SURGE ANTICI	-	150	1	-
16	DOUBLE FLANGED PIPE-DI	16	150	2	1000
17	FLANGED ADAPTER RESTRAINED	16	150	1	
18	DUCTILE IRON BACKING RING	16	250	1	-
19	HDPE STUB END	16	250	1	
20	ELECTRO FUSION COUPLING	16	250	1	
21	PRESSURE SENSOR WITH PRESSURE GAUGE	-	-	2	-

NOTE :
Electro- Magnetic flowmeter must have Earthing System.



SECTION THROUGH A-A

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

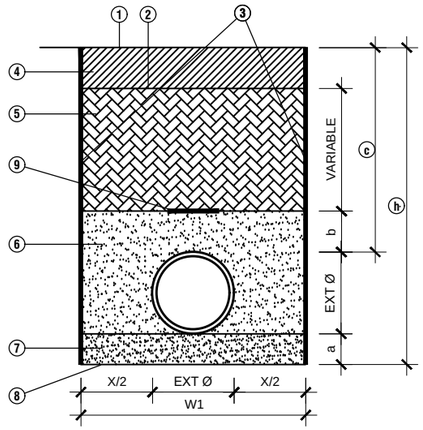
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KRITIPUR
DRAWING TITLE: OMU & DMA ASSEMBLY DISTRIBUTION NETWORK OMU-7

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	P.M. TIMALSINA	1	
APPROVED:	TL	2	
DATE:	June-2024	3	
SCALE:	1:40	4	
DRAWING No.	OMU-7	5	

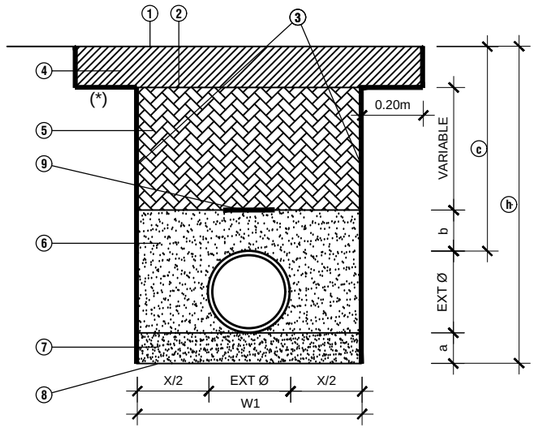
DISTRIBUTION NETWORK IMPROVEMENT WORKS IN KIRTIPUR

CONTRACT No.: PID/SKV/DNI2-KIRTIPUR

TYPICAL DRAWINGS



TYPE 1 (1 PIPELINE)
SIDEWALKS, VERGES, GRASS SURFACES, UNPAVED ROADS AND PAVED ROADS NETWORK PIPELINES



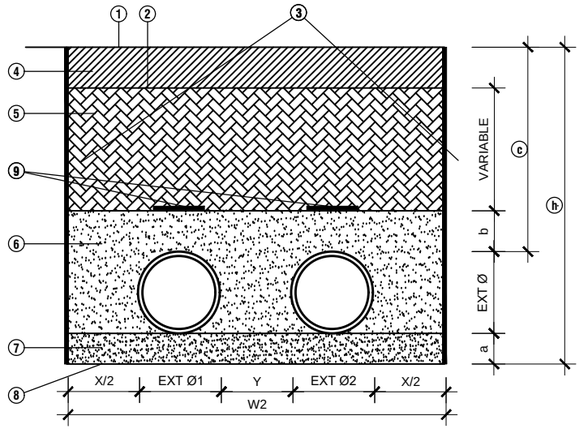
TYPE 2 (1 PIPELINE)
PAVED ROADS MAIN PIPELINES

(*) IF THE TRENCH SIDE MATCHES THE PAVED ROAD LIMIT THIS SURFACE REINSTATEMENT LATERAL EXTENSION IS NOT NEEDED IN THAT

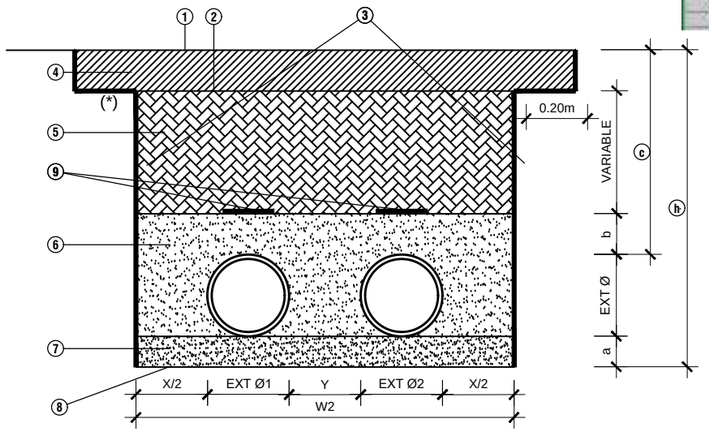
DN	Material	Width (m)	Craddle bedding	Working Space	Embedment above pipe	Min. pipe Cover (m)	Total Height (m)
Ext Φ		W1	a	X/2	b	c	h
300	DI	0.7	0.15	0.2	0.2	0.9	1.35
350	DI	0.75	0.15	0.2	0.2	0.9	1.4
400	DI	0.8	0.15	0.2	0.2	1	1.55
450	DI	0.85	0.15	0.2	0.2	1	1.6
500	DI	0.9	0.15	0.2	0.2	1.1	1.75
600	DI	1.1	0.2	0.25	0.3	1.1	1.9
700	DI	1.2	0.2	0.25	0.3	1.2	2.1
800	DI	1.3	0.2	0.25	0.3	1.2	2.2
900	DI	1.5	0.2	0.25	0.3	1.2	2.3
1000	DI	1.6	0.2	0.25	0.3	1.2	2.4

SN.	Pipe Diameter (mm)	Pipe Type	Trench					Excavation	Sand Bedding	Shoring	Backfilling	Shifting of Excess Soil
			Width (m)	Sand below (m)	Sand above (m)	Min. pipe cover (m)	Total Height (m)					
1	15	PE 100 PN16	0.4	0	0	0.7	0.72	0.29	-	-	0.08	0.21
2	20	PE 100 PN16	0.4	0	0	0.7	0.72	0.29	-	-	0.08	0.21
3	25	PE 100 PN16	0.4	0	0	0.7	0.73	0.29	-	-	0.08	0.21
4	75	PE 100 PN10	0.5	0	0	0.9	0.92	0.49	-	-	0.25	0.24
5	90	PE 100 PN10	0.5	0	0	0.9	0.99	0.5	-	-	0.26	0.24
6	110	PE 100 PN10	0.5	0	0	0.9	1.01	0.51	-	-	0.26	0.25
7	125	PE 100 PN10	0.55	0	0	0.9	1.03	0.57	-	-	0.3	0.27
8	140	PE 100 PN10	0.55	0	0	0.9	1.04	0.57	-	-	0.29	0.28
9	160	PE 100 PN10	0.55	0	0	0.9	1.06	0.58	-	-	0.29	0.29
10	180	PE 100 PN10	0.6	0	0	0.9	1.08	0.65	-	-	0.34	0.31
11	200	PE 100 PN10	0.6	0	0	0.9	1.1	0.66	-	-	0.34	0.32
12	225	PE 100 PN10	0.65	0	0	0.9	1.13	0.73	-	-	0.38	0.35
13	250	PE 100 PN10	0.65	0	0	0.9	1.15	0.75	-	-	0.39	0.36
14	280	PE 100 PN10	0.7	0	0	0.9	1.18	0.83	-	-	0.43	0.4
15	315	PE 100 PN10	0.7	0	0	0.9	1.22	0.85	-	-	0.43	0.42

Page 1



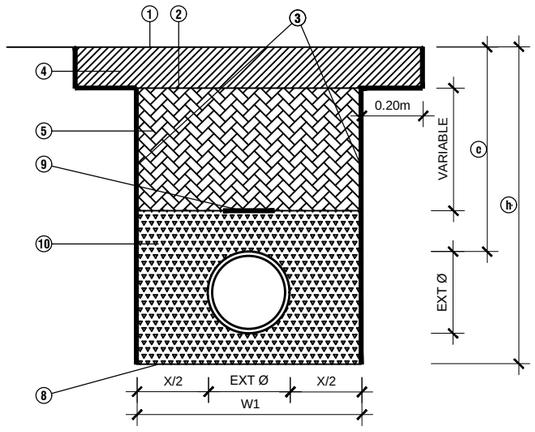
TYPE 3 (2 PIPELINE)
SIDEWALKS, VERGES, GRASS SURFACES, UNPAVED ROADS AND PAVED ROADS NETWORK PIPELINES



TYPE 4 (2 PIPELINE)
PAVED ROADS MAIN PIPELINES

X/2 Represents the minimum working space between the pipe and the trench wall or the trench shuttering
Y=0.35 if Ext Ø/i ≤ 700
Y=0.50 it Ext Ø/i > 700

(a) THICKNESS OF BEDDING	EXTØ <300mm	600mm≥ EXT Ø ≥ 300mm	EXTØ >600mm
USUAL SOIL CONDITIONS	0.10m	0.15m	0.20m
ROCK OR HARD SOIL CONDITION	0.15m	0.20m	0.30m



NOTATION	DESCRIPTION
1	SURFACE
2	BOTTOM OF EXISTING LAYER
3	TRENCH WALLS
4	BOTTOM OF REINSTATEMENT OF SURFACE LAYER
5	SAND BACKFILL
6	EMBEDMENT BACKFILL
7	GRADE OF EMBEDMENT
8	TRENCH BOTTOM
9	DETECTABLE WARNING TAPE
10	SCREENED EXCAVATED BACKFILL MATERIAL

FOR HDPE PIPES

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

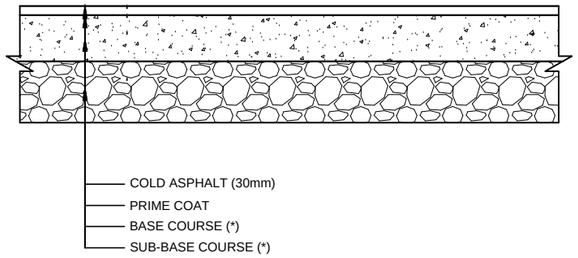
IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

SKV/S2 - KIRTIPUR: PID/SKV/DNI2 - KIRTIPUR

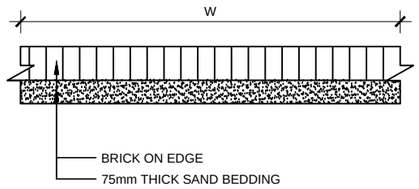
DRAWING TITLE: TRENCH OF PIPELINE TYPICAL DRAWING DETAIL DESIGN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:30	4	
DRAWING No.	TP-1-1	5	

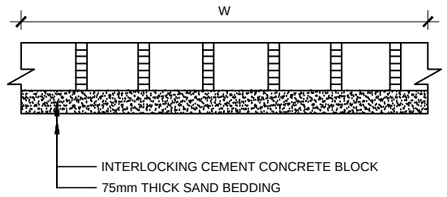


TEMPORARY REINSTATEMENT OF ASPHALT ROAD SURFACE FOR TRENCH WIDTH - 1

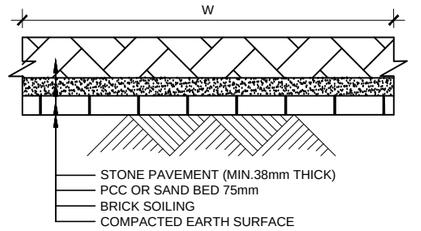
(*) FINAL REINSTATEMENT LAYERS



BRICK PAVING - 2A



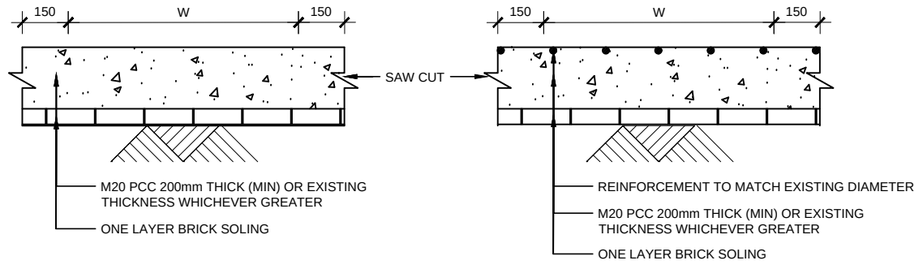
INTERLOCKING PAVING - 2B



STONE PAVEMENT - 2C

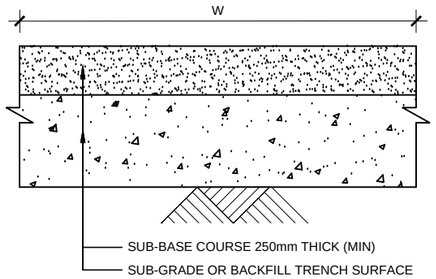
REINSTATEMENT OF ROADS PAVEMENT 2

Note:- Flag stone pavement reinstatement will be as per site condition and instruction of engineer

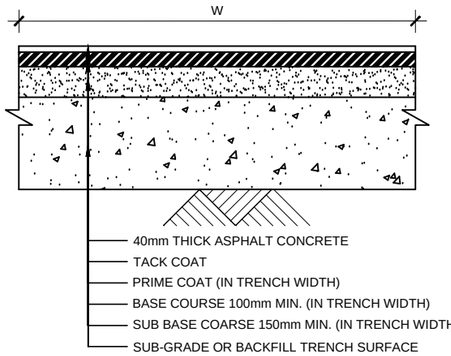


PCC ROAD - 3A

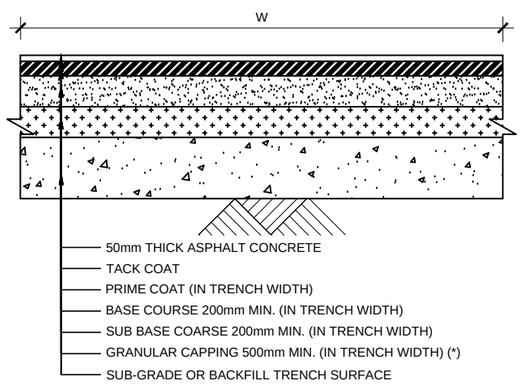
PCC ROAD - 3B



GRAVEL ROAD - 3C



BLACK TOP ROADS - 3D
(MUNICIPAL ROAD)



BLACK TOP ROADS - 3E
(DoR ROAD)

(*) OPTIONAL IF IT IS REQUIRED BY ROAD DEPARTMENT PERMIT

REINSTATEMENT OF ROADS - 3

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

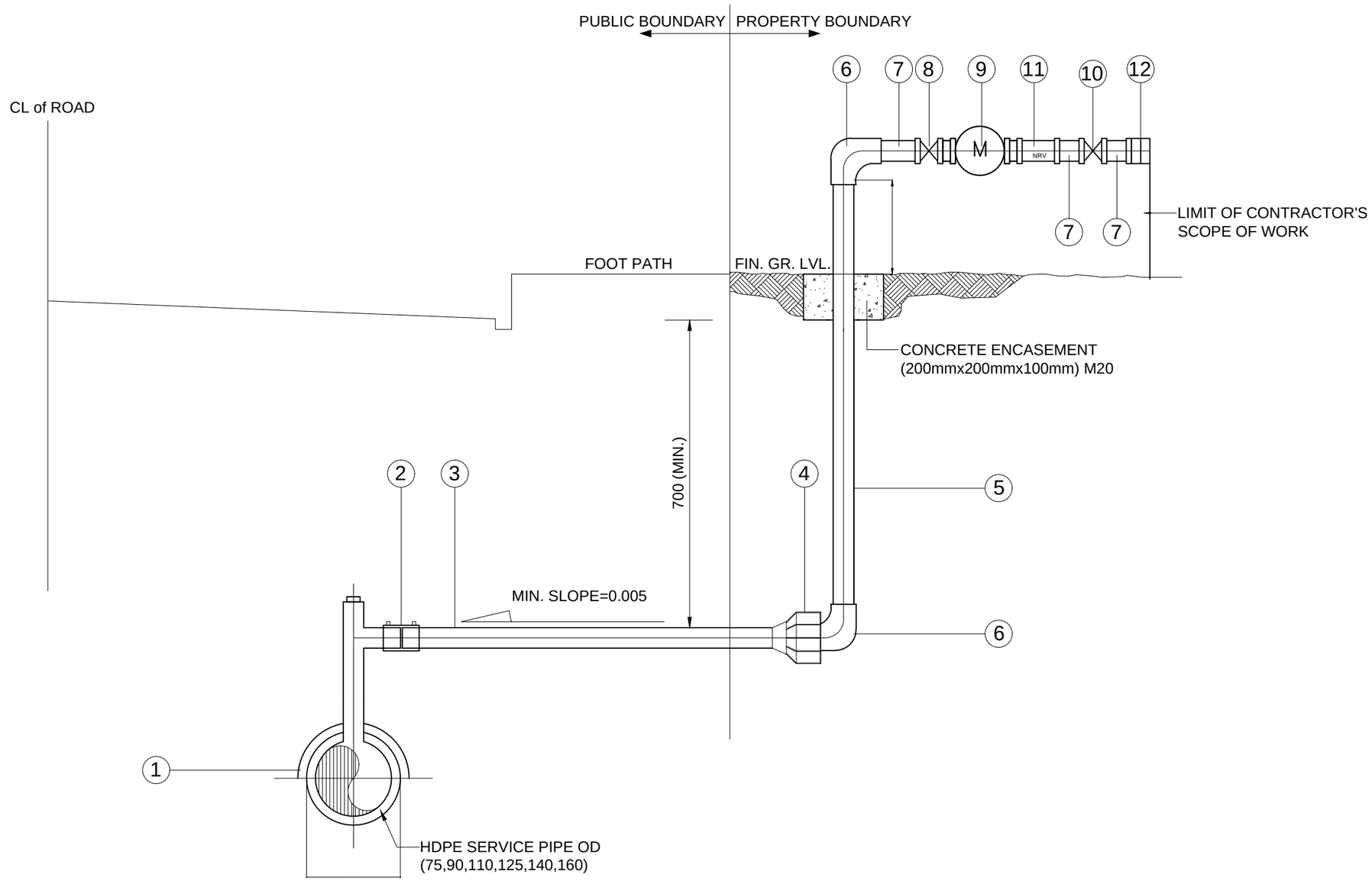
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

SKV/S2 - KIRTIPUR: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: ROAD REINSTATEMENT TYPICAL DRAWING DETAIL DESIGN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRAVO-BES	2	
DATE:	Jan-2024	3	
SCALE:	1:20	4	
DRAWING No.	TP-1-2	5	



TYPICAL HOUSE SERVICE CONNECTION 1

ITEM	PIPE / FITTING
1	ELECTRO FUSION TAPPING TEE SADDLE(PN16)
2	ELECTRO FUSION COUPLER (PN16)
3	HDPE PIPE (HSC) (PN16)
4	FEMALE THREADED 90° COMPRESSION ELBOW WITH METAL THREADES (SS304)
5	GI PIPE
6	GI ELBOW
7	GI NIPPLE
8	BRASS CORPORATION STOP WITH MAGNETIC LOCKING KEY PN10
9	CLASSIC ROTARY PISTON TYPE VOLUMETRIC WATER METER WITH THREADED END CONNECTION
10	BRASS CORPORATION STOP WITHOUT LOCKING KEY
11	BRASS NON RETURN VALVE (NRV)
12	GI UNION

NOTES:

1. NOTATION:
   G.I. = GALVANIZED IRON
2. THE SERVICE CONNECTION SHALL BE LOCATED AS APPROVED BY THE ENGINEER.
3. ALL G.I. PIPE AND FITTINGS SHALL BE SCHEDULE 40.
4. CORPORATION STOP SHALL BE OF BRASS AND AS PER BSEN 1213:2000 OR EQUIVALENT.
5. MAGNETIC LOCKABLE / WITHOUT LOCK BALL VALVE SHALL BE OF BRASS AND AS PER BS 6675:1986 OR EQUIVALENT.
6. HOUSEHOLD SERVICE CONNECTION TYPE (DIAMETER= WILL BE FINALIZED AFTER CONSUMER SURVEY AND ASSESSMENT / VALIDATION OF CONSUMER DEMAND.
7. LOCATION OF WATER METER SHALL BE FINALIZED MUTUALLY BETWEEN CONSUMER AND EMPLOYER AND THE SAME SHALL PREFERABLE BE INSTALLED WITHIN THE PREMISES OF THE CONSUMER.

FITTINGS SIZE ACCORDING CONNECTION TYPE													
TYPE	DN	Q3(m3-h)	1	2	3	4	5	6	7	8	9	10	11
T-15	15	2.5	OD*20	20	20	20	15	15	15	15	15	15	15
T-20	20	4.0	OD*25	25	25	25	20	20	20	20	20	20	20
T-25	25	6.3	OD*32	32	32	32	25	25	25	25	25	25	25
T-30	30	10	OD*40	40	40	40	30	30	30	30	30	30	30
T-40	40	16	OD*50	50	50	50	40	40	40	40	40	40	40
T-50	50	25	OD*63	63	63	63	50	50	50	50	50	50	50

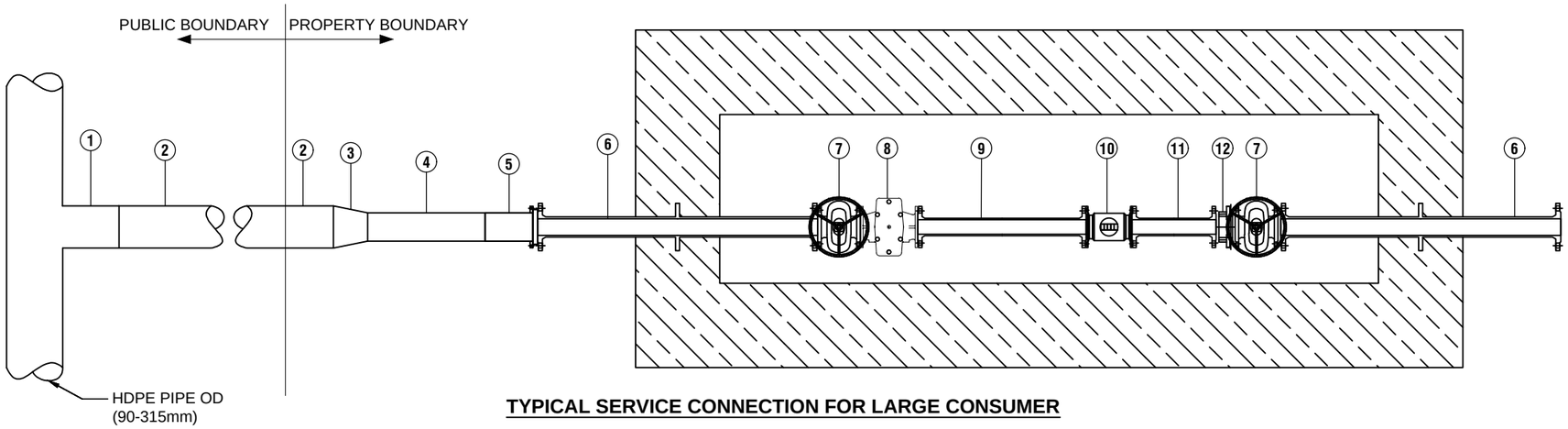
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: HOUSE HOLD SERVICE CONNECTIONS TYPICAL DRAWING DETAIL DESIGN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:20	4	
DRAWING No.	TP-2-1	5	



TYPICAL SERVICE CONNECTION FOR LARGE CONSUMER

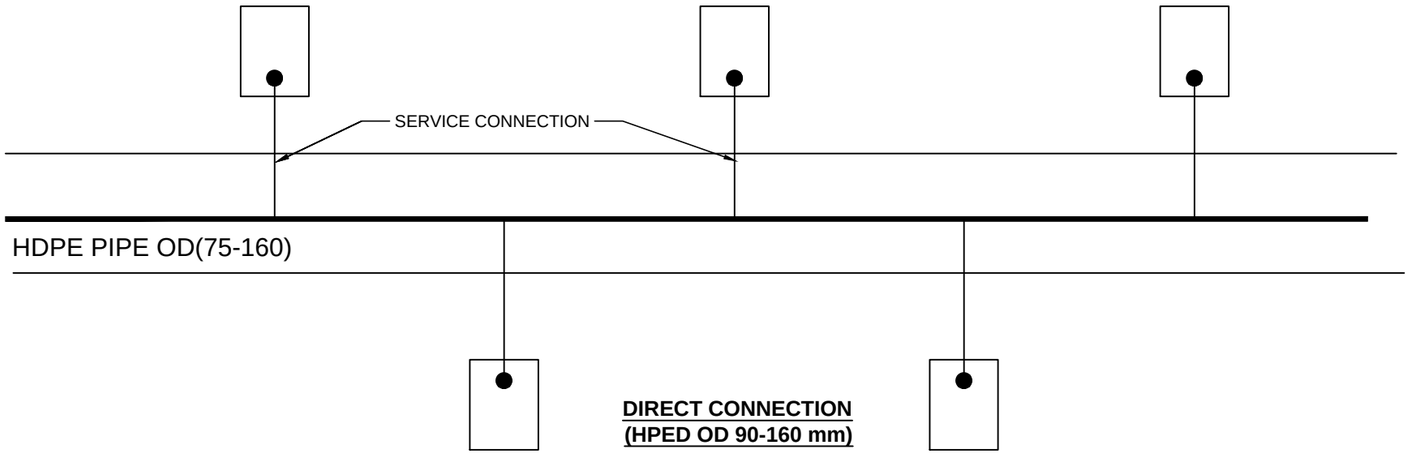
ITEM	PIPE / FITTING
1	EQUAL TEE
2	HDPE PIPE
3	EF REDUCER ODx63mm
4	HDPE PIPE OD 63
5	DI HDPE FLANGE ADAPTER DN50
6	PUDDLE FLANGE DN50
7	FLANGED GATE VALVE
8	STRAINER
9	FLANGED PIPE DN 50 - 600mm
10	WOLTMAN WATER METER DN 50
11	FLANGED PIPE DN 50 - 300mm
12	CHECK VALVE DN50

NOTES:

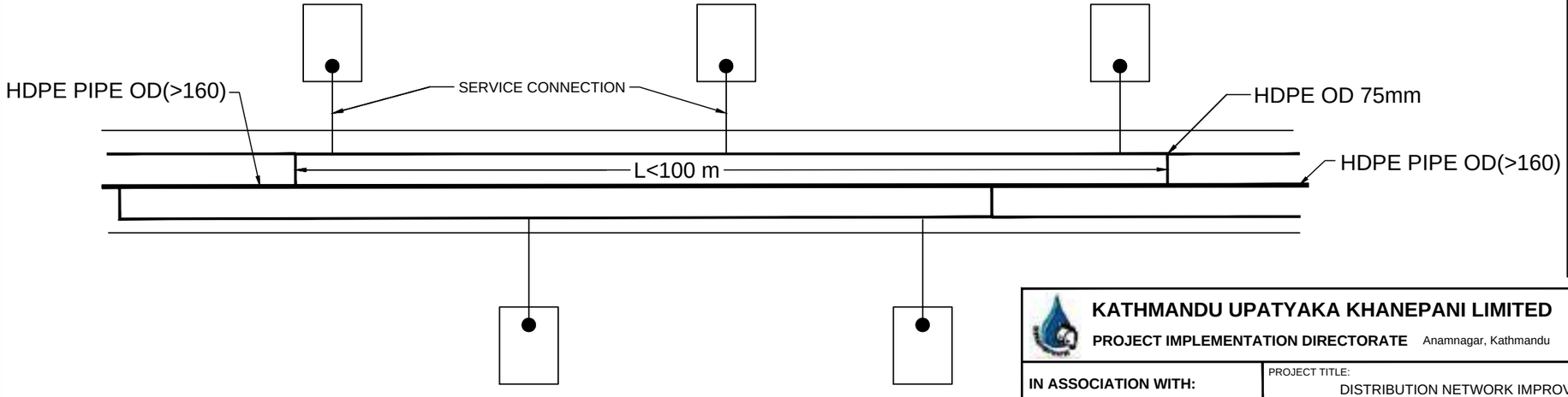
1. NOTATION:

   G.I. = GALVANIZED IRON
2. THE SERVICE CONNECTION SHALL BE LOCATED AS APPROVED BY THE ENGINEER.
3. ALL G.I. PIPE AND FITTINGS SHALL BE SCHEDULE 40.
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6. HOUSEHOLD SERVICE CONNECTION TYPE (DIAMETER= WILL BE FINALIZED AFTER CONSUMER SURVEY AND ASSESSMENT / VALIDATION OF CONSUMER DEMAND.
7. LOCATION OF WATER METER SHALL BE FINALIZED MUTUALLY BETWEEN CONSUMER AND EMPLOYER AND THE SAME SHALL PREFERABLE BE INSTALLED WITHIN THE PREMISES OF THE CONSUMER.

TIPOLOGY OF SERVICE CONNECTION ACCORDING WITH NETWORK DIAMETER.



DIRECT CONNECTION
(HPED OD 90-160 mm)



CONNECTION TO A TERCIARY PIPELINE
HDPE OD 75 mm (HDPE OD >160 mm)

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

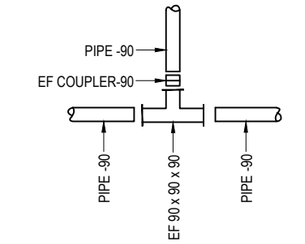
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

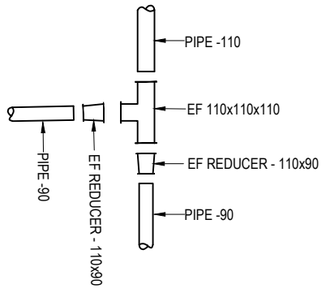
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: HOUSE HOLD SERVICE CONNECTIONS
TYPICAL DRAWING
DETAIL DESIGN

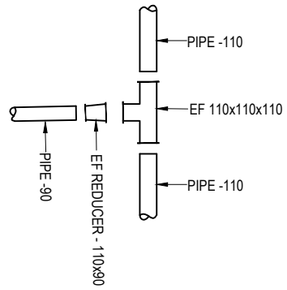
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BERMUDES	2	
DATE:	Jan-2024	3	
SCALE:	1:20	4	
DRAWING No.	TP-2-2	5	



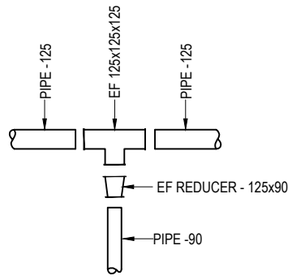
JUNCTION 90x90x90



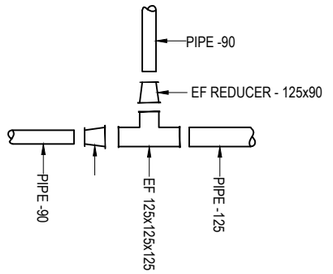
JUNCTION 110x90x90



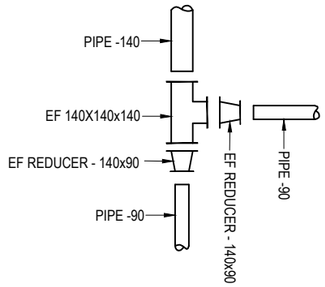
JUNCTION 110x90x110



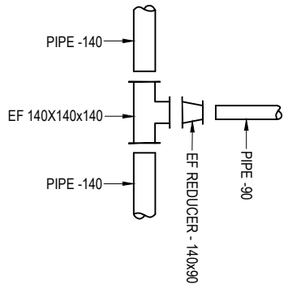
JUNCTION 125x90x125



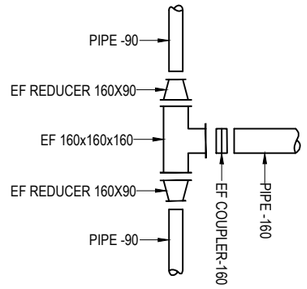
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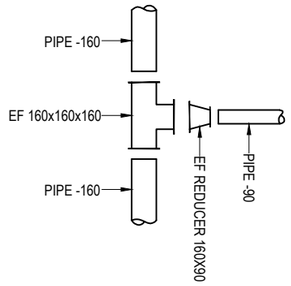
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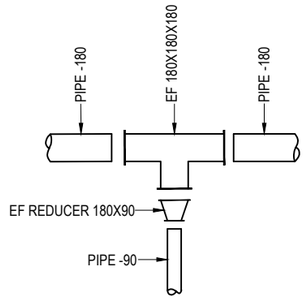
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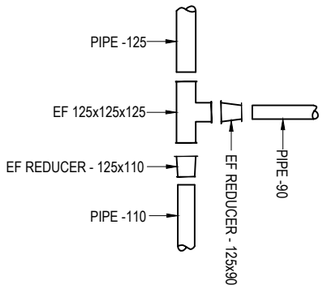
JUNCTION 90x90x160



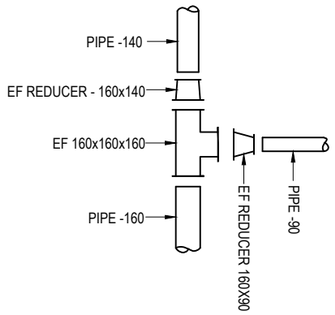
JUNCTION 160x160x90



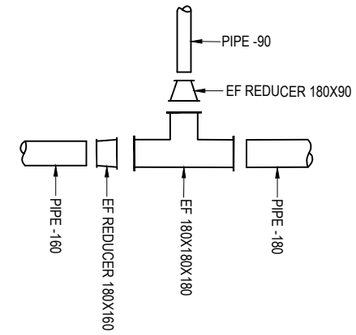
JUNCTION 180x90x180



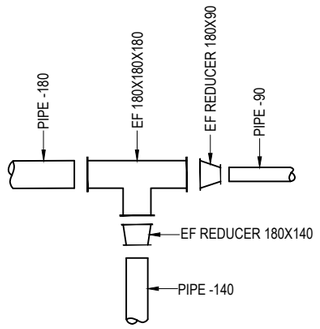
JUNCTION125x110x90



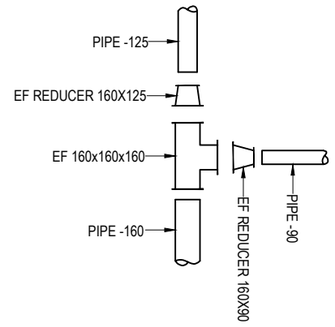
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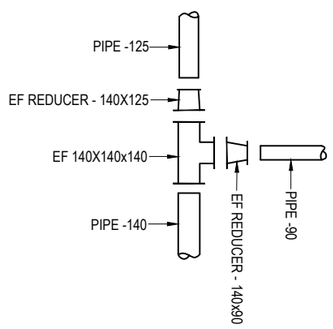
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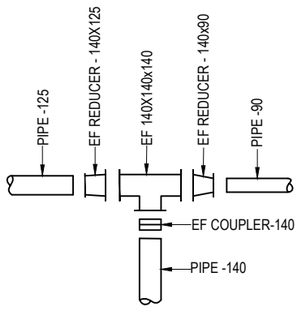
JUNCTION 180x140x90



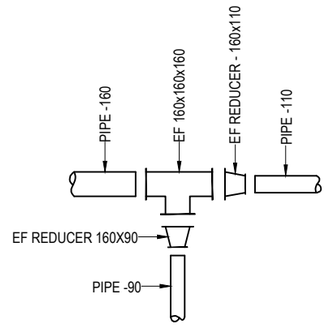
JUNCTION 125x160x90



JUNCTION 125x140x90



JUNCTION 125x140x90



JUNCTION 160x90x110

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

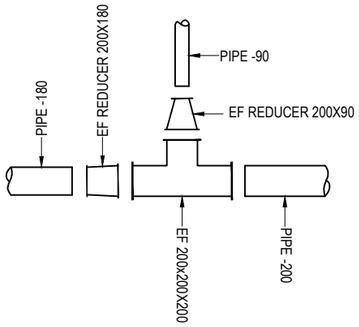
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

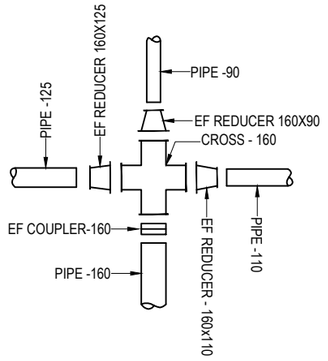
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: HDPE PIPE CONNECTION
JUNCTION TYPICAL DRAWING
DN 90-1

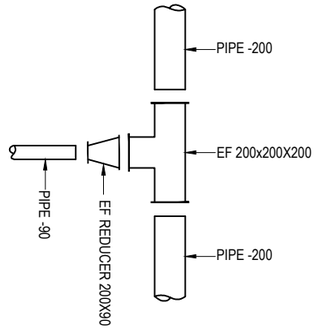
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DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	TP - 3 - 1	5	



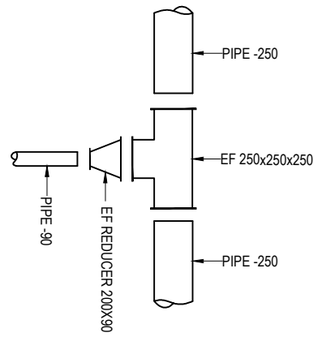
JUNCTION 90x180x200



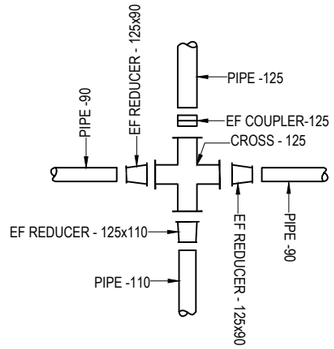
JUNCTION 90x125x160x110



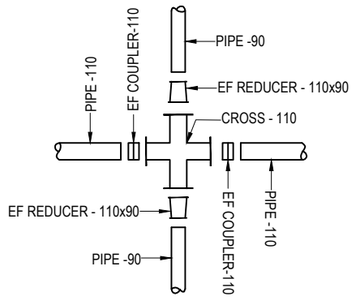
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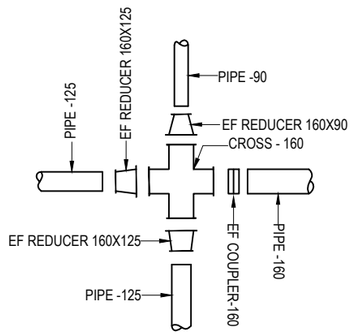
JUNCTION 250x90x250



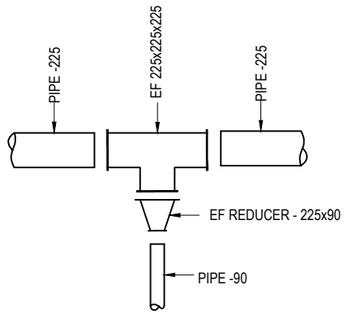
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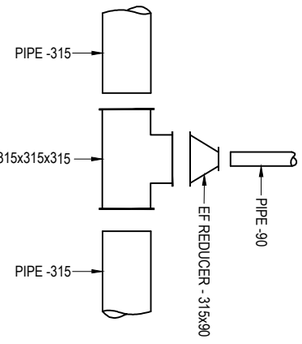
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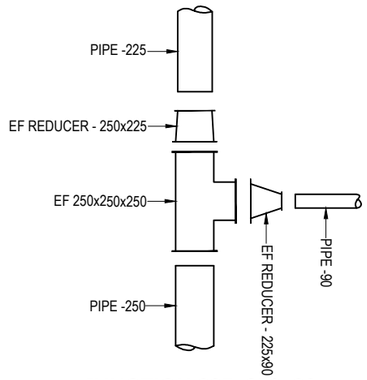
JUNCTION 90x125x125x160



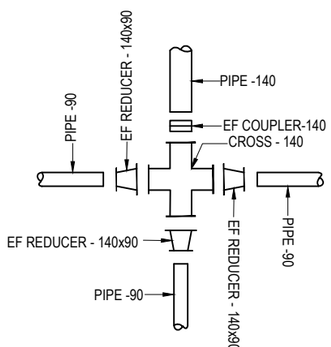
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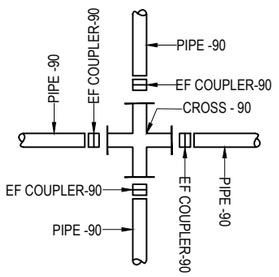
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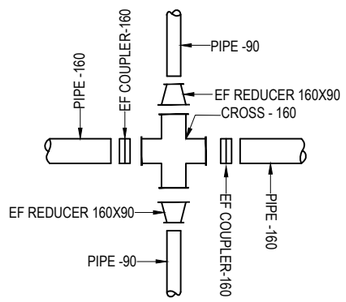
JUNCTION 225x250x90



JUNCTION 140x90x90x90



JUNCTION 90x90x90x90



JUNCTION 90x160x90x160

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

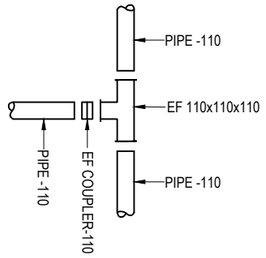
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

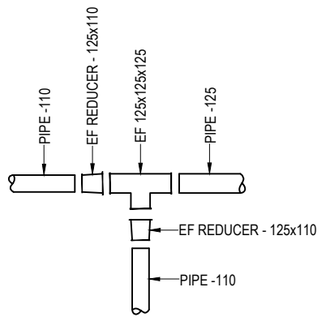
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: HDPE PIPE CONNECTION JUNCTION TYPICAL DRAWING DN 90-2

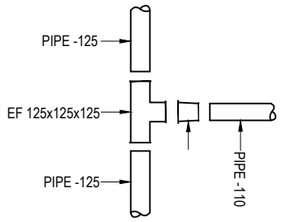
		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRETE	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	TP - 3 - 2	5	



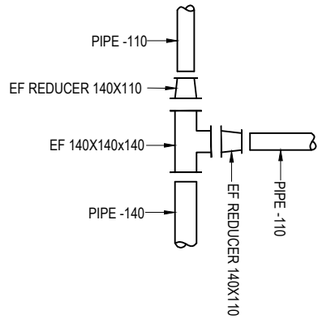
JUNCTION 110x110x110



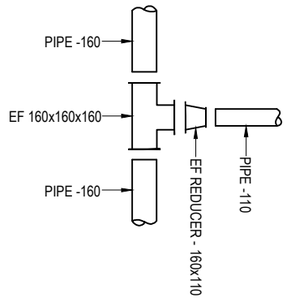
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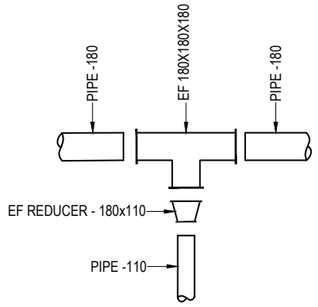
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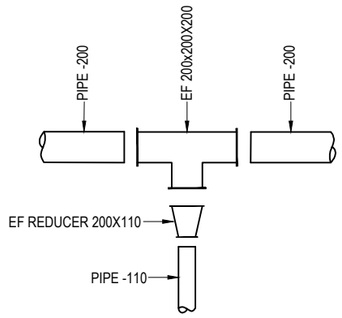
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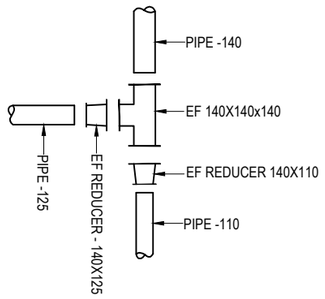
JUNCTION 160x160x110



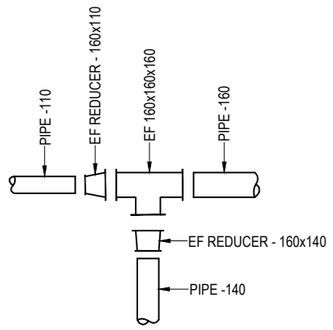
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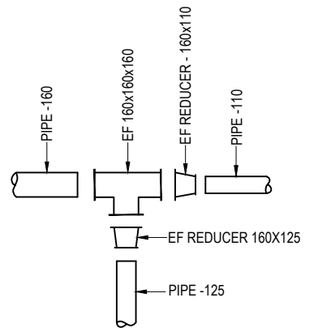
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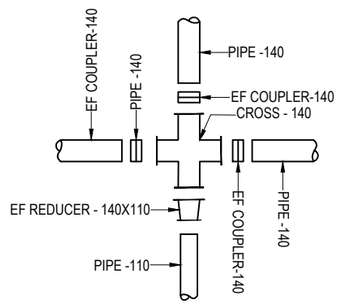
JUNCTION 140x125x110



JUNCTION 110x140x160



JUNCTION 160x125x110



JUNCTION 140x140x110x140

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

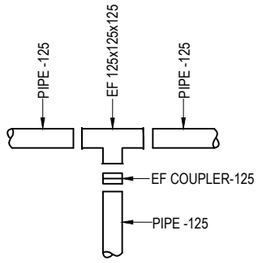
Eptisa-ERMC JV (DSC-07)

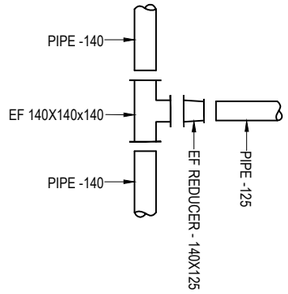
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

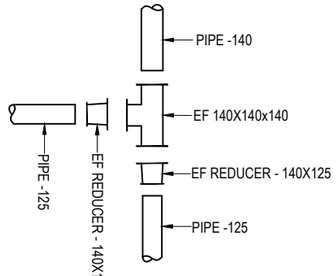
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

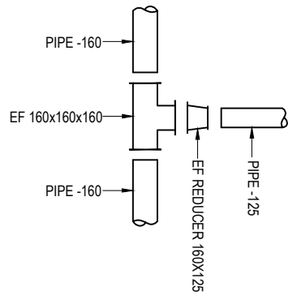
DRAWING TITLE: HDPE PIPE CONNECTION
JUNCTION TYPICAL DRAWING
DN 110

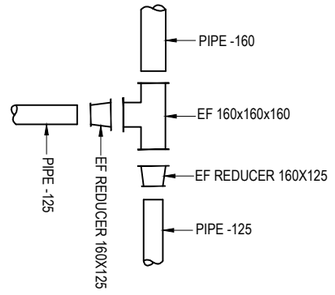
		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
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DRAWING No.	TP - 3 - 3	5	



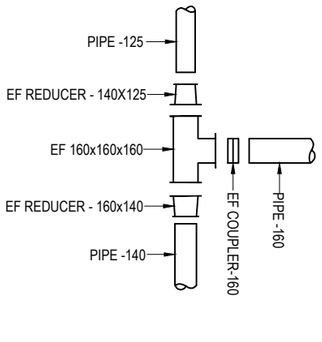




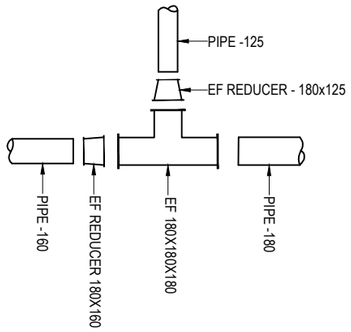




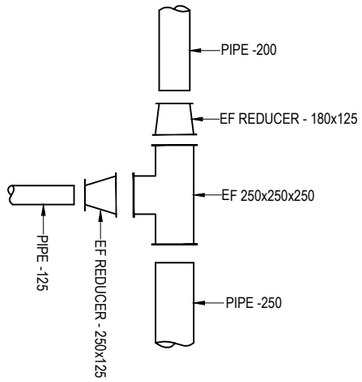
JUNCTION 125x140x160



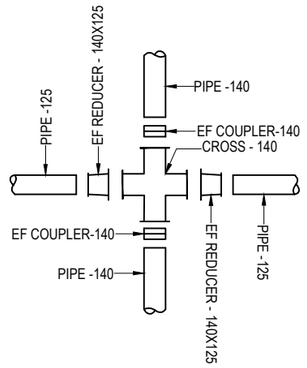
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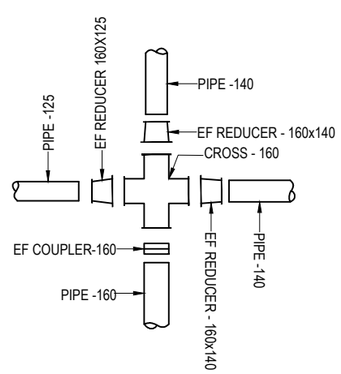
JUNCTION 200x125x250



JUNCTION 140x125x140x125



JUNCTION 140x125x160x140



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

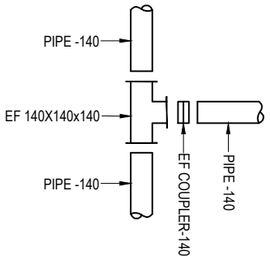
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

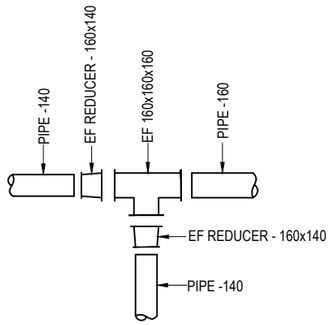
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: HDPE PIPE CONNECTION
JUNCTION TYPICAL DRAWING
DN 125

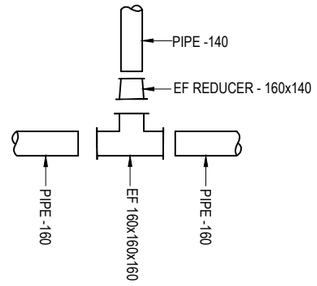
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DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRAVO BES	2	
DATE:	Jan-2024	3	
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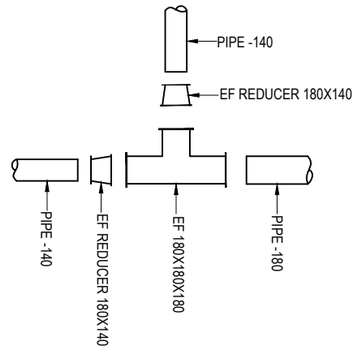
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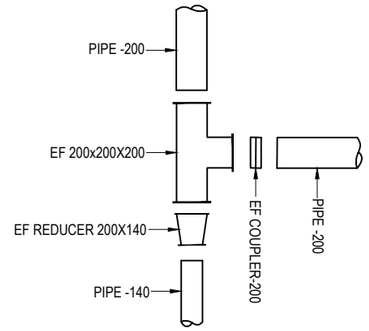
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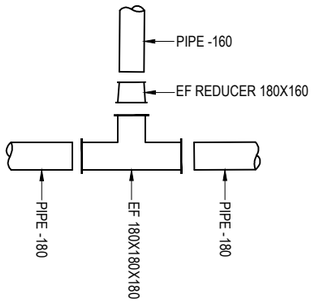
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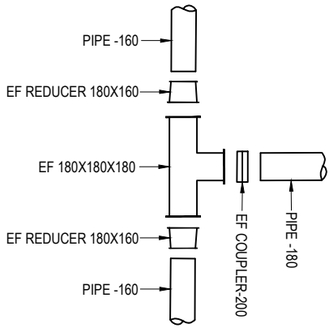
JUNCTION 140x140x180



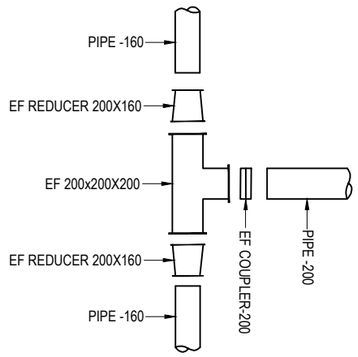
JUNCTION 200x140x200



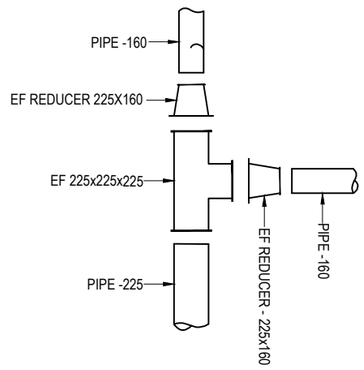
JUNCTION 160x180x180



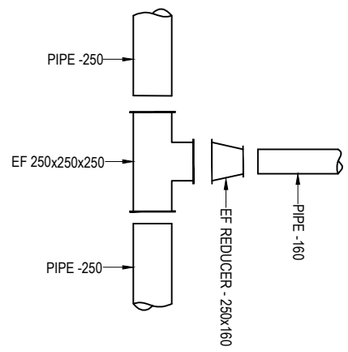
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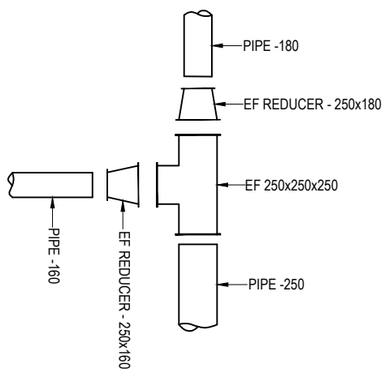
JUNCTION 160x160x200



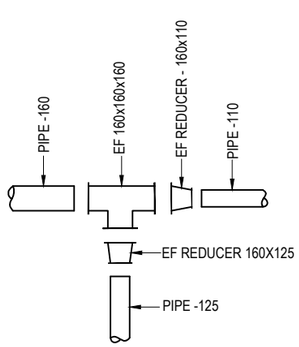
JUNCTION 160x225x160



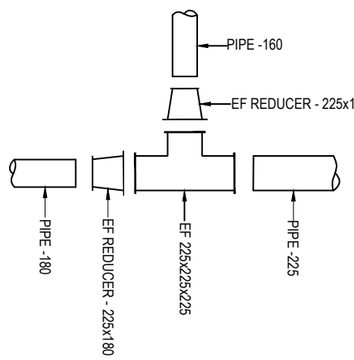
JUNCTION 250x250x160



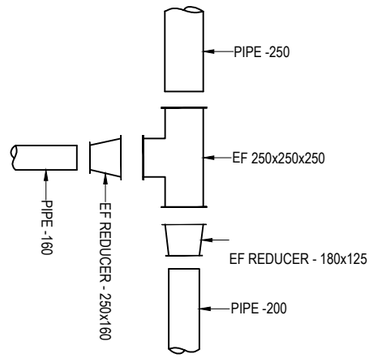
JUNCTION 180x160x250



JUNCTION 160x125x110



JUNCTION 160x180x225



JUNCTION 250x160x200

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

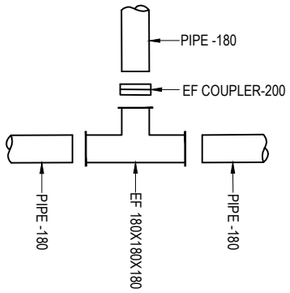
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

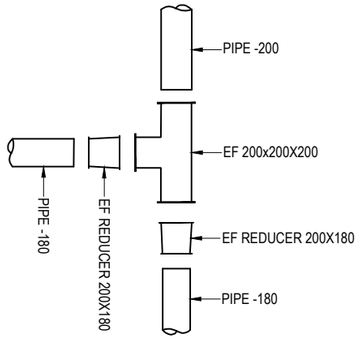
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: HDPE PIPE CONNECTION JUNCTION TYPICAL DRAWING DN 140 & 160

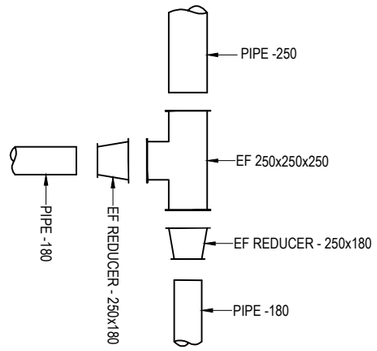
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DRAWN:	SAJ	1	
DESIGNED:	J. M. NAVARRO	2	
APPROVED:	M. BENAVIDES	3	
DATE:	Jan-2024	4	
SCALE:	1:50	5	
DRAWING No.	TP - 3 - 5		



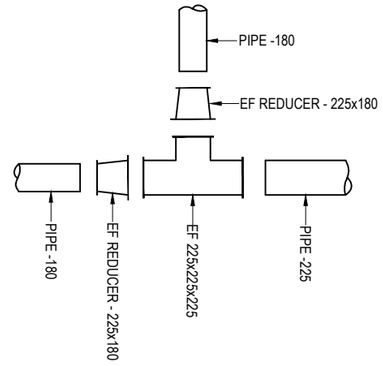
JUNCTION 180x180x180



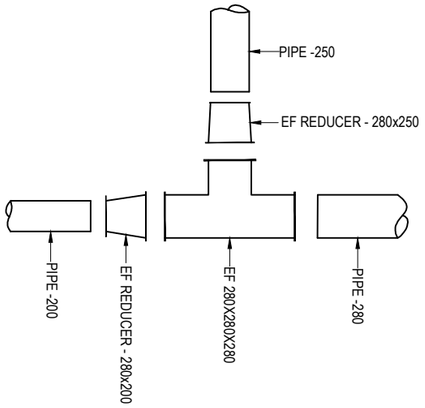
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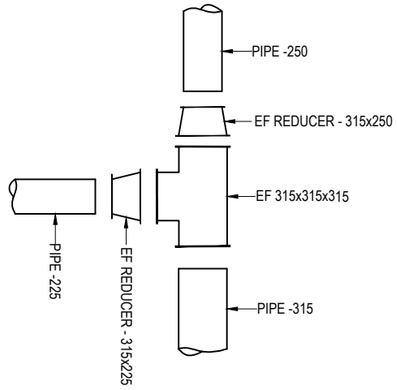
JUNCTION 250x180x180



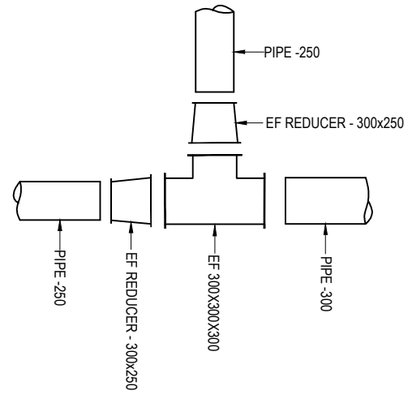
JUNCTION 180x180x225



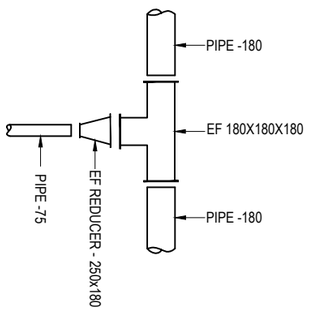
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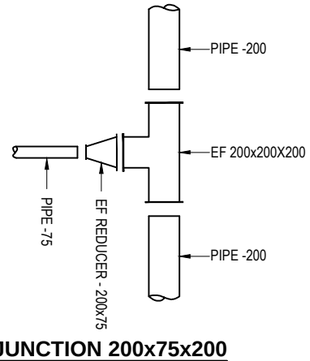
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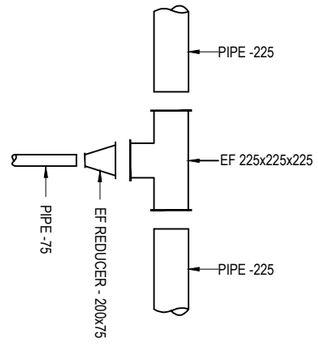
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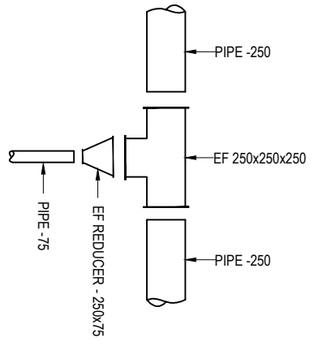
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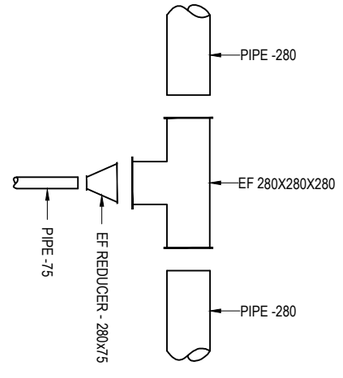
JUNCTION 200x75x200



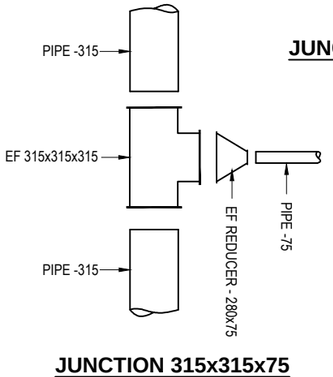
JUNCTION 225x75x225



JUNCTION 250x75x250



JUNCTION 280x75x280



JUNCTION 315x315x75

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

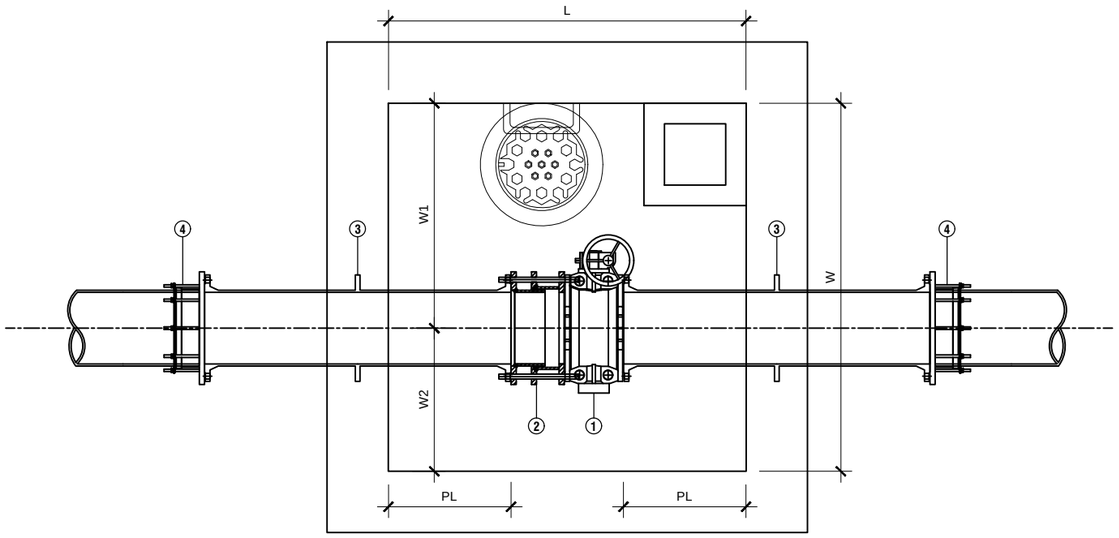
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

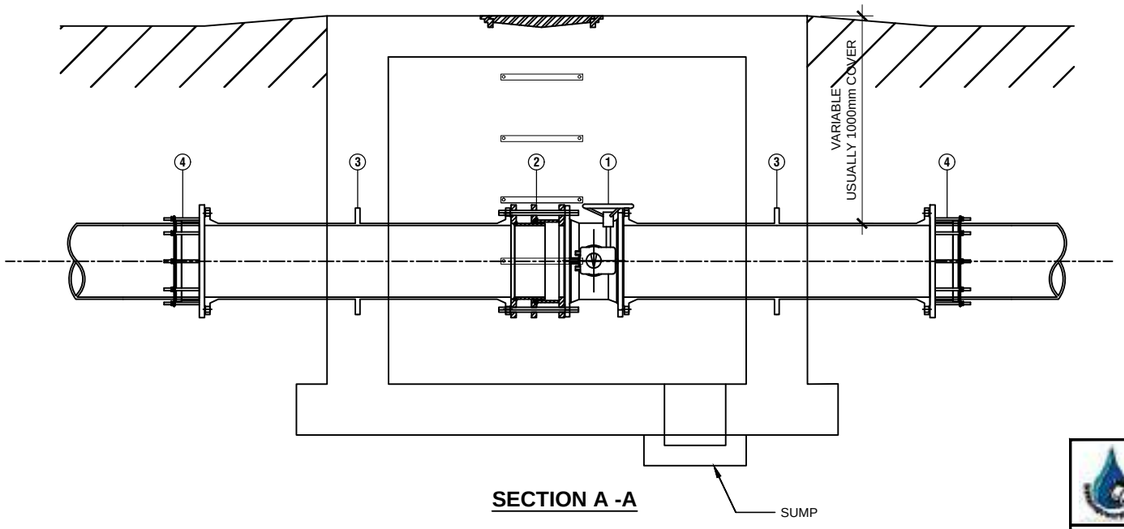
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: HDPE PIPE CONNECTION JUNCTION TYPICAL DRAWING DN 180 TO 250 AND 75

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	TP - 3 - 6	5	



PLAN



SECTION A -A

ITEM	DESIGNATION	PN	DN	QTY.
1	BUTTERFLY VALVE DI (*)	16	300	1
2	SELF RESTRAINING DISMANTLING JOINT	16	DI	1
3	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE L=1500mm - DI	16	PP	2
4	FLANGED ADAPTOR - DI	16	FA	2
5	DI MANHOLE COVER	-	600	1
6	DI STEPS			8

PROPOSAL CHAMBER EQUIPMENT LIST DETAILS

ITEM	DESIGNATION	PN	DN						QTY.
			200	250	300	400	450	500	
1	BUTTERFLY VALVE	16	400	450	350	600	700	750	1
2	SELF RESTRAINING DISMANTLING JOINT	16	320	370	450	570	660	750	1
P1	INTERNAL LENGTH OF PIPE FROM CHAMBER WALL BOTH SIDES	-	600	600	600	600	600	600	-
-	TOTAL LENGTH OF CHAMBER		1560	1620	1800	1740	1920	1950	

Width of Chamber

DN	W1 in mm	W2 in mm	W in mm
200 - 600	1800	800	2200
600 - 650	1800	700	2000
400 - 500	1200	600	1500

(*) BUTTERFLY VALVES: DOUBLE ECCENTRIC EQUIPPED WITH GEAR BOX AND HANDWHEEL AND POSITION INDICATOR AND DESIGNED FOR FUTURE INSTALLATION OF ELECTRICAL ACTUATOR.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

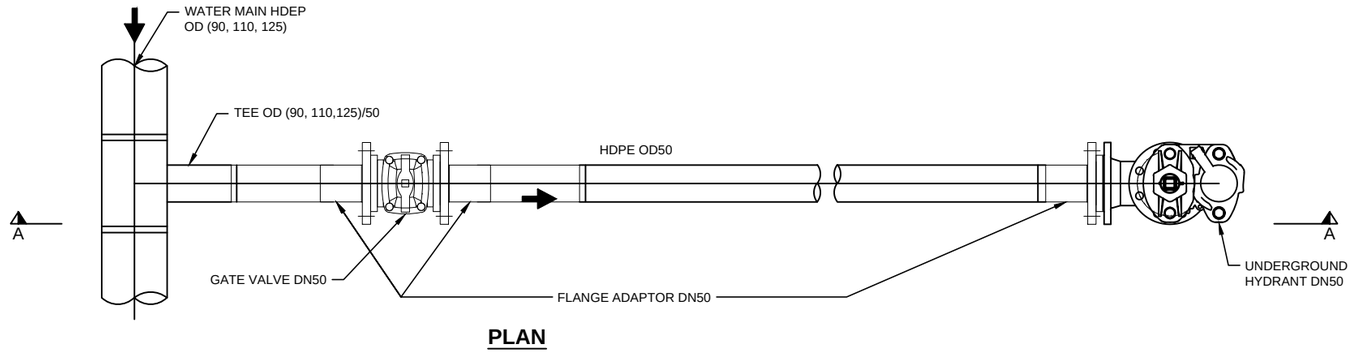
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

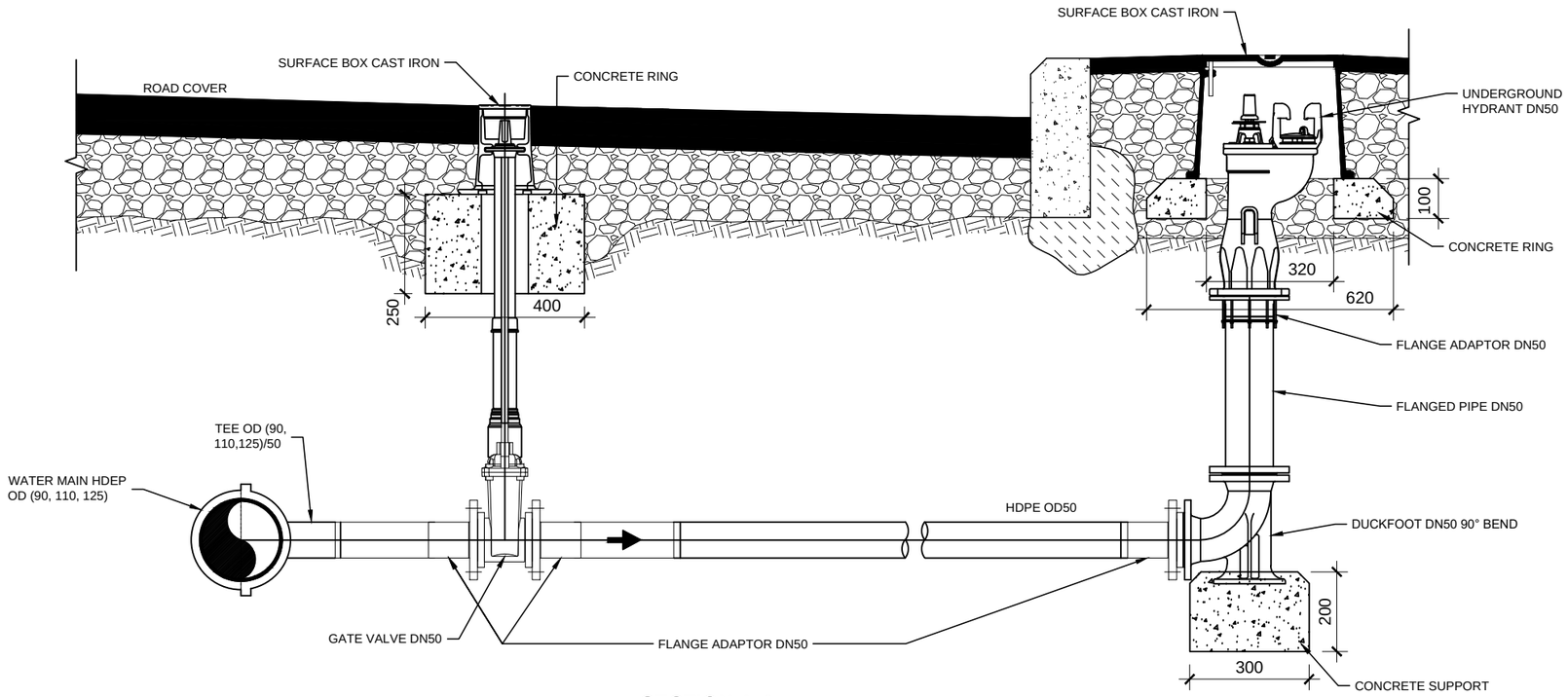
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: ISOLATION BUTTERFLY VALVE TYPICAL DRAWING DETAIL DESIGN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:30	4	
DRAWING No.	TP - 4	5	



PLAN



SECTION A-A

UNDERGROUND HYDRANT DN50 - TYPICAL INSTALLATION CONNECTION NETWORK PIPELINE OD<140

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

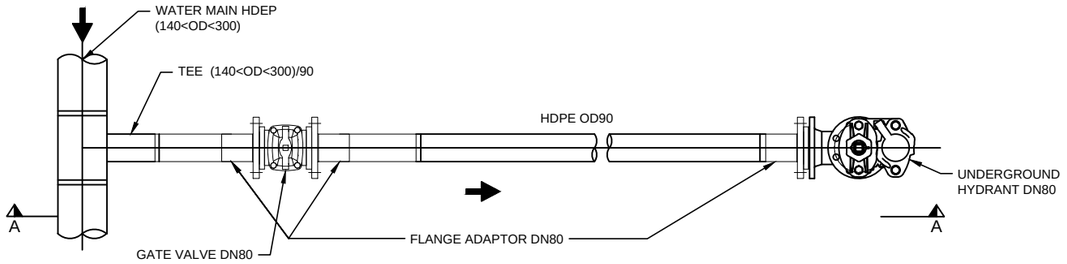
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

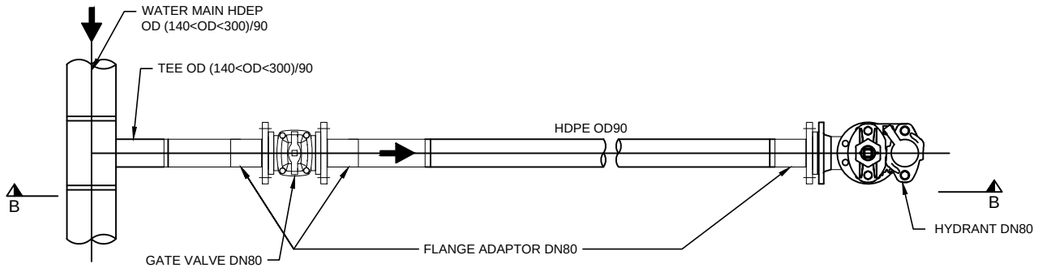
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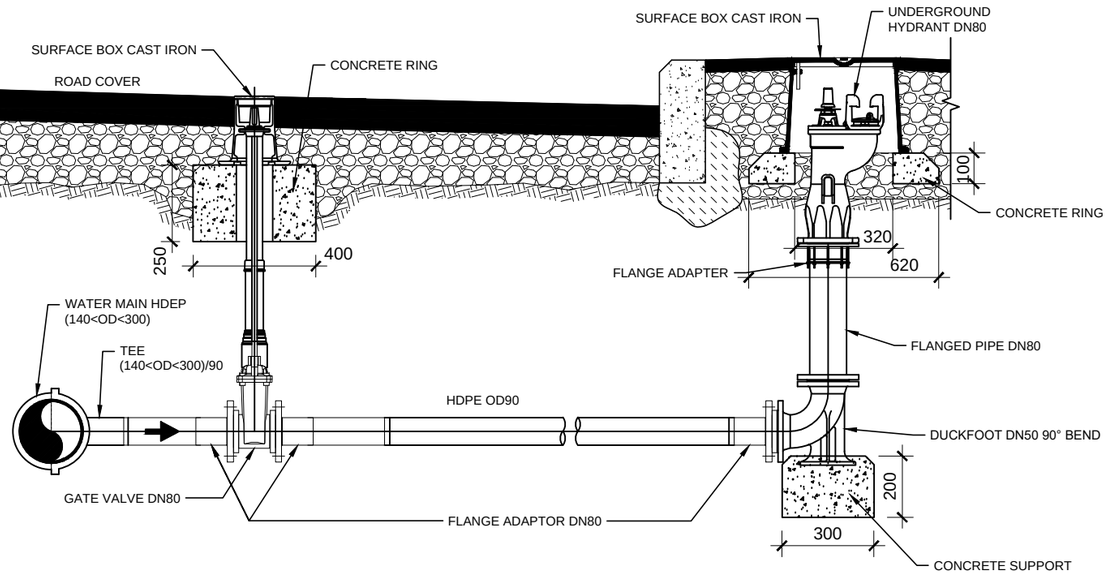
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DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	Approved	2	
DATE:	Jan-2024	3	
SCALE:	1:15	4	
DRAWING No.	TP-5-1	5	



PLAN

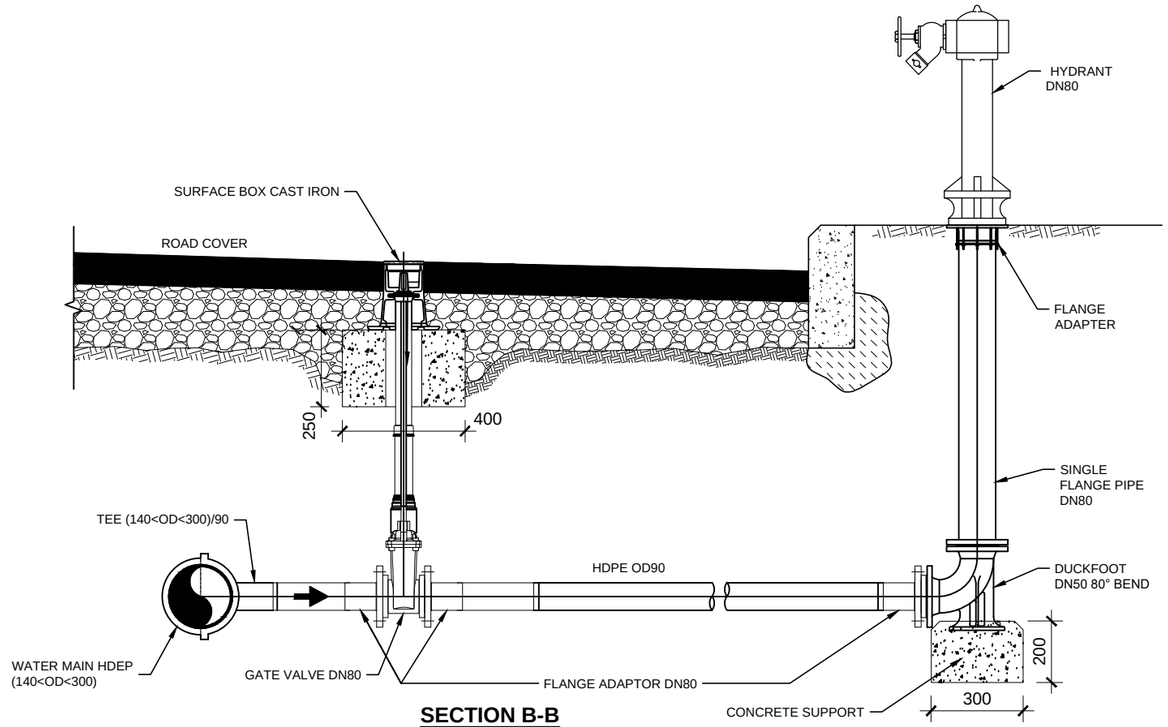


PLAN



SECTION A-A

TYPE 1: HYDRANT UNDERGROUND
UNDERGROUND HYDRANT DN80 - TYPICAL INSTALLATION
CONNECTION NETWORK PIPELINE 140<OD<300



SECTION B-B

TYPE 2: HYDRANT ABOVE GROUND
SIMPLE CONNECTOR STANDBY COLUMN HYDRANT DN80 - TYPICAL
INSTALLATION CONNECTION NETWORK PIPELINE 140<OD<300

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

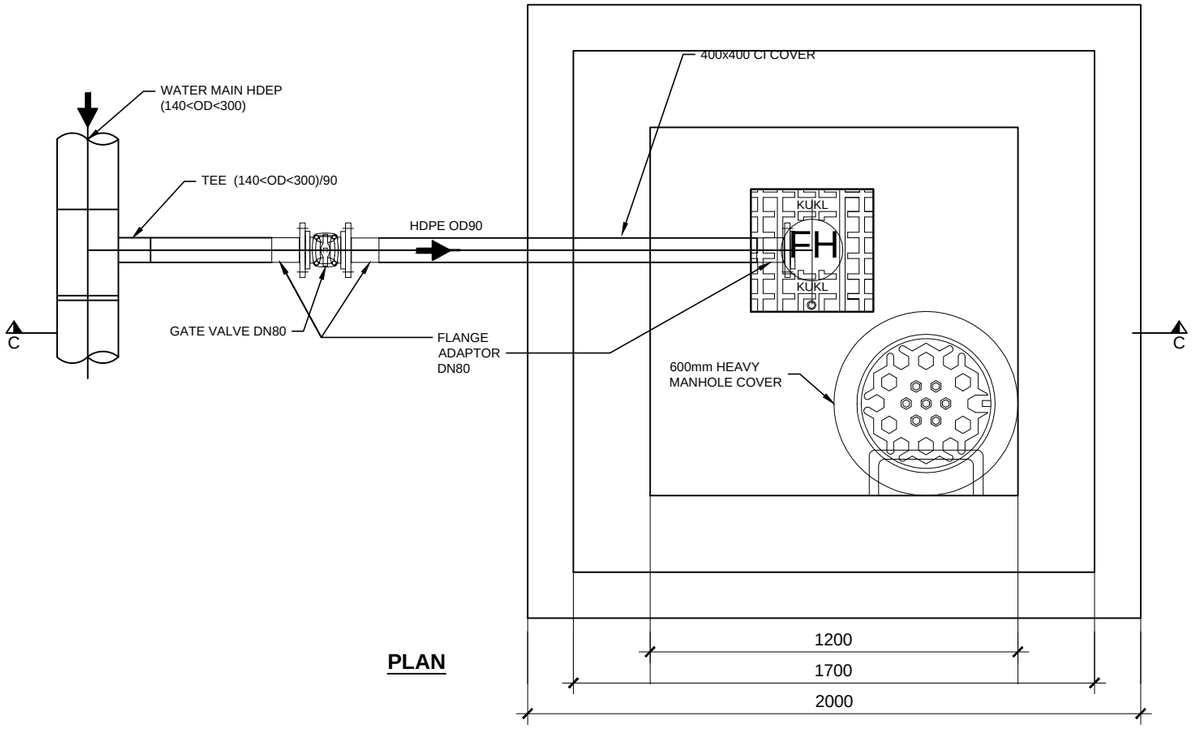
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

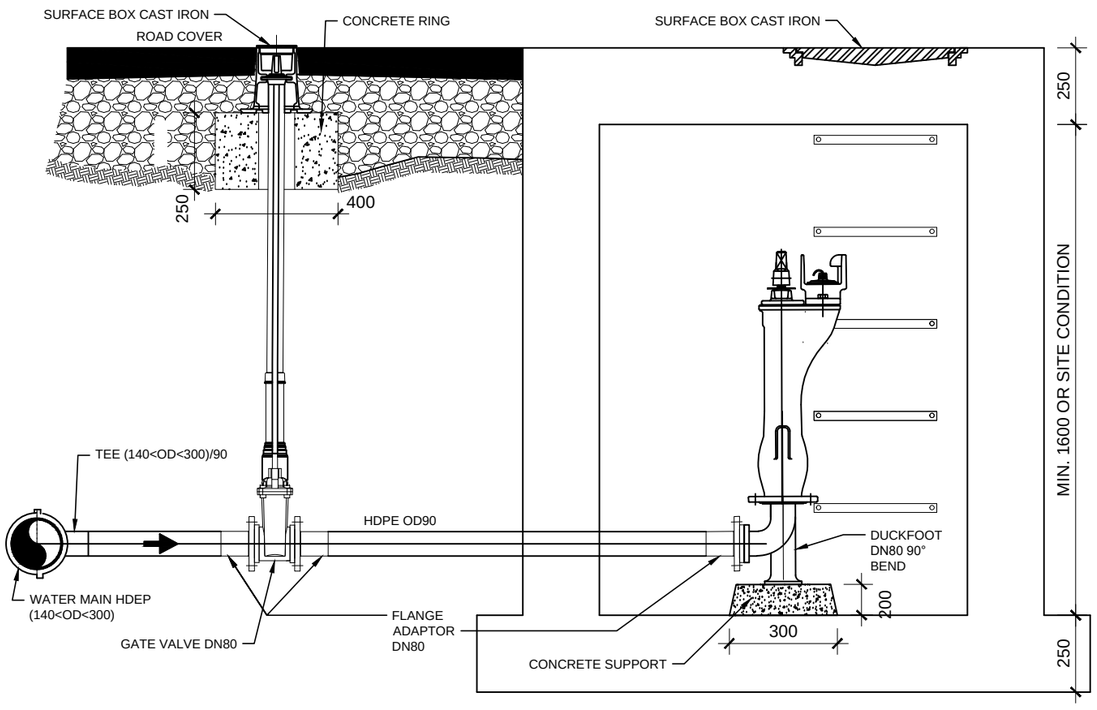
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DRAWING TITLE: HYDRANT DN80 CONNECTIONS
TYPICAL DRAWING
DETAIL DESIGN

		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	Approved	2	
DATE:	Jan-2024	3	
SCALE:	1:20	4	
DRAWING No.	TP-5-2	5	



PLAN



SECTION C-C

TYPE 3: HYDRANT ON CHAMBER UNDERGROUND HYDRANT DN80 - TYPICAL INSTALLATION CONNECTION NETWORK PIPELINE 140<OD<300

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

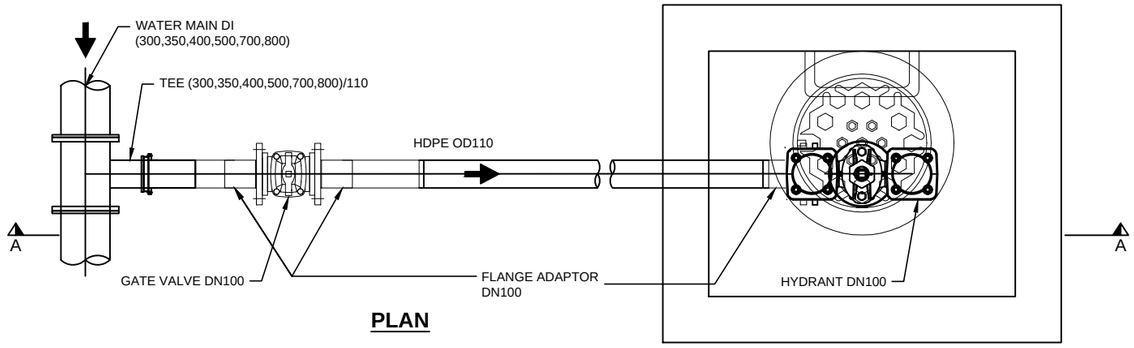
Eptisa-ERMC JV (DSC-07)

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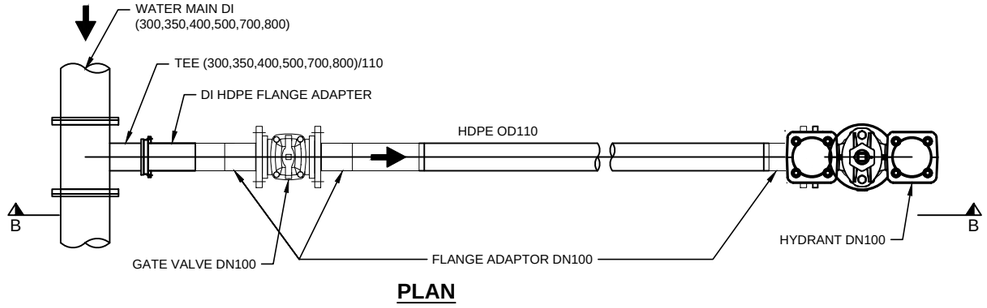
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DRAWING TITLE: HYDRANT DN80 CONNECTIONS
TYPICAL DRAWING
DETAIL DESIGN

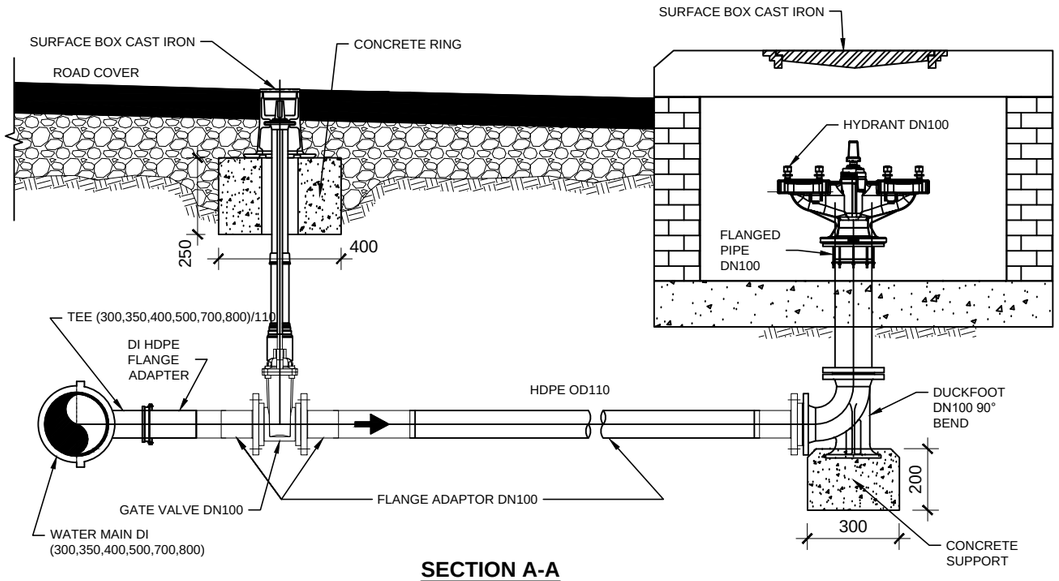
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DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	Approved	2	
DATE:	Jan-2024	3	
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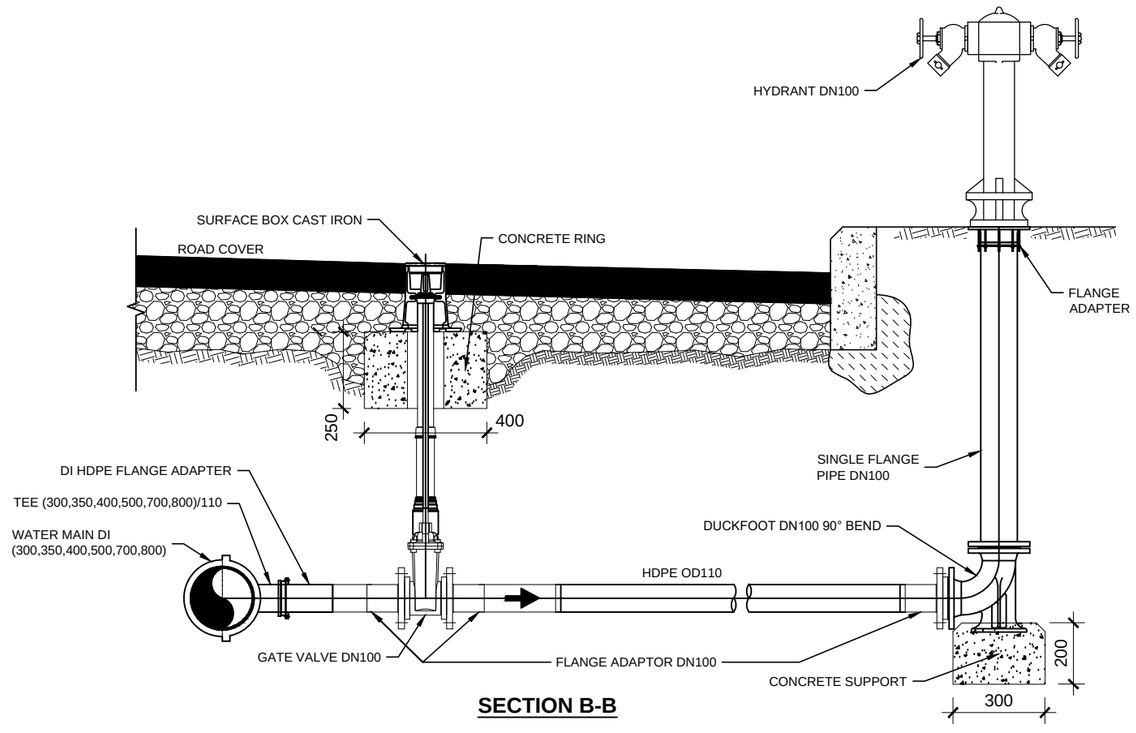
PLAN



PLAN



SECTION A-A



SECTION B-B

TYPE 1: UNDERGROUND HYDRANT

DOUBLE CONNECTOR COLUMN HYDRANT DN100 - TYPICAL INSTALLATION

CONNECTION NETWORK PIPELINE DI (300,350,400,500,700,800)

TYPE 2: HYDRANT ABOVE GROUND

DOUBLE CONNECTOR COLUMN HYDRANT DN100 - TYPICAL INSTALLATION

CONNECTION NETWORK PIPELINE DI (300,350,400,500,700,800)

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

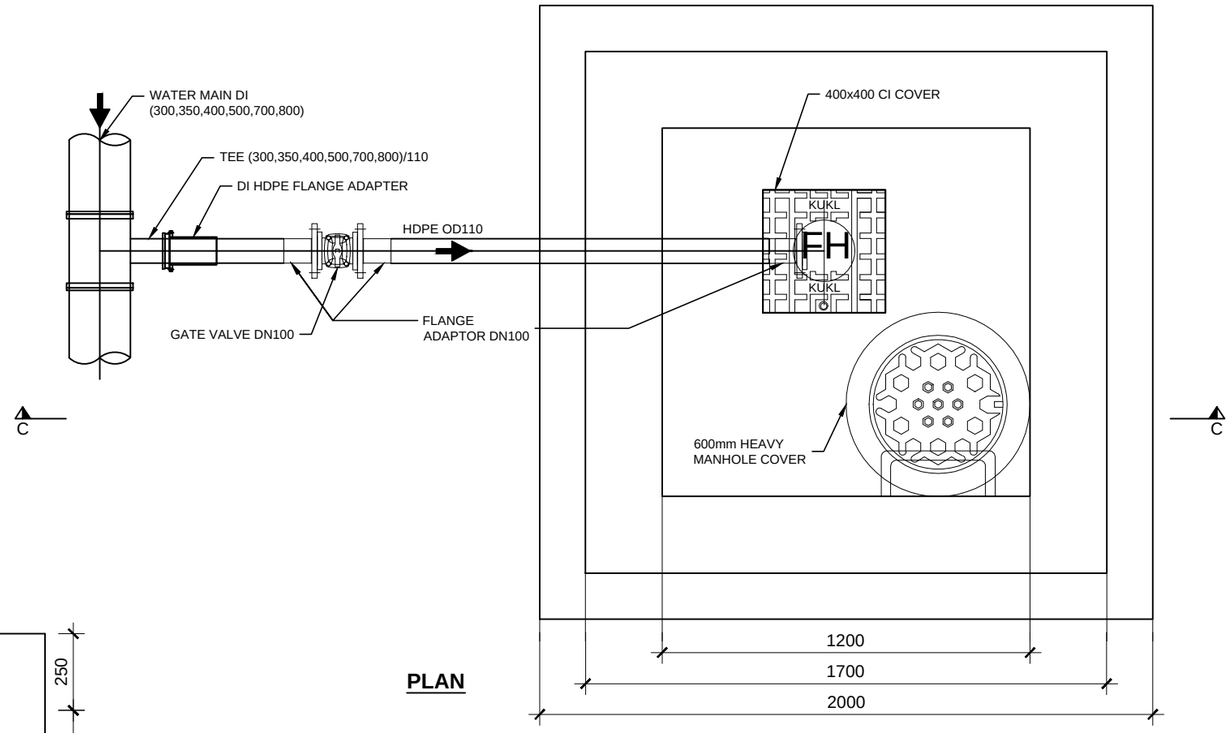
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

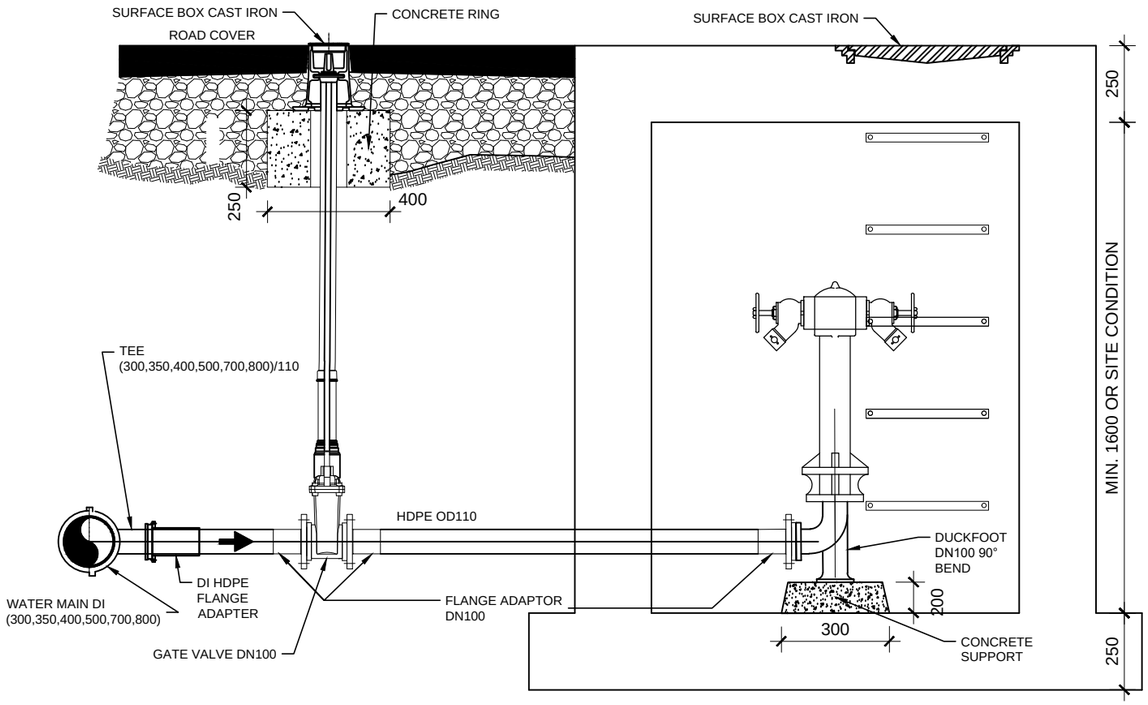
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: HYDRANT DN100 CONNECTIONS
TYPICAL DRAWING
DETAIL DESIGN

		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	Approved	2	
DATE:	Jan-2024	3	
SCALE:	1:20	4	
DRAWING No.	TP-5-4	5	



PLAN



SECTION C-C

TYPE 3: HYDRANT ON CHAMBER

DOUBLE CONNECTOR COLUMN HYDRANT DN100 - TYPICAL INSTALLATION

CONNECTION NETWORK PIPELINE DI (300,350,400,500,700,800)

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

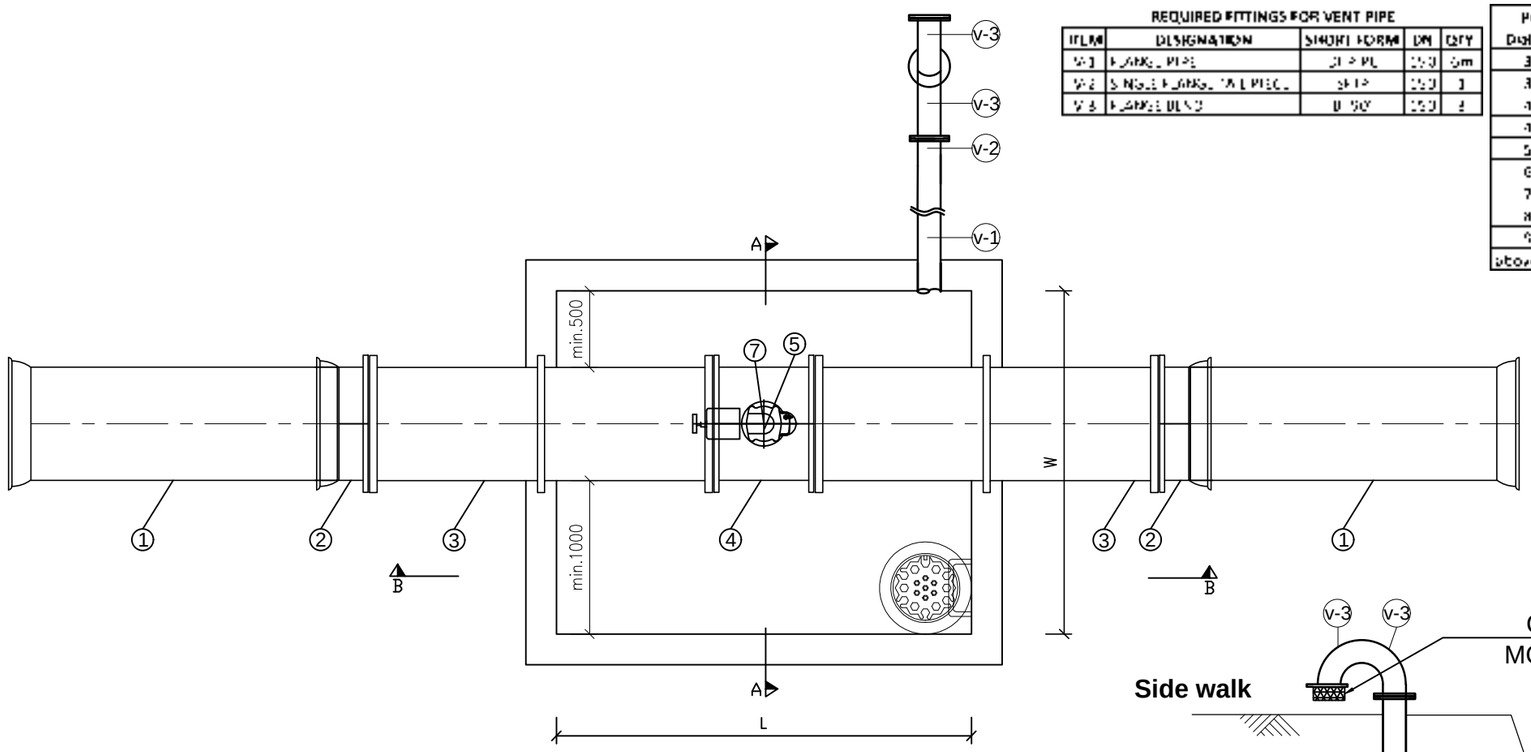
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: HYDRANT DN100 CONNECTIONS
TYPICAL DRAWING
DETAIL DESIGN

		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	Approved	2	
DATE:	Jan-2024	3	
SCALE:	1:20	4	
DRAWING No.	TP-5-5	5	



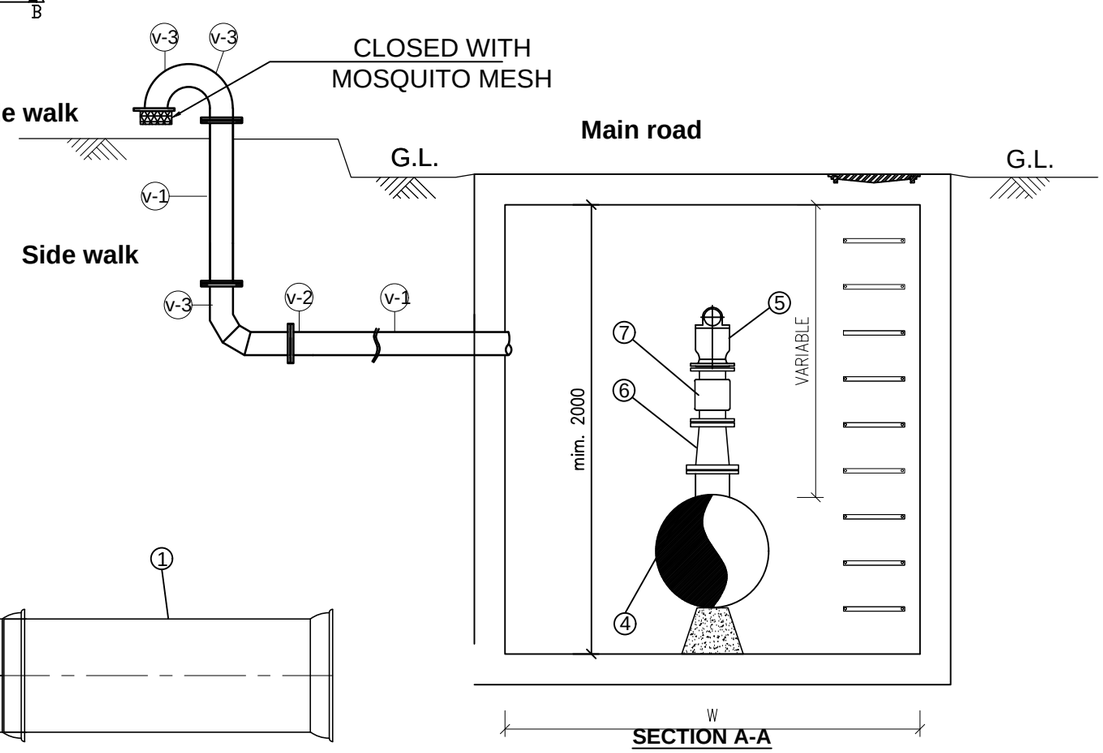
PLAN

REQUIRED FITTINGS FOR VENT PIPE

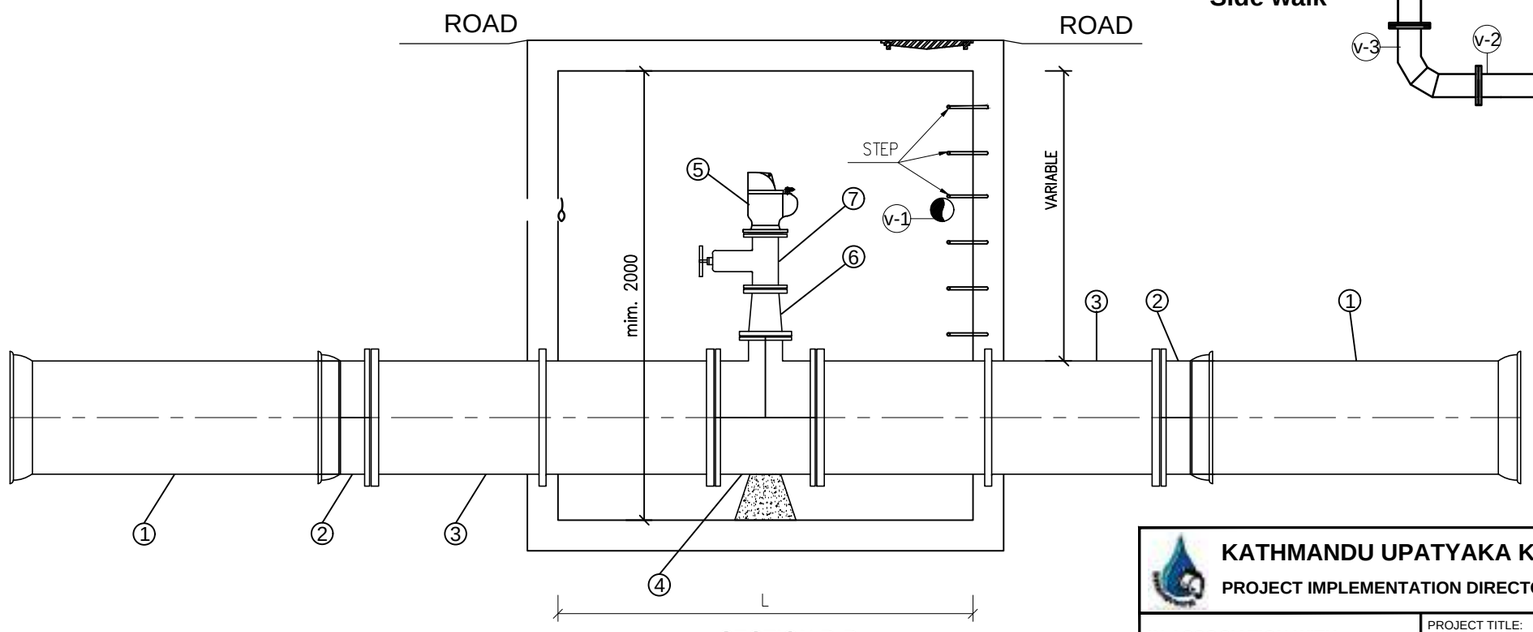
ITEM	DESIGNATION	SHORT FORM	DN	QTY
V-1	FLANGED PIPE	F.F.P.L.	DN	6m
V-2	S.S.NIPPLE FLANGED TAIL PIECE	S.F.T.P.	DN	1
V-3	FLANGED BLIND	B.F.	DN	2

Pipe Dia(mm)	Material	Flanged socket(ID)	Puddle flange(ID)	Length of puddle flange	Tee	Reducer	Gate valve (ID)	Air valve (ID)
300	D	330	300	1000	300/100	100/50	50	50
350	D	550	350	1000	350/80	-	80	80
400	D	430	400	1000	400/80	-	80	80
450	D	450	450	1000	450/80	-	80	80
500	D	530	500	1000	500/100		100	100
600	D	630	600	1000	600/100		100	100
700	D	730	700	1000	700/200	200/150	150	150
800	D	830	800	1000	800/200	200/150	150	150
900	D	930	900	1000	900/200	200/150	150	150
above 1000	D	above 1000	above 1000	1000	1000/200		200	200

ITEM	DESIGNATION
1	DI PIPE DN(300,350,400,500,700,800)
2	FLANGED ADAPTER
3	PUDDLE FLANGE
4	UNEQUAL TEE
5	DOUBLE SOCKET AIR VALVE
6	FLANGED REDUCER
7	FLANGED GATE VALVE
*	LENGTH OF CHAMBER MAY WILL VARY ACCORDING TO PIPE SIZE



SECTION A-A



SECTION B-B

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

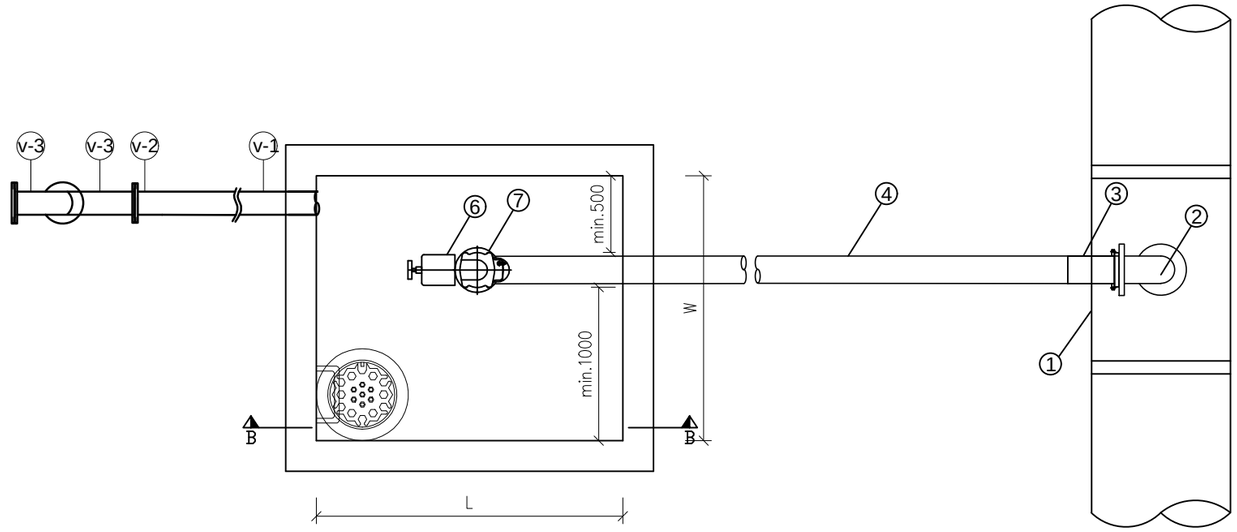
Eptisa-ERMC JV (DSC-07)

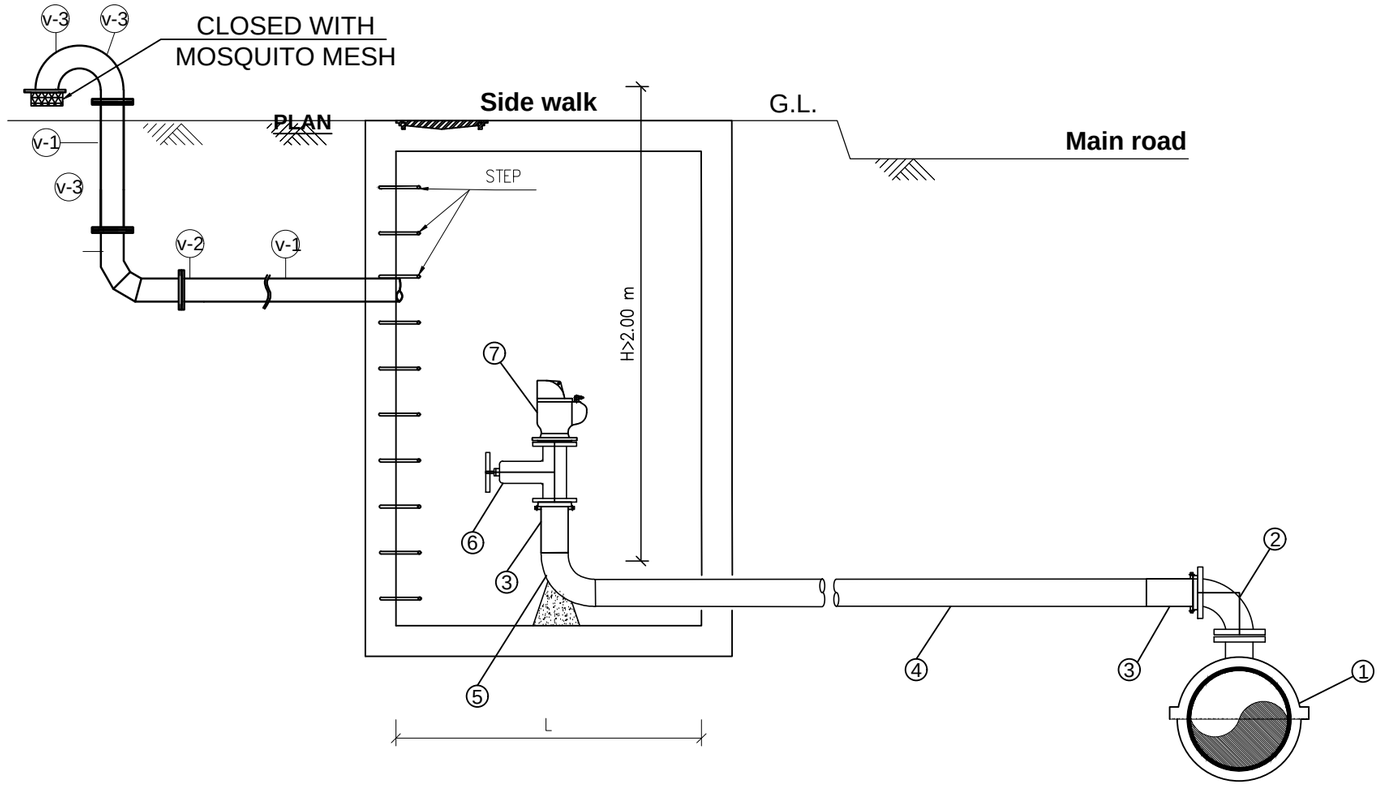
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: AIR RELEASE VALVE TYPE-1 ROAD DETAIL DESIGN

		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAYDES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	TP-6-1	5	





SECTION B-B

ITEM	DESIGNATION
1	UNEQUAL FLANGE TEE
2	90° BEND
3	DI – DPE FLANGE ADAPTER
4	– DPE PIPE
5	ELECTROFUSION BEND
6	FLANGED GATE VALVE
7	DOUBLE AIR VALVE PROVIDING THREE FUNCTION
1	LENGTH OF CHAMBER "L" AS WILL VARY ACCORDING TO PIPE SIZE

Pipe Dia(mm)	Material	Flanged socket(Ø)	Puddle flange(Ø)	Length of puddle flange	Tee	Gate valve Reducer	Gate valve (Ø)	Air valve (Ø)
300	D	530	300	1000	300/100	100/50	50	50
350	D	550	350	1000	350/80	-	80	80
400	D	630	400	1000	400/80	-	80	80
450	D	650	450	1000	450/80	-	80	80
500	D	730	500	1000	500/100		100	100
600	D	830	600	1000	600/100		100	100
700	D	930	700	1000	700/200	200/150	150	150
800	D	1030	800	1000	800/200	200/150	150	150
900	D	1130	900	1000	900/200	200/150	150	150
above 1000	D	above 1100	above 1000	1000	1000/200		200	200

REQUIRED FITTINGS FOR VENT PIPE

ITEM	DESIGNATION	SHORT FORM	DN	QTY
V-1	FLANGE PIPE	DI-F-PL	150	6m
V-2	S.NECK FLANGE (DI) PLUG	S-F-P	150	1
V-3	FLANGE ELBOW	D-90	150	2

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

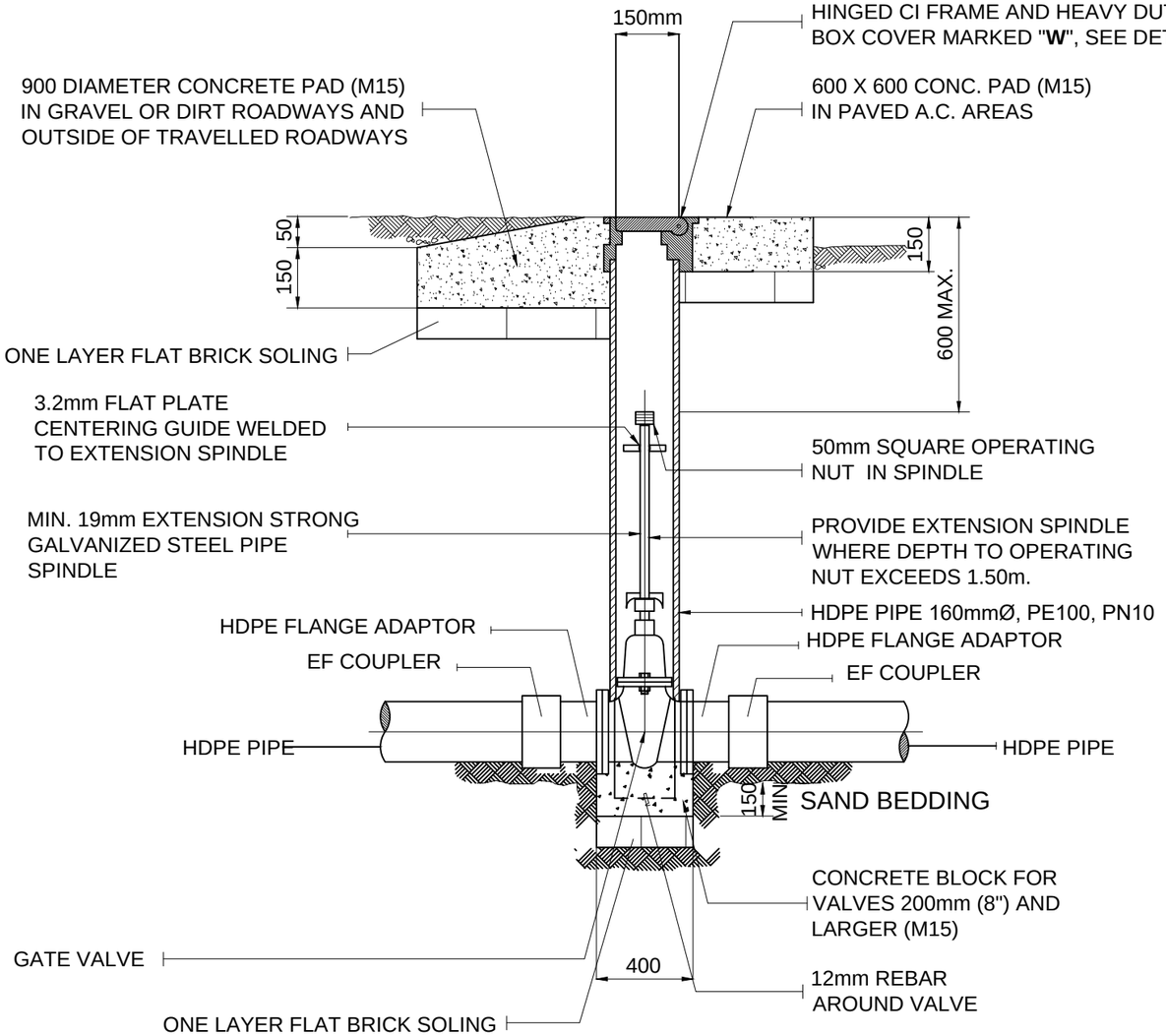
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

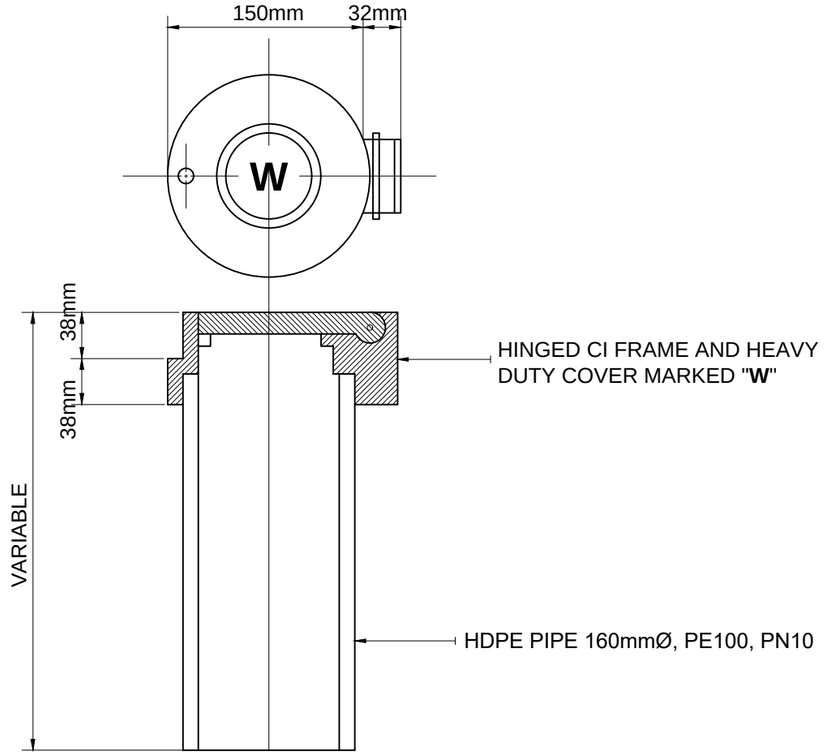
DRAWING TITLE: AIR RELEASE VALVE TYPE-2 SIDEWALK DETAIL DESIGN

		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	TP-6-2	5	



INSTALLATION OF BURIED GATE VALVE FOR HDPE MAINS (Ø50 - Ø315)mm

1



VALVE BOX & COVER DETAIL

2

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

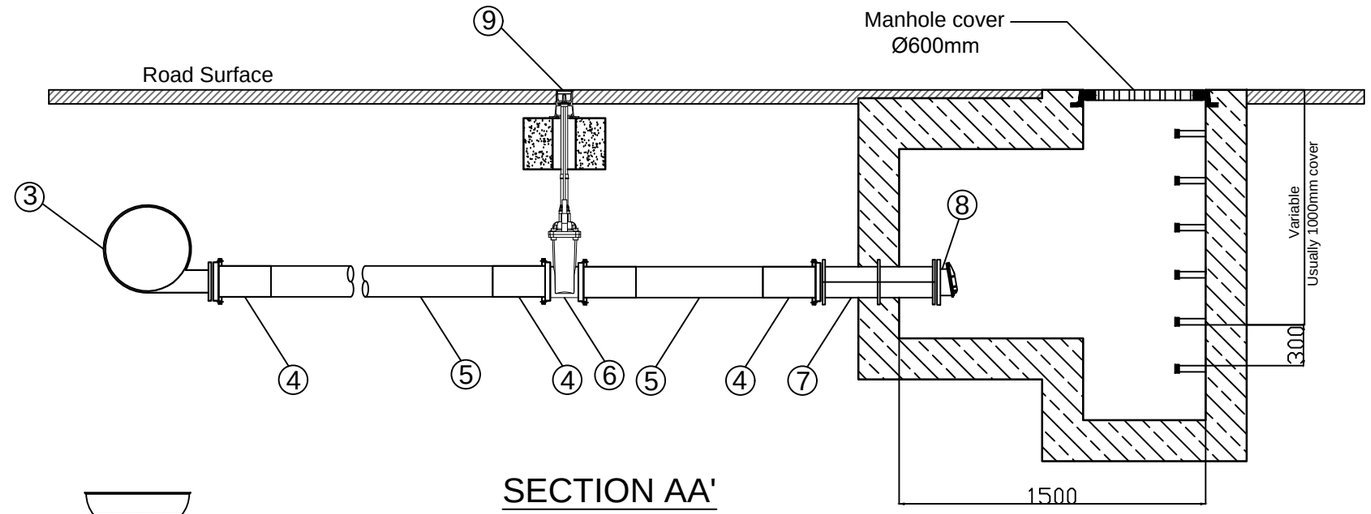
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

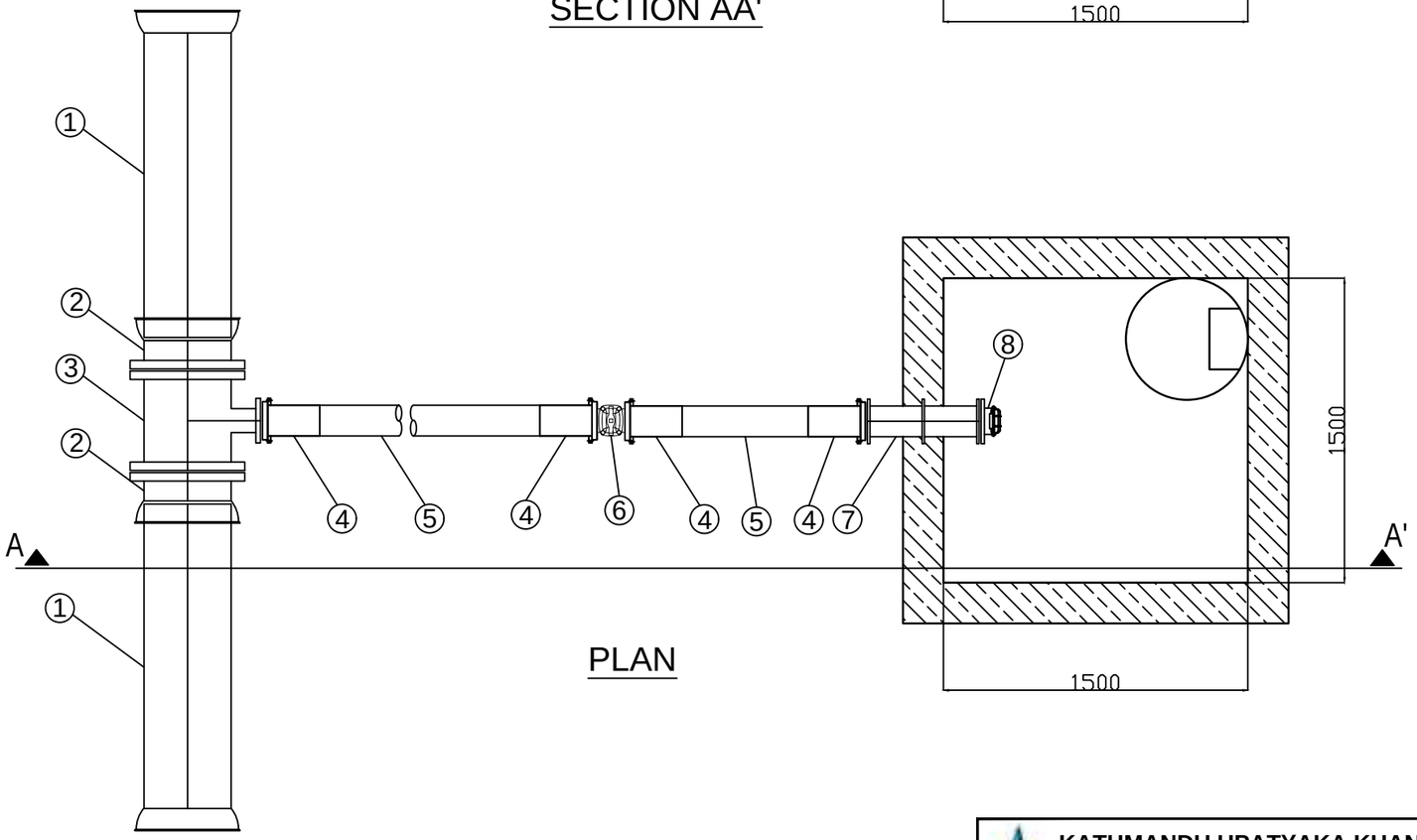
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: UNDERGROUND GATE VALVE FOR HDPE TYPICAL DRAWING DETAILS DESIGN

		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:25	4	
DRAWING No.	TP-7	5	



SECTION AA'



PLAN

ITEM	DESIGNATION
1	D PIPE
2	FLANGE SOCKET RESTRAINED JOINT
3	D TANGENTIAL/INVERT ATTACHMENT
4	FLANGED ADAPTOR
5	HDPE PIPELINE
6	GATE VALVE
7	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE
8	FLANGE MOUNTED FLAP VALVE
9	SURFACE BOX CASTING FOR VALVE

Pipe DN DI	Material	Valve Dia(mm)	Pipe DN HDPE
300	DI	80	90
350	DI	100	110
400	DI	100	110
500	DI	150	160
700	DI	150	160
800	DI	150	160

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

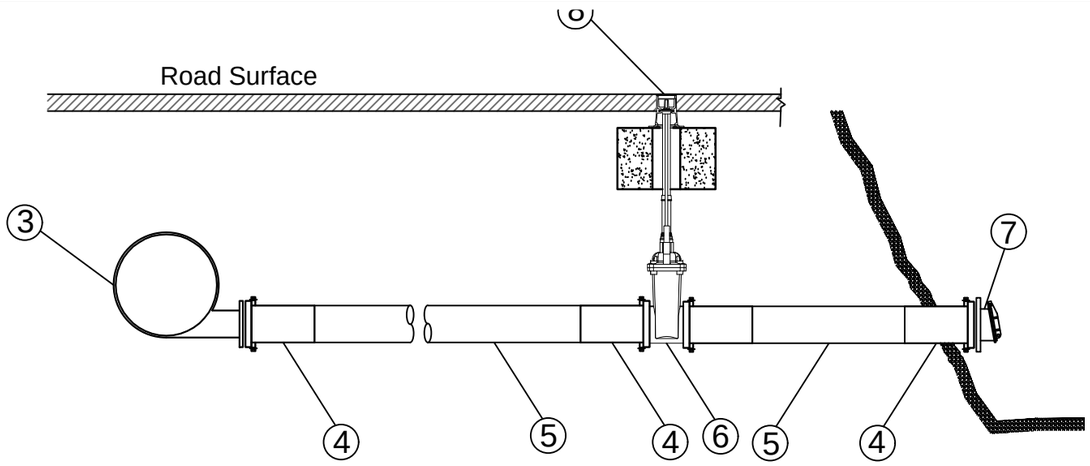
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

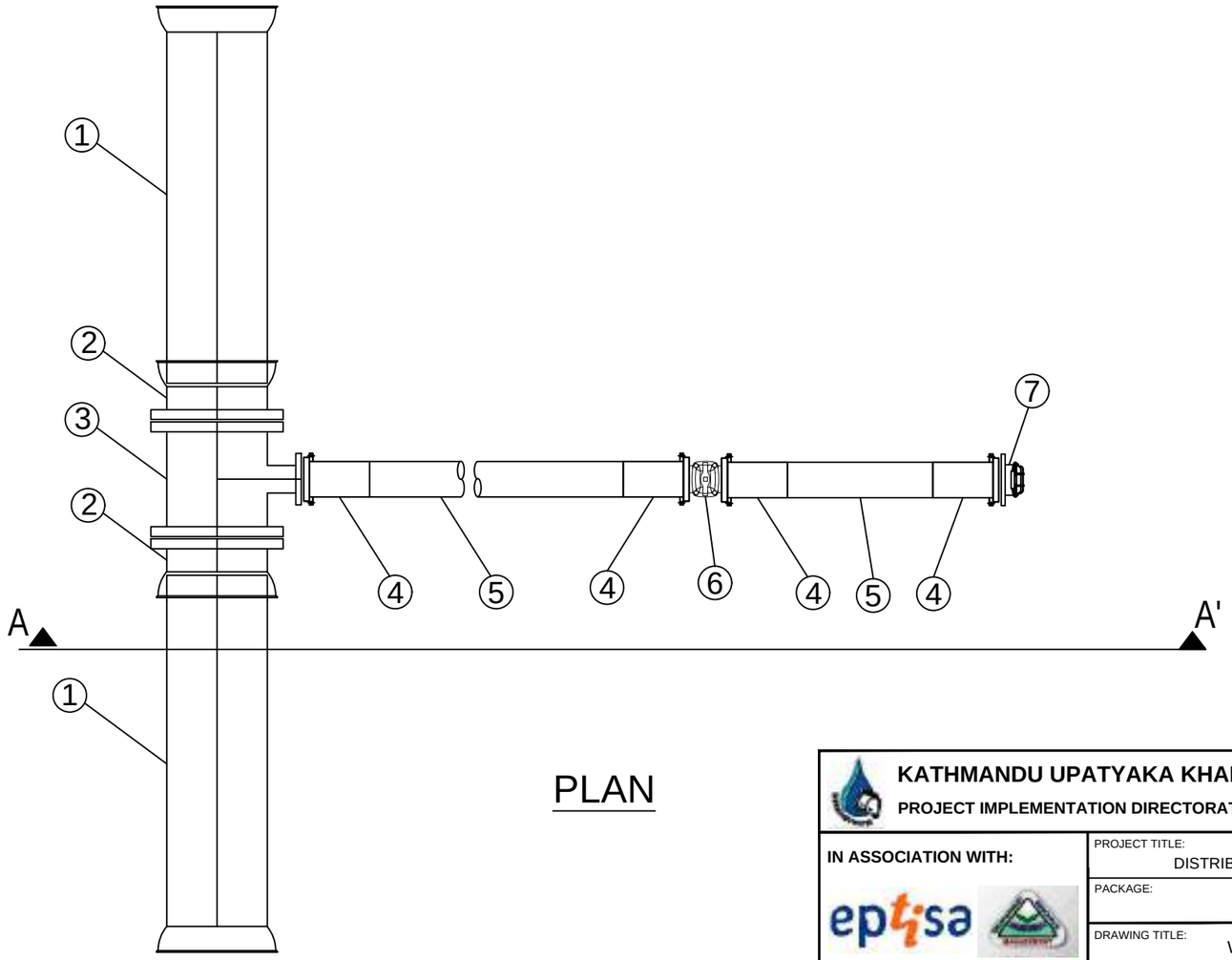
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: WASHOUT ASSEMBLY AT CHAMBER
FLUSH VALVE ASSEMBLY FOR DI PIPE
TYPICAL DRAWING DETAILS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:30	4	
DRAWING No.	TP-8-1	5	



SECTION AA'



PLAN

ITEM	DESIGNATION
1	DI PIPE
2	FLANGE SOCKET RESTRAINED JOINT
3	DI TANGENTIAL/INVERT ALL FLANGE TEE
4	FLANGE ADAPTOR
5	HDPE PIPELINE
6	GATE VALVE
7	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE
8	FLANGE MOUNTED FLAP VALVE
9	SURFACE BOX CAST IRON FOR VALVE

Pipe DN DI	Material	Valve Dia(mm)	Pipe DN HDPE
300	D	80	90
450	D	100	110
400	D	100	110
900	D	150	160
700	D	150	160
800	D	150	160

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

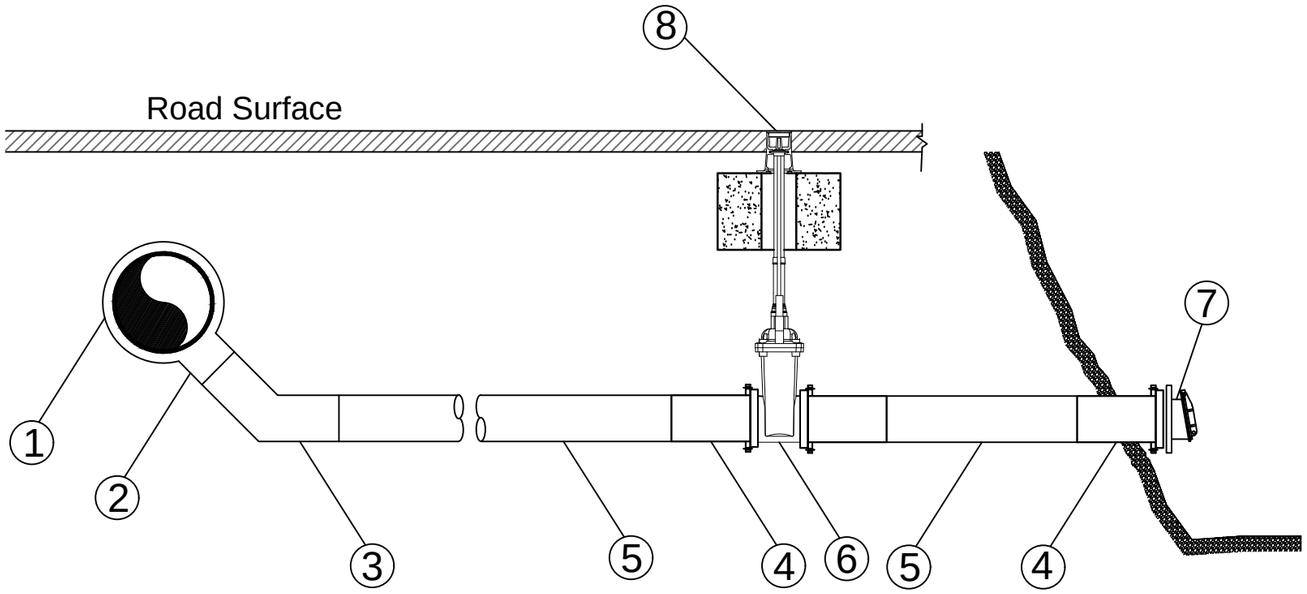
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

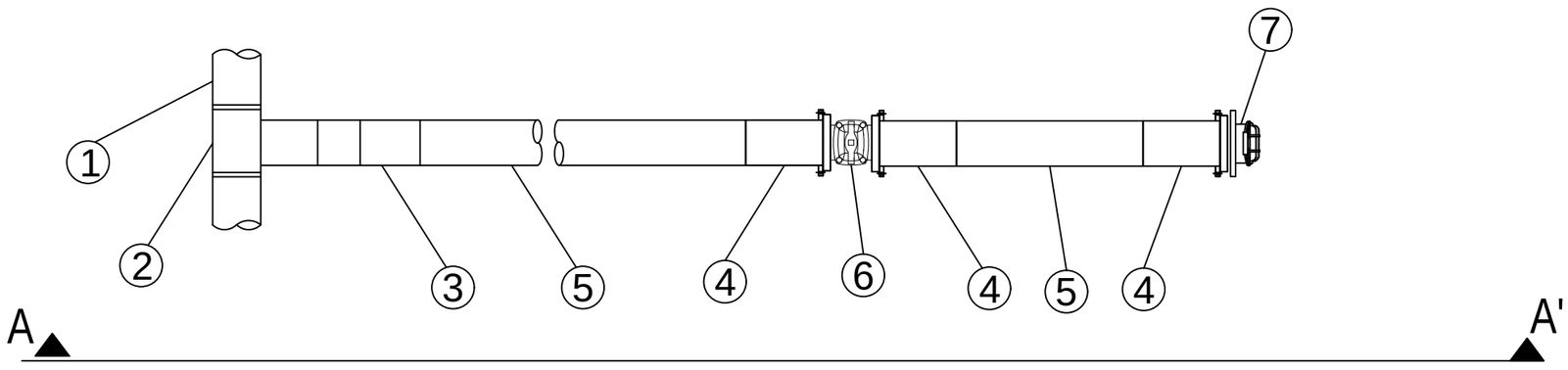
DRAWING TITLE: WASHOUT ASSEMBLY AT RIVER
FLUSH VALVE ASSEMBLY FOR DI PIPE
TYPICAL DRAWING DETAILS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:25	4	
DRAWING No.	TP-8-2	5	



SECTION AA'

ITEM	DESIGNATION	DN (min)
1	HDPE PIPE	90-315
2	ELECTRO-FUSION TEE	(90-315)/50
3	ELECTRO-FUSION 45°BEND	50
4	DI HDPE FLANGED ADAPTOR	50
5	HDPE PIPELINE	50
6	FLANGED GATE VALVE	50
7	FLANGE MOUNTED FLAP VALVE	50
8	SURFACE BOX CAST IRON FOR VALVE	-



PLAN

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

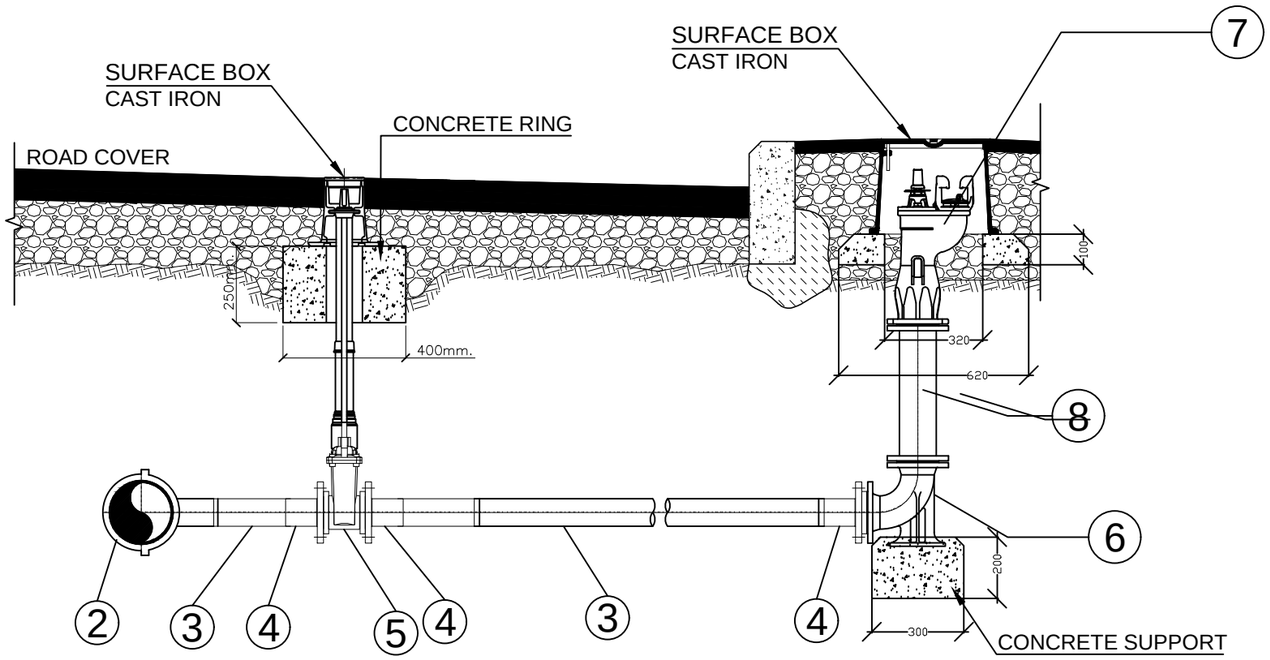
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

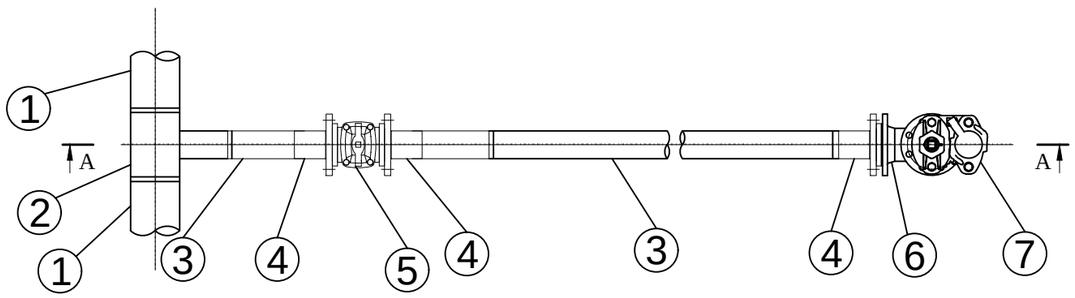
DRAWING TITLE: HDPE WASHOUT ASSEMBLY AT RIVER
FLUSH VALVE ASSEMBLY FOR DI PIPE
TYPICAL DRAWING DETAILS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:20	4	
DRAWING No.	TP-8-3	5	

ITEM	DESIGNATION	DN (mm)
1	HDPE PIPE	90-315
2	ELECTRO FUSION TEE	(90-63)/90
3	ELECTRO-FUSION 45° BEND	50
4	DI HDPE FLANGED ADAPTOR	50
5	HDPE PIPE NIPPLE	50
6	FLANGED GATE VALVE	50
7	FLANGE MOUNTED FLAP VALVE	50
8	SURFACE BOX CAST IRON FOR VALVE	



SECTION A-A



PLAN

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

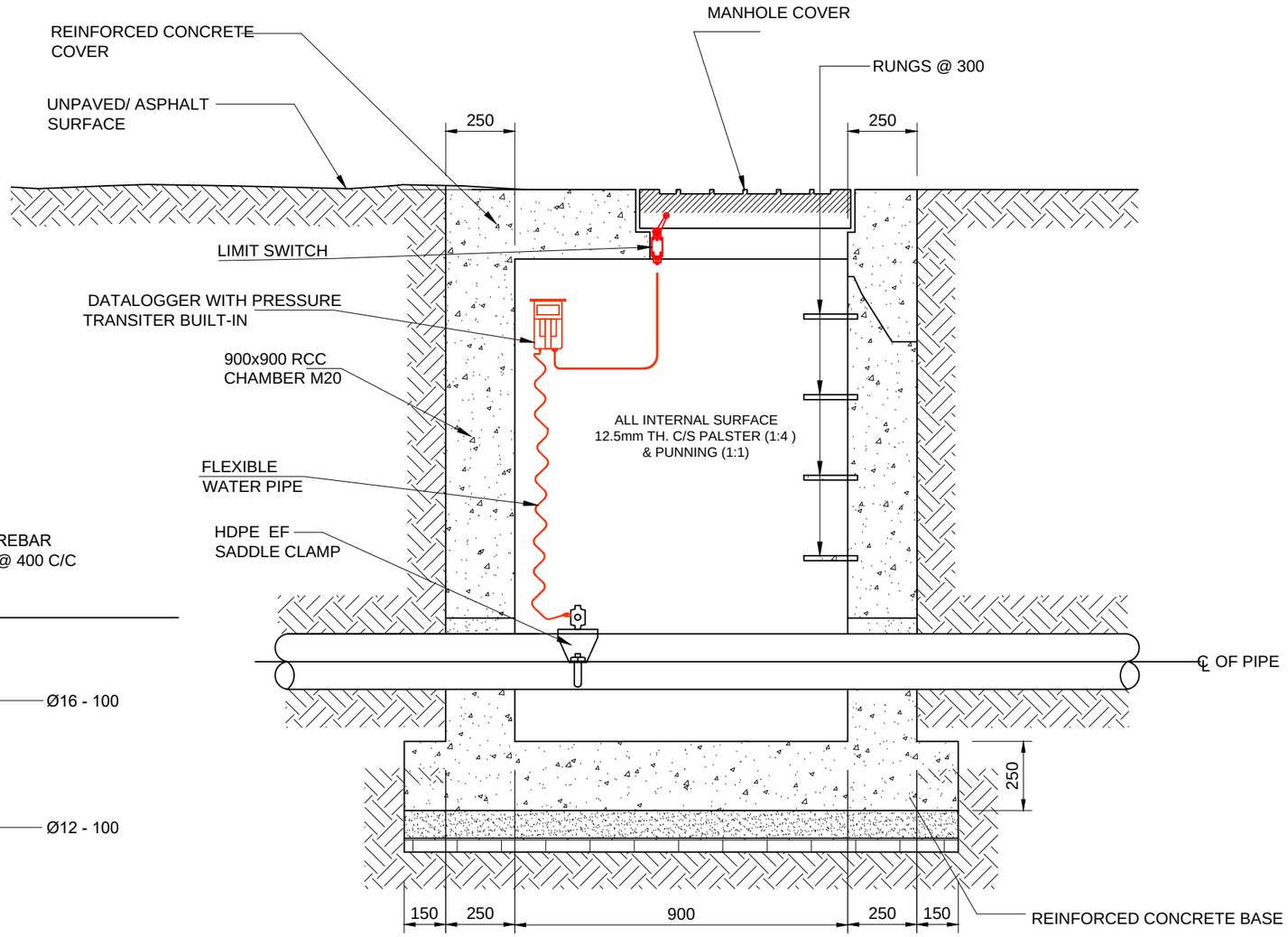
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: WASHOUT DISCHARGE AT HYDRANT
FLUSH VALVE ASSEMBLY FOR DI PIPE
TYPICAL DRAWING DETAILS

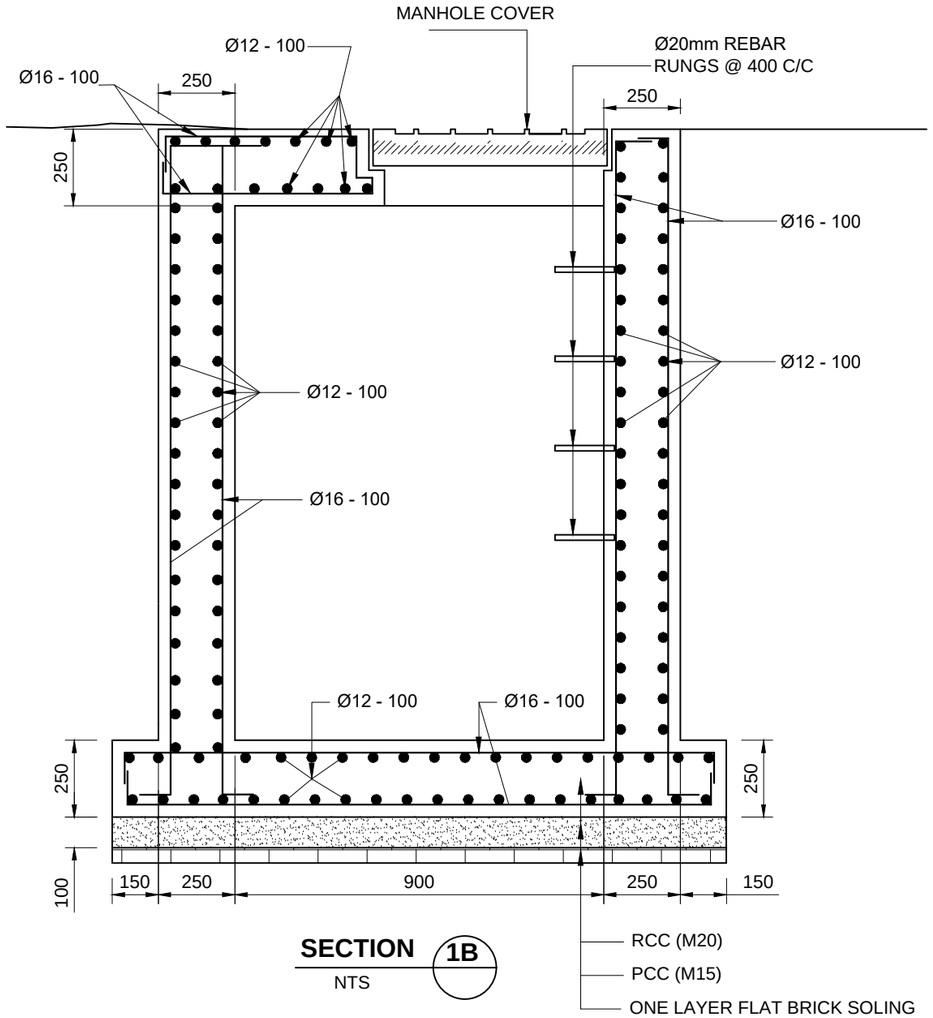
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DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BERMÚDES	2	
DATE:	Jan-2024	3	
SCALE:	1:20	4	
DRAWING No.	TP-8-4	5	

NOTES:

1. THE PRESSURE POINT WILL BE INSTALLED WHENEVER POSSIBLE IN A NEARBY DMA CHAMBER, WASHOUT, OR HYDRANT. IF THERE IS NO NEARBY CHAMBER, A NEW CHAMBER SHOULD BE CONSTRUCTED ACCORDING TO THIS DRAWING.
2. ALL CONCRETE SHALL BE CLASS M20 UNLESS OTHERWISE SPECIFIED



SECTION 1A
NTS



SECTION 1B
NTS

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

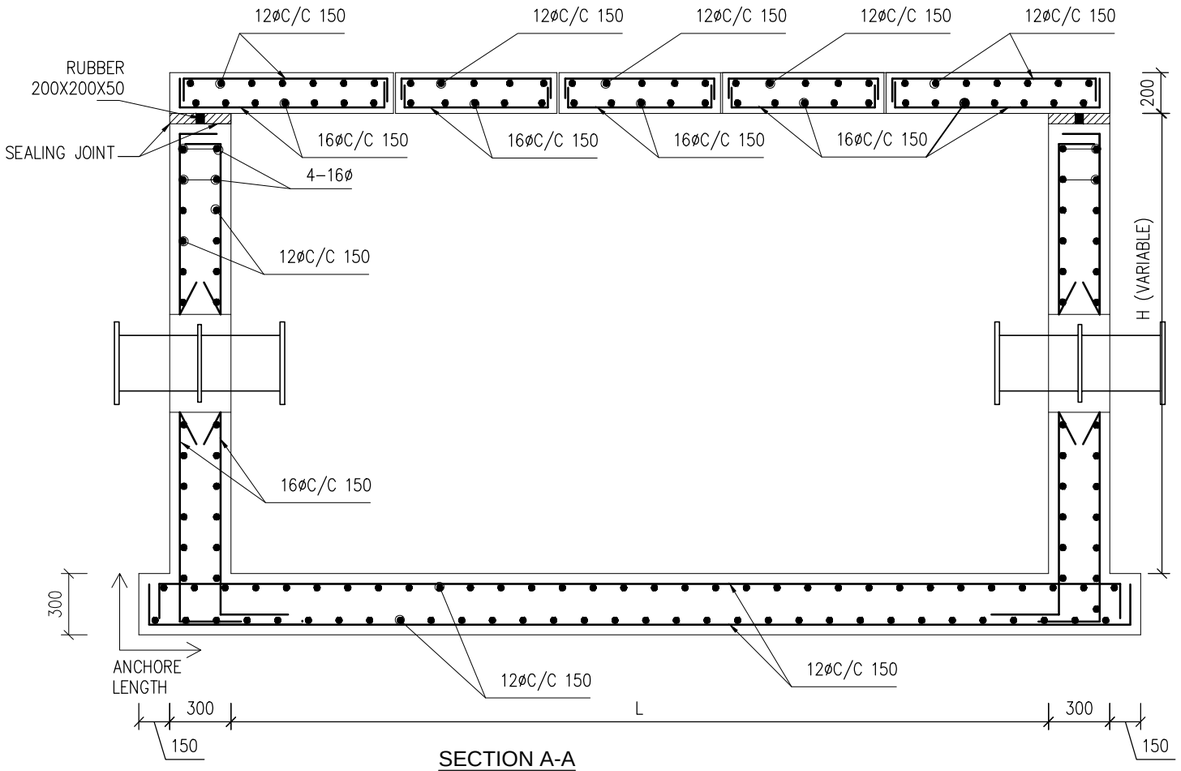
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

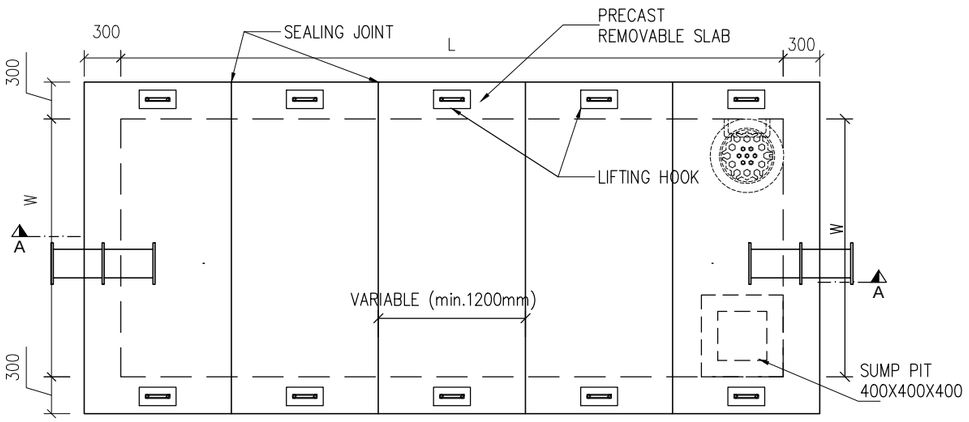
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: PRESSURE TEST POINT & REINFORCEMENT DETAILS TYPICAL DRAWING

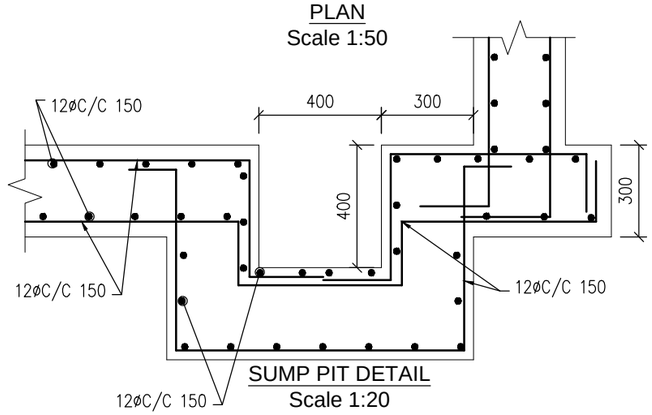
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DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRETE	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:20	4	
DRAWING No.	TP-9	5	



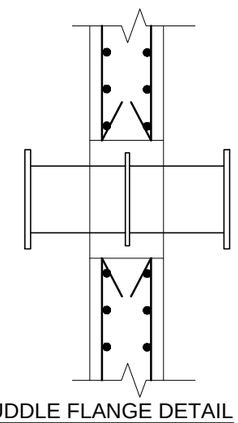
SECTION A-A
Scale 1:30



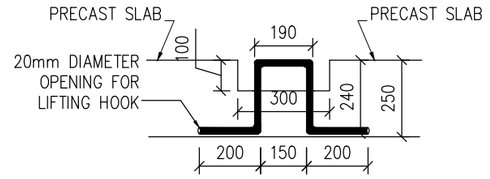
PLAN
Scale 1:50



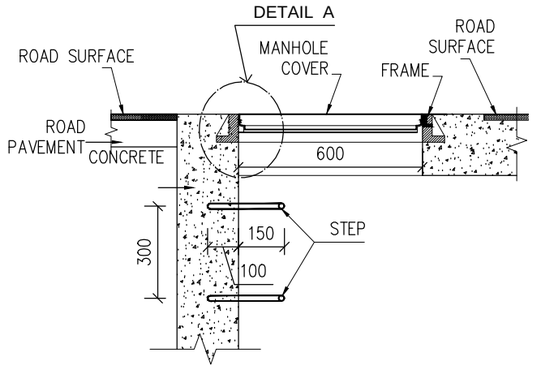
SUMP PIT DETAIL
Scale 1:20



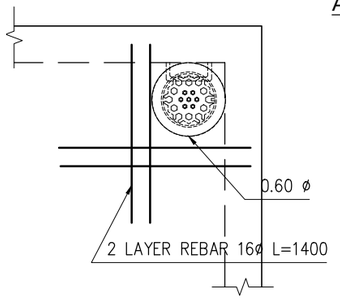
PUDDLE FLANGE DETAIL
Scale 1:25



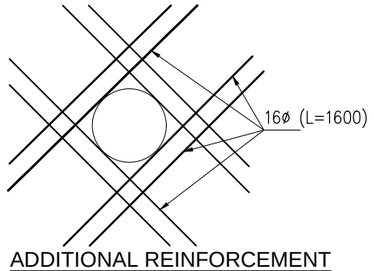
FIXED LIFTING HOOK
SCALE 1:20



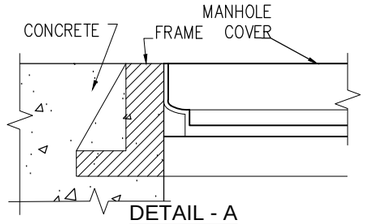
DETAIL OF MANHOLE COVER
SCALE 1:20



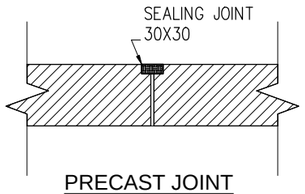
MANHOLE COVER
Scale 1:50



ADDITIONAL REINFORCEMENT
PUDDLE FLANGE
Scale 1:50



DETAIL - A
SCALE 1:5



PRECAST JOINT
Scale 1:20

GENERAL NOTE:

1. STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH RELEVANT ARCHITECTURAL AND SERVICES DRAWINGS.
2. UNLESS SPECIFIED OTHERWISE, ALL LEVELS SHOWN IN STRUCTURAL DRAWINGS ARE STRUCTURAL LEVELS ONLY.
3. DO NOT SCALE FOLLOW WRITTEN DIMENSION ONLY
4. ALL DIMENSION & LEVEL ARE IN MILLIMETERS UNLESS NOTED OTHERWISE. ALL DIMENSION TO BE VERIFIED ON SITE & APPROVED BY THE ENGINEER
5. GRADE OF CONCRETE MIX SHALL BE M-20 CONFORMING TO IS:456-2000. CONFORMING TO IS:456-2000.
6. REINFORCEMENT SHALL BE HIGH STRENGTH DEFORMED BARS OF GRADE Fe:500D CONFORMING IS 1786:2008
7. CLEAR COVER TO BARS
   a. FOR CONCRETE MEMBERS IN CONTACT WITH SOIL = 50mm
   b. FOR LONGITUDINAL (VERTICAL) BARS IN COLUMN, WALL = 50mm
   c. FOR OUTER BARS IN SLAB = 25mm
9. DEVELOPMENT / LAP LENGTH (Ld.) FOR BARS.

BAR DIA (mm)	8	10	12	16	20	25
FOR M25 Ld(mm)	400	500	600	800	1000	1250

10. MANHOLE SAFETY STEPS WITH STEEL REINFORCED ROD DIA 12 mm INJECTION MOLDED OF TOUGH COPOLYMER POLYPROPYLENE COVER, SPACING OF 300MM.

TABLE OF CHAMBER WITH DIMENTION

ITEM	CHAMBER	L	W	NOS.	REMARKS
1	OMU-1	3122	1950	1	
2	DMA	4270	1250	2	
3	DMA	3674	1250	1	
4	OMU-2	2550	1800	1	
5	DMA	4674	1800	2	
6	OMU-3	4430	1800	1	
7	DMA	4674	1250	2	
8	OMU-4	4430	1800	1	
9	DMA	4674	1250	1	
10	DMA	4270	1250	1	
11	OMU-5	3122	1800	1	
12	DMA	3674	1250	2	
13	DMA	4910	1250	1	
14	OMU-6	2930	1800	1	
15	DMA	3674	1250	3	
16	OMU-7	3122	1950	1	
17	DMA	4270	1250	1	
18	DMA	3674	1250	2	

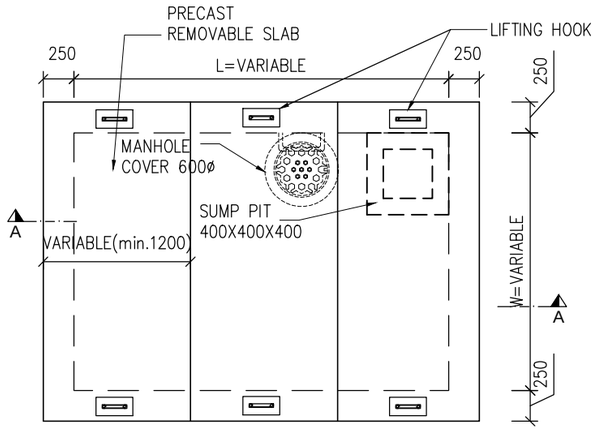
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

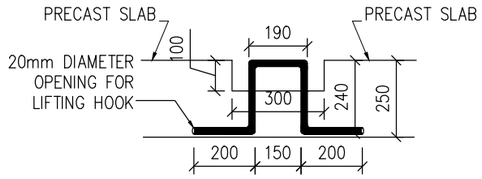
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: OMU AND DMA CHAMBER TYPICAL DRAWING STRUCTURAL DETAILS

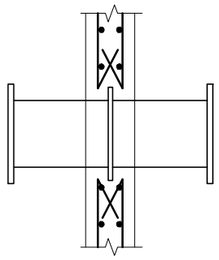
		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M.NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	INDICATED	4	
DRAWING No.	TP-10	5	



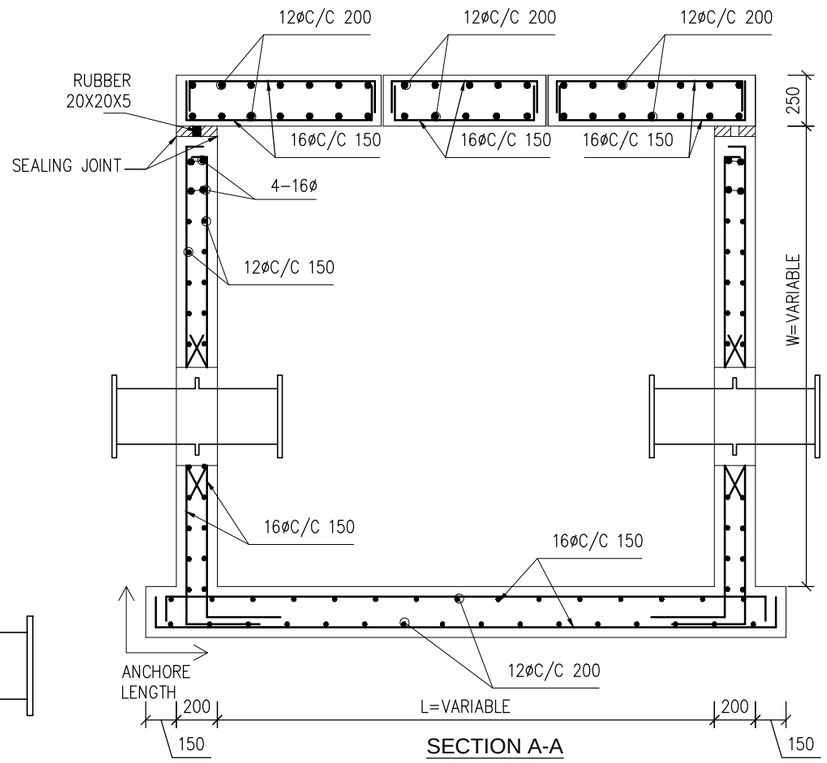
PLAN
Scale 1:50



FIXED LIFTING HOOK
SCALE 1:20



PUDDLE FLANGE DETAIL
Scale 1:25



SECTION A-A
Scale 1:50

GENERAL NOTE:

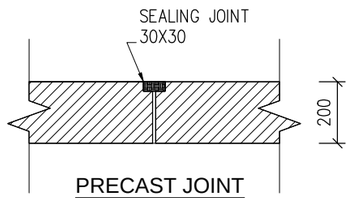
1. STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH RELEVANT ARCHITECTURAL AND SERVICES DRAWINGS.
2. UNLESS SPECIFIED OTHERWISE, ALL LEVELS SHOWN IN STRUCTURAL DRAWINGS ARE STRUCTURAL LEVELS ONLY.
3. DO NOT SCALE FOLLOW WRITTEN DIMENSION ONLY
4. ALL DIMENSION & LEVEL ARE IN MILLIMETERS UNLESS NOTED OTHERWISE. ALL DIMENSION TO BE VERIFIED ON SITE & APPROVED BY THE ENGINEER
5. GRADE OF CONCRETE MIX SHALL BE M-20 CONFORMING TO IS:456-2000. CONFORMING TO IS:456-2000.
6. REINFORCEMENT SHALL BE HIGH STRENGTH DEFORMED BARS OF GRADE Fe:500D CONFORMING IS 1786:2008
7. CLEAR COVER TO BARS
   a. FOR CONCRETE MEMBERS IN CONTACT WITH SOIL = 50mm
   b. FOR LONGITUDINAL (VERTICAL) BARS IN COLUMN, WALL = 50mm
   c. FOR OUTER BARS IN SLAB = 25mm
9. DEVELOPMENT / LAP LENGTH (Ld.) FOR BARS.

BAR DIA (mm)	8	10	12	16	20	25
FOR M25 Ld(mm)	400	500	600	800	1000	1250

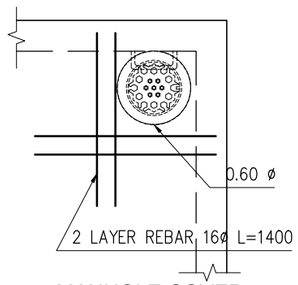
10. MANHOLE SAFETY STEPS WITH STEEL REINFORCED ROD DIA 12 mm INJECTION MOLDED OF TOUGH COPOLYMER POLYPROPYLENE COVER, SPACING OF 300MM.

TABLE OF CHAMBER WITH DIMENTION

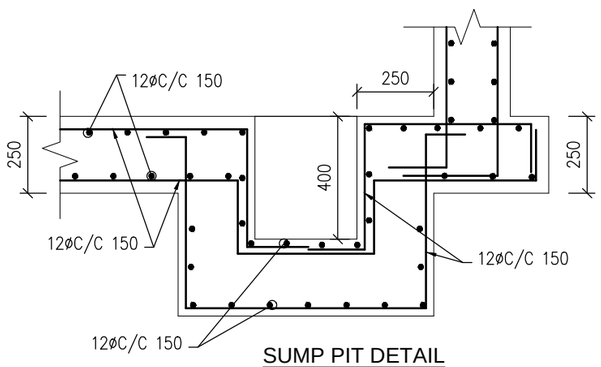
ITEM	CHAMBER	DIA(ø)	L	W	REMARKS
1	BUTTERFLY VALVE	800	1900	2200	
		700	1900	2200	
		600	1600	2000	
		400	1700	1800	
		450	1700	1800	
		400	1700	1800	
2	WASHOUT VALVE	900 500	2200	2100	
		400 300	2000	1900	
3	AIR RELEASE VALVE (TYPE-1)	675 280 HUPF	2000	1700	
		900 500	2400	2400	
		400 300	1900	1900	
4	AIR RELEASE VALVE (TYPE 2)	900 300	1500	1500	
5	UNDER GROUND HYDRANT	900 500	1700	1700	
		400 300	1700	1700	



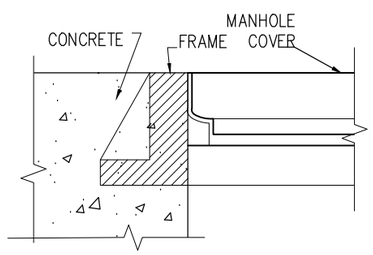
PRECAST JOINT
Scale 1:20



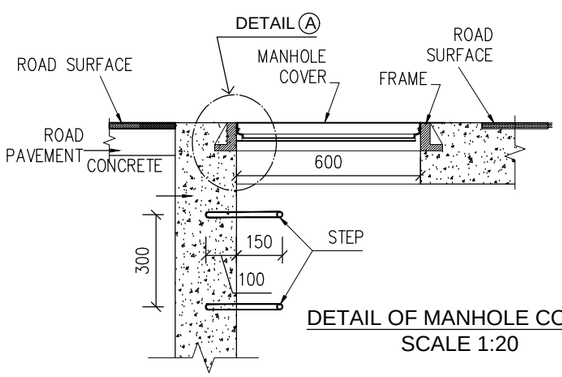
MANHOLE COVER
Scale 1:50



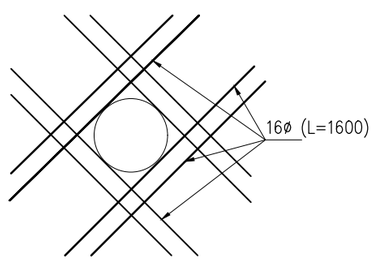
SUMP PIT DETAIL
Scale 1:20



DETAIL - A
SCALE 1:5



DETAIL OF MANHOLE COVER
SCALE 1:20



ADDITIONAL REINFORCEMENT
PUDDLE FLANGE
Scale 1:50

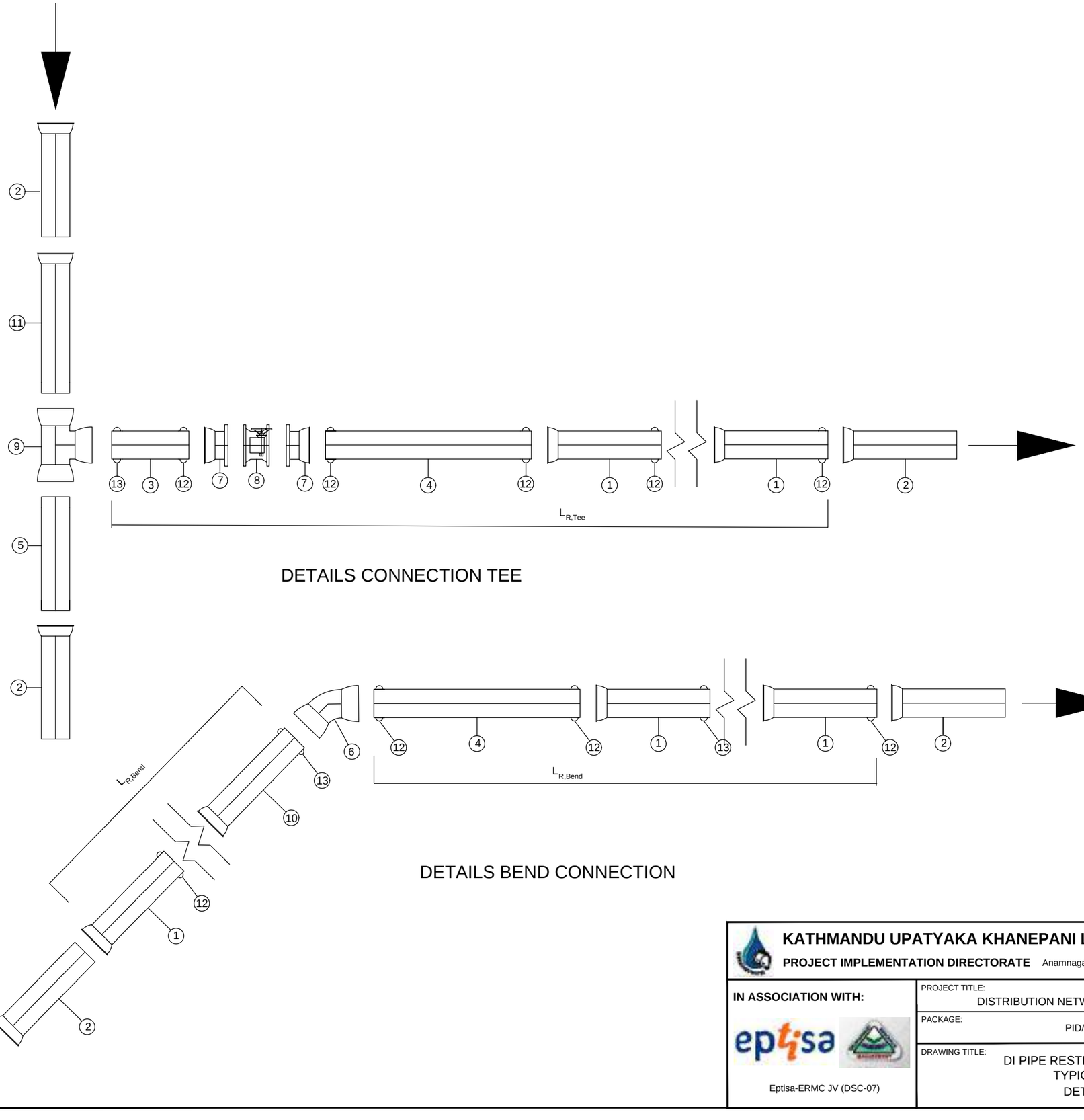
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: GENERAL CHAMBER TYPICAL DRAWING STRUCTURAL DETAILS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J.M.NAVARRO	1	
APPROVED:	M.BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	INDICATED	4	
DRAWING No.	TP-11	5	



DETAILS CONNECTION TEE

DETAILS BEND CONNECTION

Total Restrained Length								
			$L_{R,Bend}$				$L_{R,Tee}$	$L_{R,Tee}$
Diameter	Operating Pressure	P (Test Pressure)	ΦD				Dead End	Tees
			90°	45°	22.5°	11.25°		
200	8	12	27.5	16.5	11	5.5	66	11
	6	9	22	11	5.5	5.5	49.5	5.5
	4	6	16.5	11	5.5	5.5	38	5.5
250	8	12	33	16.5	11	5.5	77	16.5
	6	9	22	11	5.5	5.5	60.5	11
	4	6	16.5	11	5.5	5.5	24.5	5.5
400	8	12	33	16.5	11	5.5	88	27.5
	6	9	27.5	11	5.5	5.5	66	16.5
	4	6	16.5	11	5.5	5.5	49.5	11
450	8	12	38.5	16.5	11	5.5	93.5	33.5
	6	9	27.5	11	5.5	5.5	66	22
	4	6	22	11	5.5	5.5	49.5	11
500	8	12	38.5	16.5	11	5.5	93.5	38.5
	6	9	27.5	16.5	5.5	5.5	77	27.5
	4	6	22	11	5.5	5.5	49.5	22
600	8	12	44	16.5	11	5.5	110	60.5
	6	9	33	16.5	11	5.5	82.5	44
	4	6	22	11	5.5	5.5	55	27.5
700	8	12	44	22	11	5.5	115.5	82.5
	6	9	33	16.5	11	5.5	88	60.5
	4	6	22	11	5.5	5.5	60.5	38.5
800	8	12	49.5	22	11	5.5	132	115.5
	6	9	38.5	16.5	11	5.5	99	93.5
	4	6	27.5	11	5.5	5.5	66	66

ITEM	DESIGNATION
1	SOCKET SPIGOT PLAIN END DUCTILE IRON PIPE WITH WELD BEAD
2	SOCKET SPIGOT STANDARD DI PIPE
3	DOUBLE SPIGOT RESTRAINED PIECE (*)
4	DOUBLE SPIGOT RESTRAINED PIPE LENGTH
5	DOUBLE SPIGOT DI PIPE LENGTH
6	DOUBLE SOCKET BUSHING END PIECE
7	RESTRAINED FLANGED SOCKET
8	BUTTERFLY VALVE
9	SOCKET RESTRAINED TEE
10	SOCKET SPIGOT PLAIN END PIPE WITH WELD BEAD CUT TO LENGTH
11	SOCKET SPIGOT STANDARD PIPE CUT TO ADJUST
12	WELD BEAD FROM MANUFACTURER
13	WELD BEAD ON S TEE

(*) ONE END WELD BEAD FROM MANUFACTURER, OTHER END FIELD WELDED TO ADJUST LENGTH

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

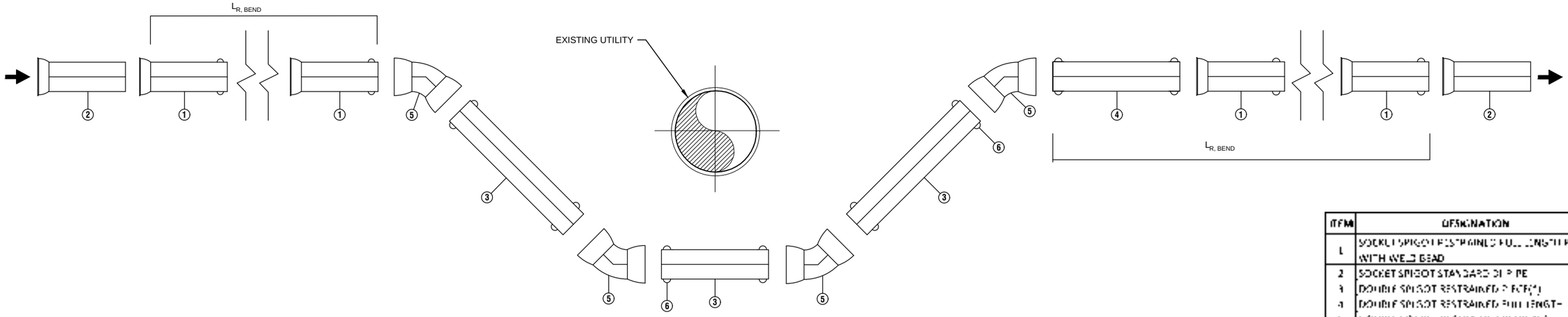
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: DI PIPE RESTRAINED CONNECTION TYPICAL DRAWING DETAIL DESIGN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:40	4	
DRAWING No.	TP-12	5	

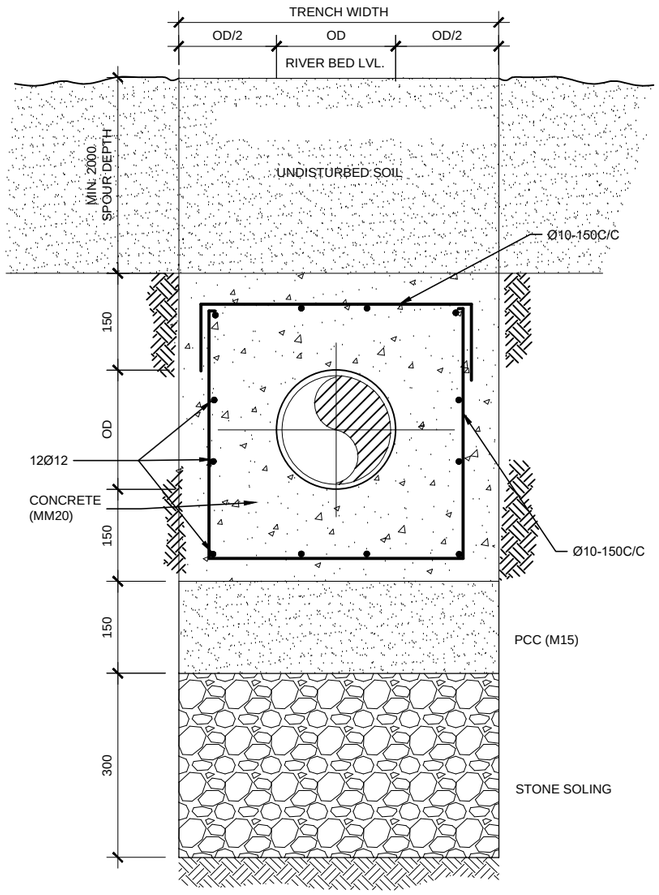


UTILITY CROSSING DI PIPELINE

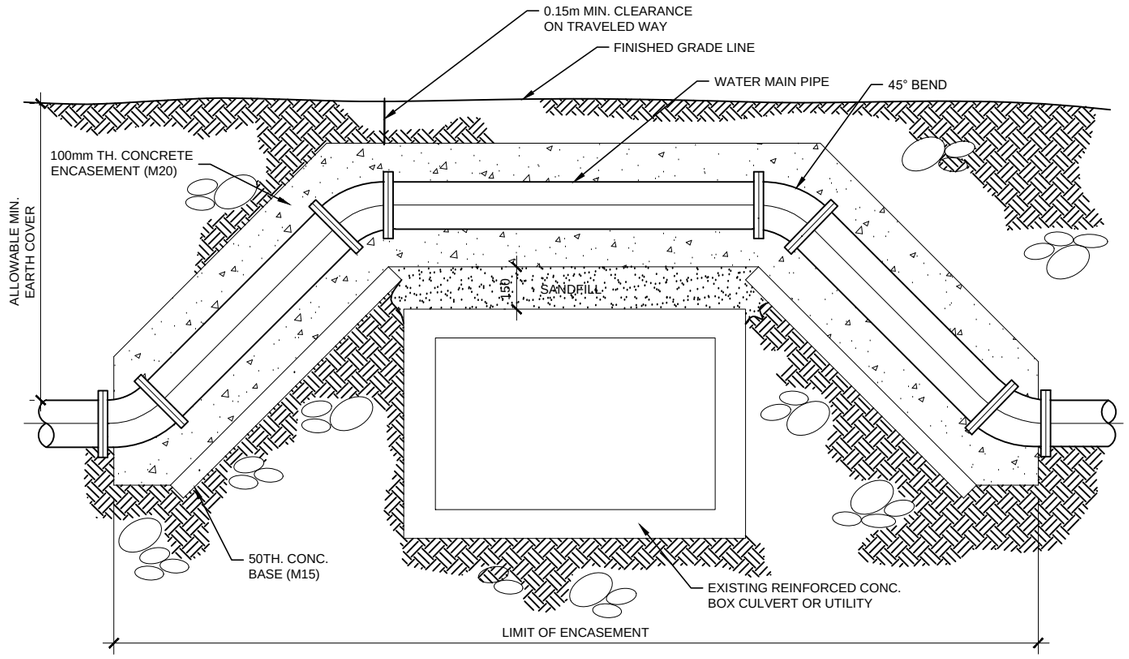
ITEM	DESIGNATION
1	SOCKET SPIGOT RESTRAINED FULL LENGTH PIPE WITH WELD BEAD
2	SOCKET SPIGOT STANDARD DI PIPE
3	DOUBLE SPIGOT RESTRAINED PIPE(*)
4	DOUBLE SPIGOT RESTRAINED FULL LENGTH
5	DOUBLE SOCKET DUCTILE IRON BEND
6	WELD BEAD

(*) ONE END WELD BEAD FROM MANUFACTURER, OTHER END FIELD WELDED TO ADJUST LENGTH

Diameter	Operating Pressure	P (Test Pressure)	Total Restraind Length					
			Ir.bend ΦD				Ir.valve Dead End or	Ir.tee Tees
			90°	45°	22.5°	11.25°		
300	8	12	27.5	16.5	11	5.5	66	11
	6	9	22	11	5.5	5.5	49.5	8.8
	4	6	16.5	11	5.5	5.5	33	11
350	8	12	33	16.5	11	5.5	77	16.5
	6	9	27.5	11	5.5	5.5	60.5	11
	4	6	16.5	11	5.5	5.5	38.5	8.8
400	8	12	33	16.5	11	5.5	88	22.5
	6	9	27.5	11	5.5	5.5	66	16.5
	4	6	16.5	11	5.5	5.5	49.5	11
450	8	12	38.5	16.5	11	5.5	99.5	27.5
	6	9	27.5	11	5.5	5.5	66	22
	4	6	22	11	5.5	5.5	49.5	11
500	8	12	38.5	16.5	11	5.5	99	33
	6	9	27.5	16.5	5.5	5.5	77	22.5
	4	6	22	11	5.5	5.5	49.5	11
600	8	12	44	16.5	11	5.5	110	44
	6	9	33	16.5	11	5.5	82.5	33
	4	6	22	11	5.5	5.5	55	22.5
700	8	12	44	22	11	5.5	115.5	33.5
	6	9	33	16.5	11	5.5	88	60.5
	4	6	22	11	5.5	5.5	60.5	16.5
800	8	12	49.5	22	11	5.5	132	44.5
	6	9	38.5	16.5	11	5.5	99	33.5
	4	6	27.5	11	5.5	5.5	66	55



CONCRETE ENCASEMENT SECTION



TYPICAL CROSS-OVER RCBC OR UTILITY

NOTE:-

1. CROSS-OVER IF THIS CONDITION IS SATISFIED COVER > 1.00 METER
2. USE RESTRAINED PIPES AND FITTINGS.
3. ALL CONCRETE SHALL BE M20 UNLESS OTHERWISE SPECIFIED.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

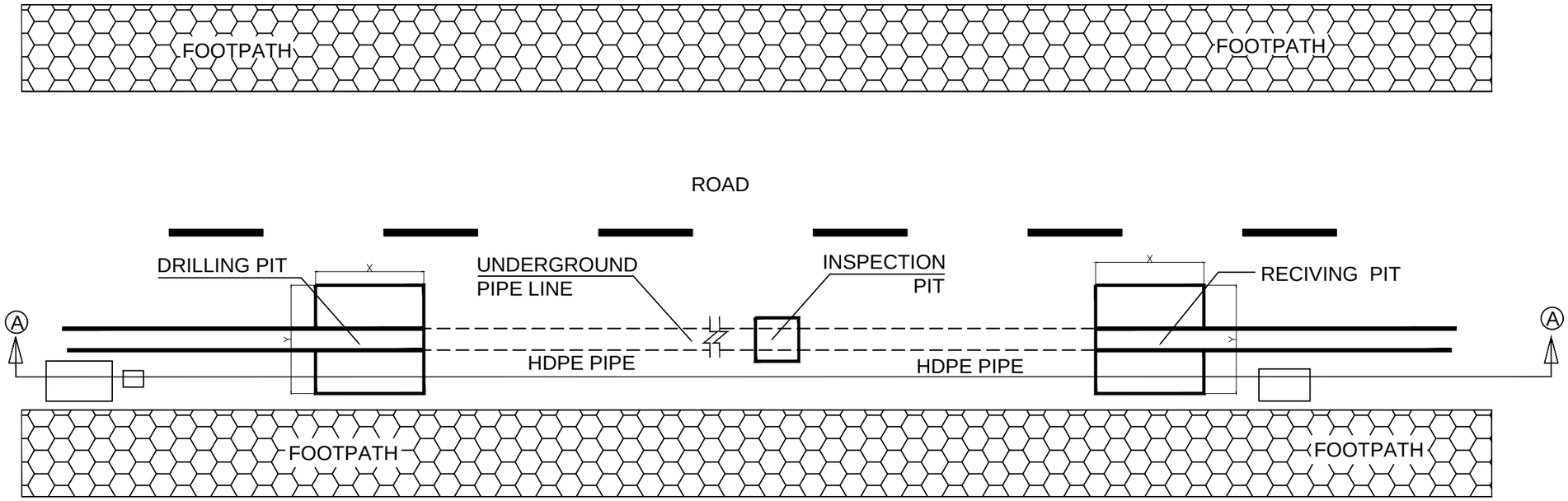
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

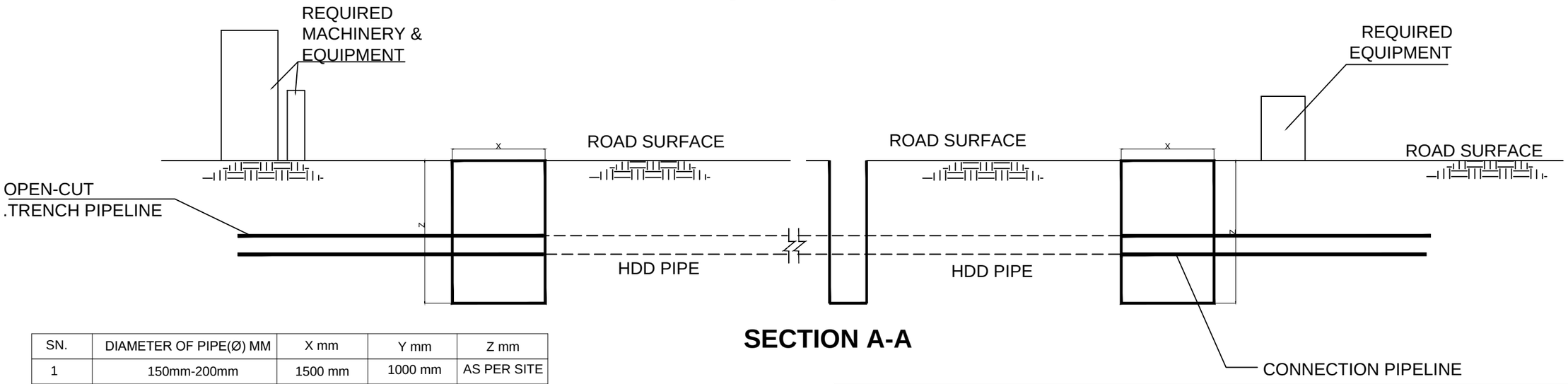
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: UTILITY CROSSING TYPICAL DRAWING DETAIL DESIGN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	TP-13	5	



HORIZONTAL DIRECTIONAL DRILLING METHOD PLAN



SECTION A-A

SN.	DIAMETER OF PIPE(Ø) MM	X mm	Y mm	Z mm
1	150mm-200mm	1500 mm	1000 mm	AS PER SITE
2	Above 200mm	1500 mm	1500 mm	AS PER SITE

NOTES:-

1. DRAWING IS INDICATIVE ONLY, ACTUAL SITE CONDITION MUST PREVAIL.
2. THERE SHOULD BE BUTT JOINT OF HDPE PIPE FOR HDD METHOD.
3. INSPECTION SHOULD BE ACCORDING TO SITE REQUIREMENT.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

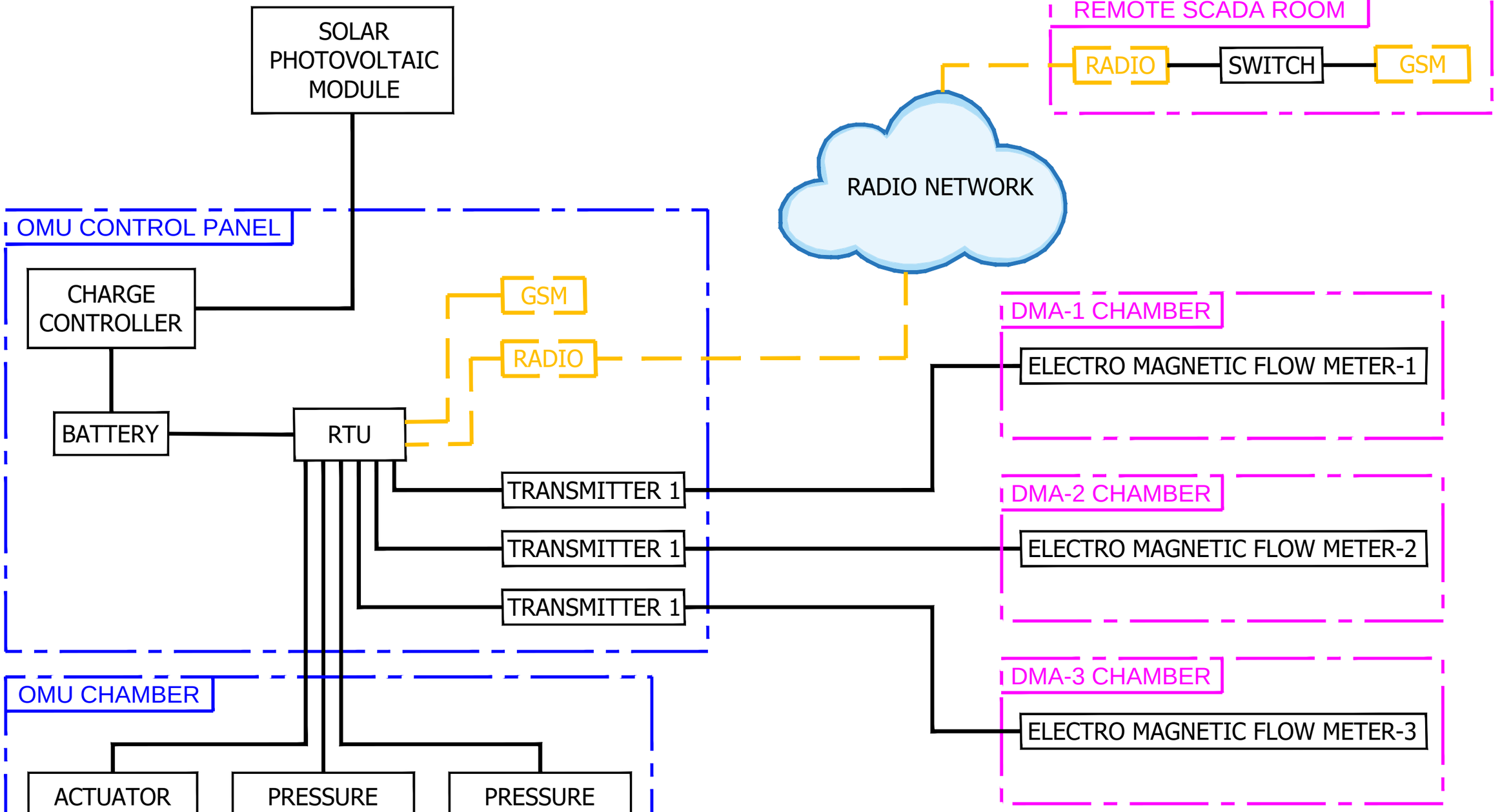
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: HORIZONTAL DIRECTIONAL DRILLING TYPICAL DRAWING DETAIL DESIGN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:70	4	
DRAWING No.	TP-14	5	



NOTE:- FOR THE OMUs WITHOUT DMA PRV ACTUATOR ARE ALSO CONNECTED.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

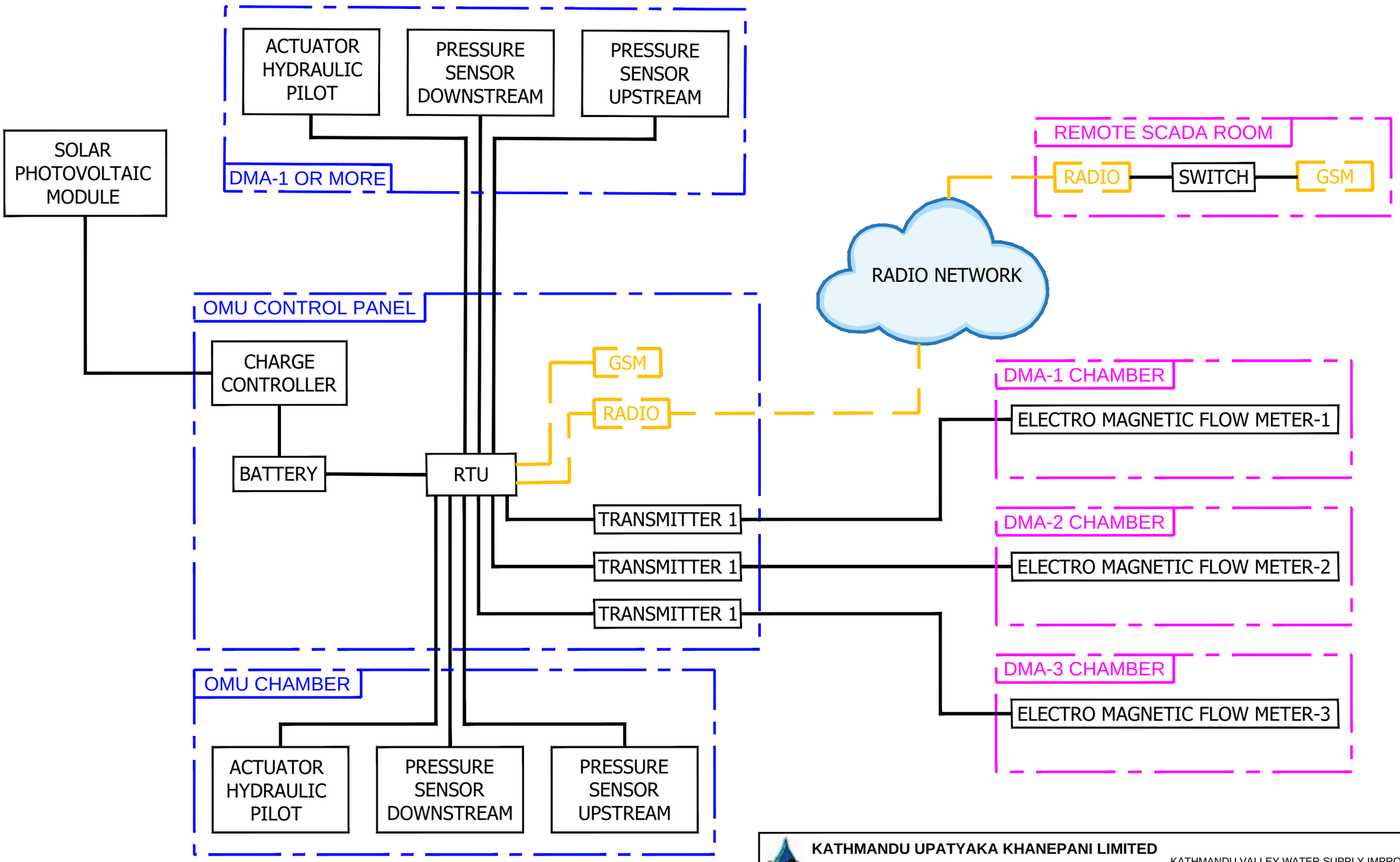
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: COMMUNICATION SCHEME OMUs & DMAs TYPICAL DRAWING SCHEME DETAILS

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	TP-15-1	5	



NOTE:- FOR THE OMUs WHERE DMA PRV ACTUATOR AND EMFM ARE ALSO CONNECTED.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

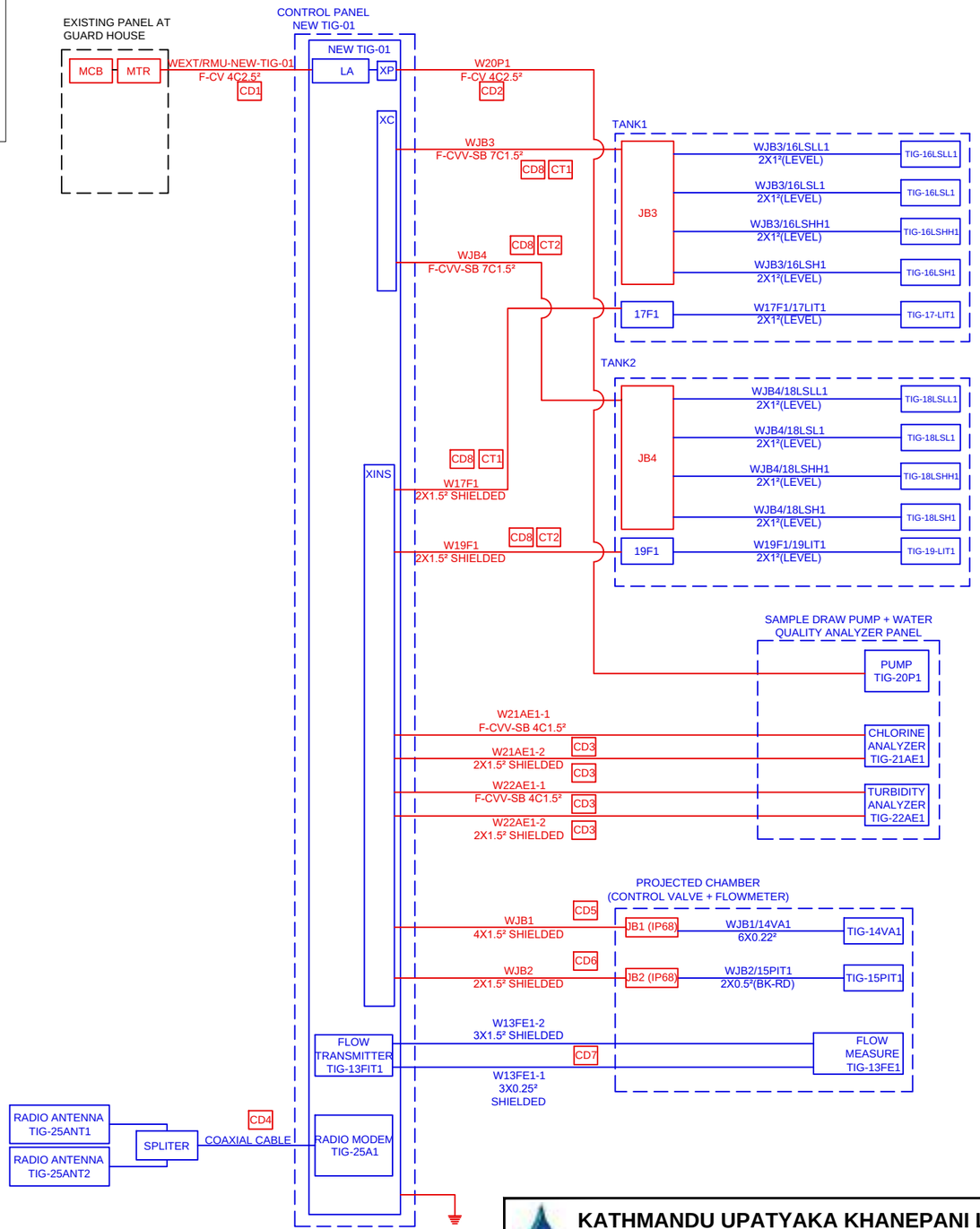
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: COMMUNICATION SCHEME OMUs & DMAs TYPICAL DRAWING SCHEME DETAILS

		Rev.	DATE
DRAWN:	P. N. K.	1	
DESIGNED:	J.M. NAVARRO	2	
APPROVED:	M. BRAVO DES -	3	
DATE:	Jan-2024	4	
SCALE:	-	5	
DRAWING No.	TP-15-2		

LEGEND:

- EXISTING
- JV SUPPLY
- SUBCONTRACTOR SUPPLY



LIST OF ABBREVIATIONS:

CD	:	CABLE DUCT
CT	:	CABLE TRAY
JB	:	JUNCTION BOX
LA	:	LIGHTNING ARRESTOR
MCB	:	MINI CIRCUIT BREAKER
MTR	:	METER

NOTE:- TIG IS REPRESENTATION FOR THE TYPICAL CASE. THE NAME OF TANK NEED TO BE INSERTED BY CONTRACTOR.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

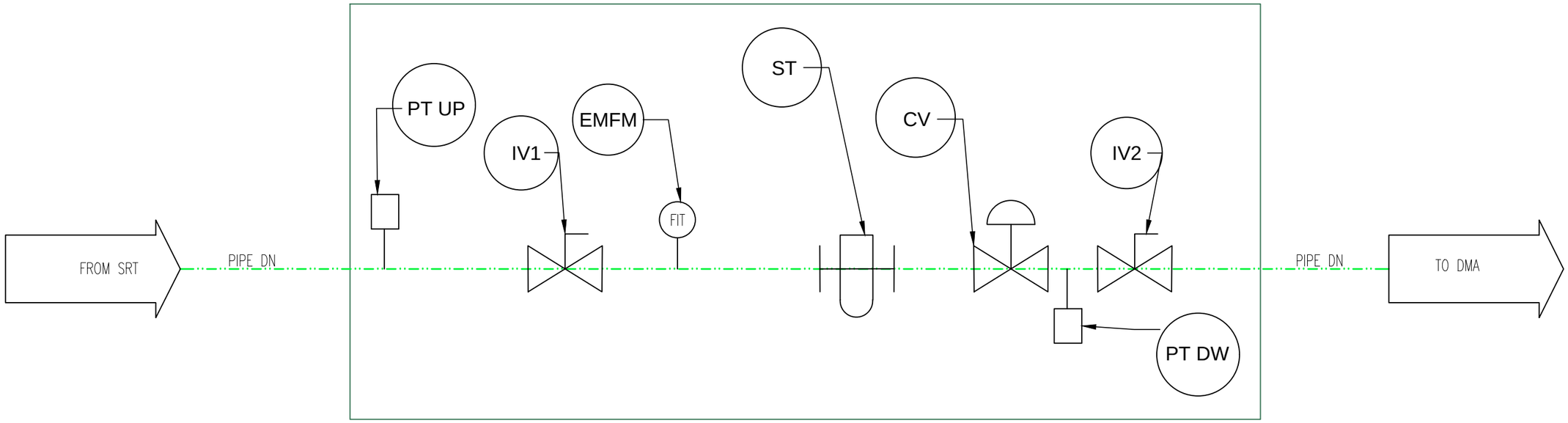
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: COMMUNICATION SCHEME OMUs & DMAs TYPICAL DRAWING RMU ELECTRICAL DIAGRAM

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	TP-15-3	5	

LEGEND	
FIT	ELECTRO MAGNETIC FLOWMETER (EMFM)
	ISOLATION VALVE (IV)
	CONTROL VALVE (CV)
	STRAINER (ST)
	PRESSURE TRANSMITTER (PT)



OMU P&ID

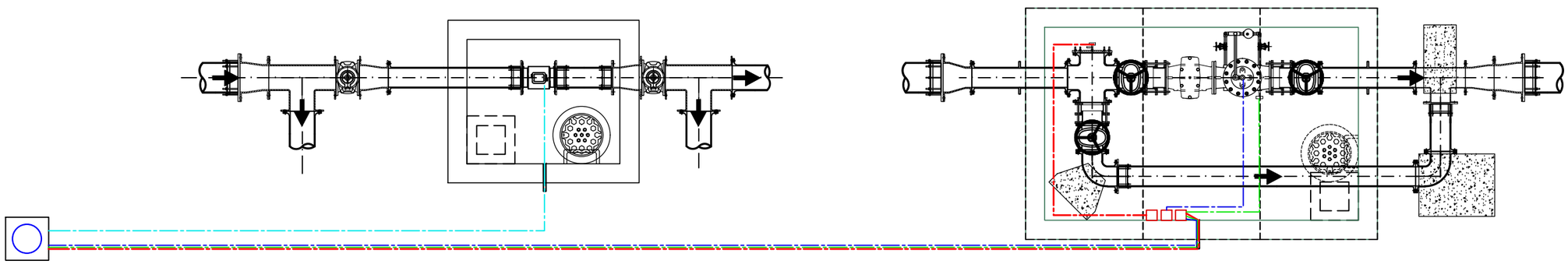
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

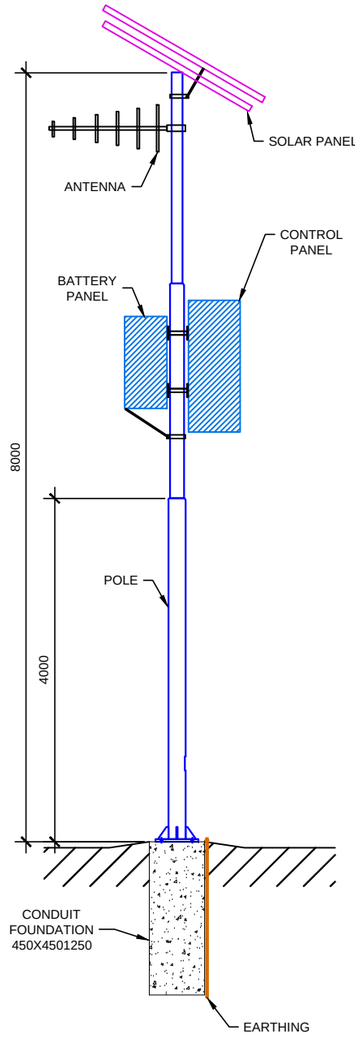
IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: OUTLET MANAGEMENT SYSTEM TYPICAL DRAWING P&ID

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	TP-15-4	5	



GENERAL PLAN VIEW
SCALE 1:50



POLE DETAIL

LEGEND	
	UPSTREAM PRESSURE SENSOR
	DOWNSTREAM PRESSURE SENSOR
	ACTUATOR CABLE
	FLOWMETER CABLE
	EARTHING

NOTE:-
CABLE DUCT IS INSTALLED (30-40) CM BELOW GROUND SURFACE.

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

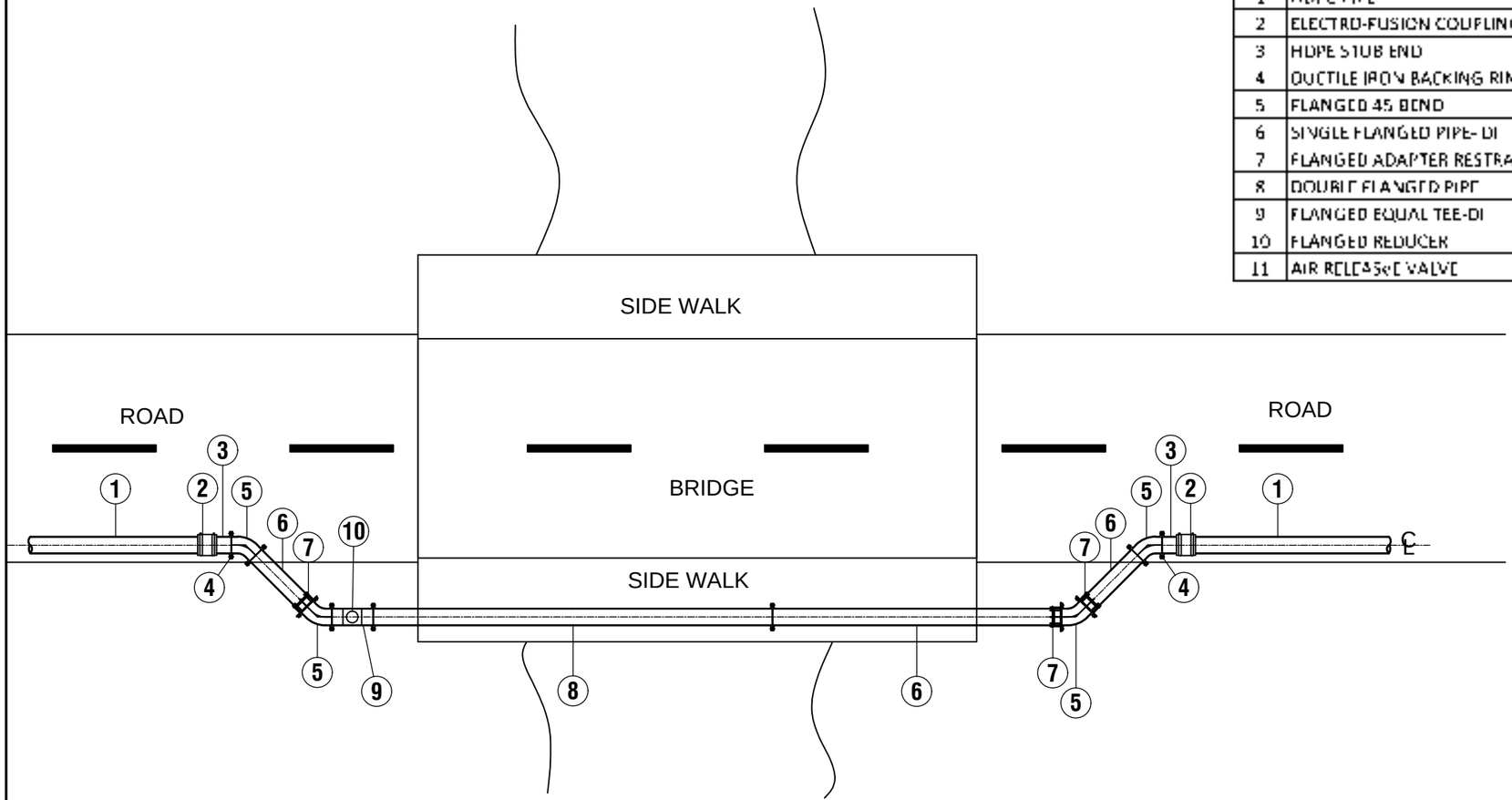
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: OUTLET MANAGEMENT SYSTEM
TYPICAL DRAWING
ELECTRICAL LAYOUT DIAGRAM

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	TP-15-5	5	

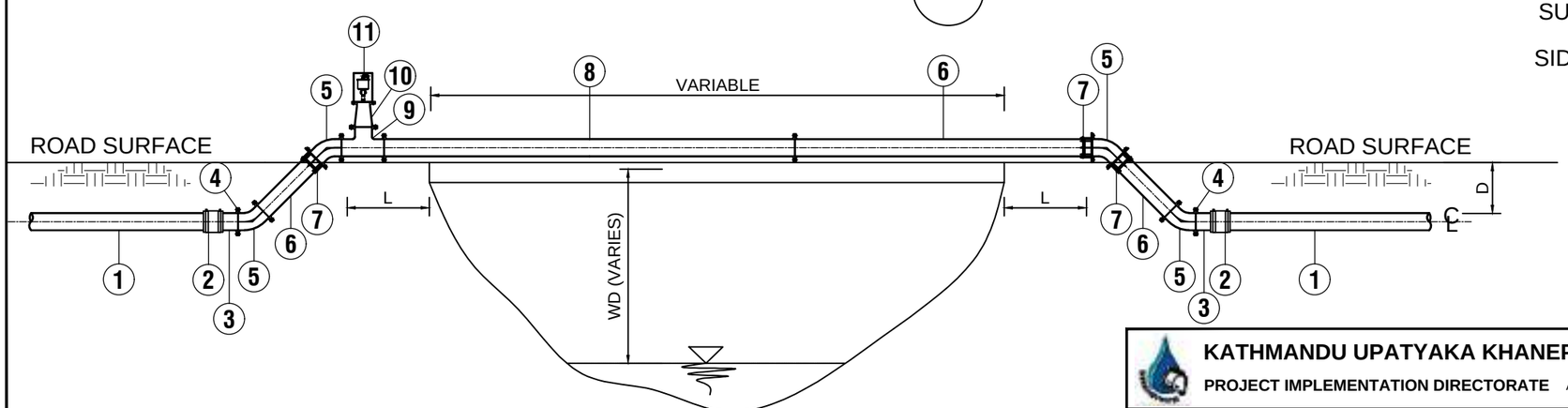
ITEM	DESIGNATION
1	HDPE PIPE
2	ELECTRO-FUSION COUPLING
3	HDPE STUB END
4	DUCTILE IRON BACKING RING
5	FLANGED 45 BEND
6	SINGLE FLANGED PIPE- DI
7	FLANGED ADAPTER RESTRAINED
8	DOUBLE FLANGED PIPE
9	FLANGED EQUAL TEE-DI
10	FLANGED REDUCER
11	AIR RELEASE VALVE

NOTES:-

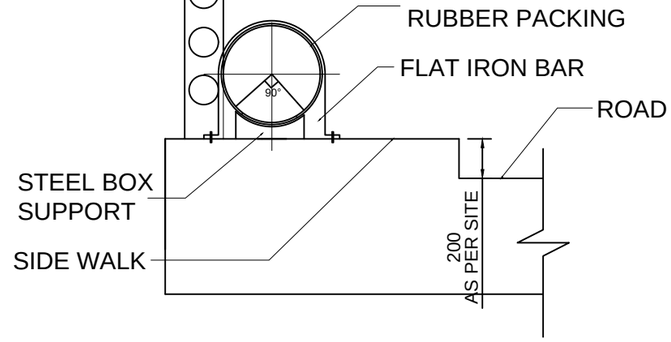
1. DRAWING IS INDICATIVE ONLY, ACTUAL SITE CONDITION MUST PREVAIL.
2. ALL STREAM CROSSINGS SHALL BE CARRIED OUT WITH DI FLANGED PIPES AND FITTINGS.
3. SUITABLE GRIP FLANGED ADAPTER/ STUB FLANGE ASSEMBLY SHALL BE USED TO CONNECT HDPE /DI CONNECTION (BOTH ENDS)
4. LOCATION AND ORIENTATION OF THE PIPE LAYING OF STREAM CROSSING HAS TO BE REFERRED TO RESPECTIVE NETWORK DRAWINGS.
5. LENGTH (L) SHALL BE (MINIMUM OF 1m) AND SUBJECT TO CHANGE TO SUIT SITE CONDITION WITH THE APPROVAL OF THE ENGINEER.
6. REQUIREMENT OF AIR VALVE WILL BE DECIDED BY THE ENGINEER.
7. STRUCTURAL DESIGN AND REINFORCEMENT DETAIL BY THE CONTRACTOR.
8. USE RESTRAINED ADAPTOR.
9. CONTRACTOR TO SUBMIT TO ENGINEER FOR APPROVAL PROPOSED CONCRETE ANCHORING SYSTEM.



STREAM CROSSING PLAN 1



STREAM CROSSING SECTION 2



PIPE SUPPORT DETAIL A

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

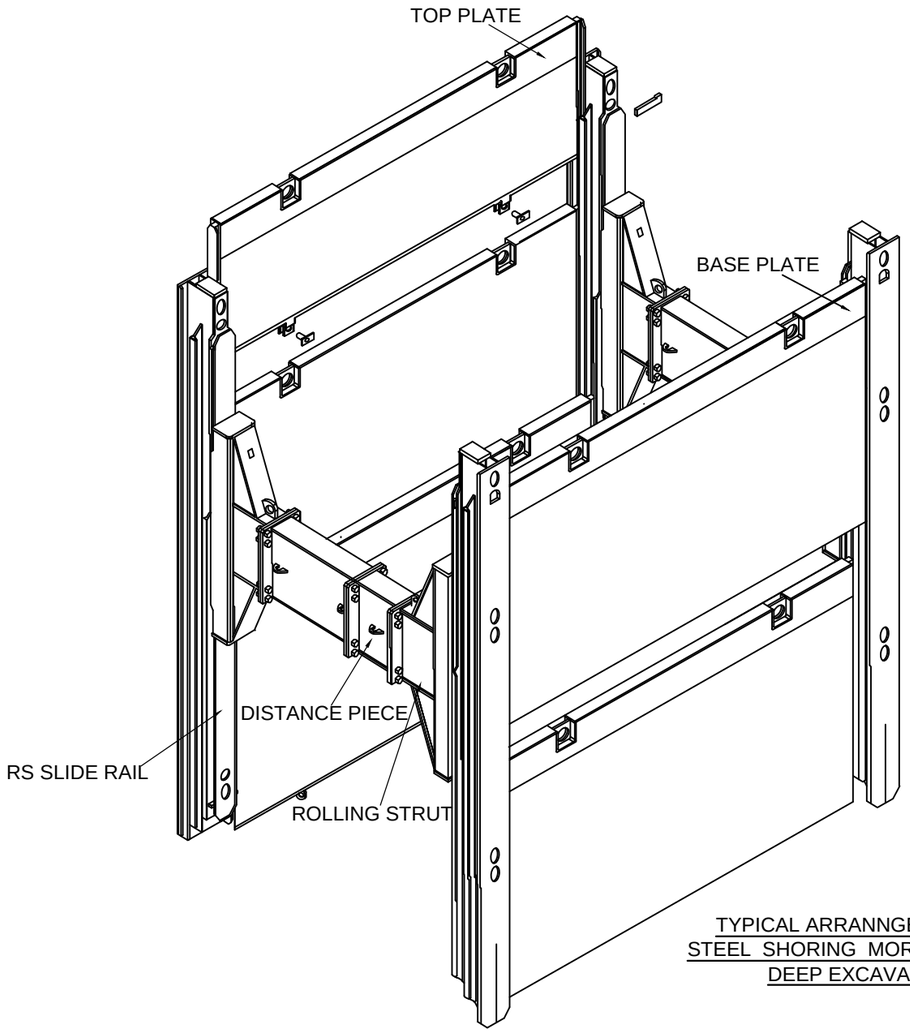
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

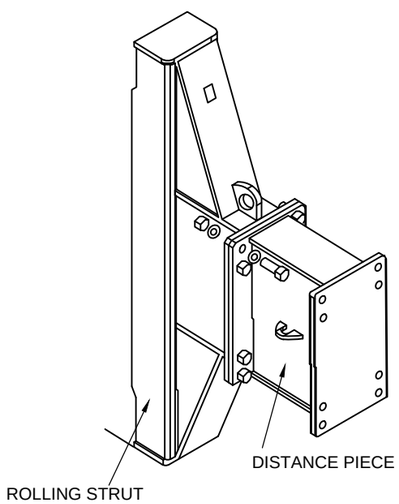
PACKAGE: PID/SKV/DNI2-KIRTIPUR

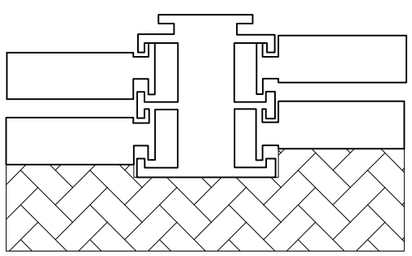
DRAWING TITLE: TYPICAL STREAM BRIDGE CROSSING
TYPICAL DRAWING
DETAIL DESIGN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:70	4	
DRAWING No.	TP-16	5	

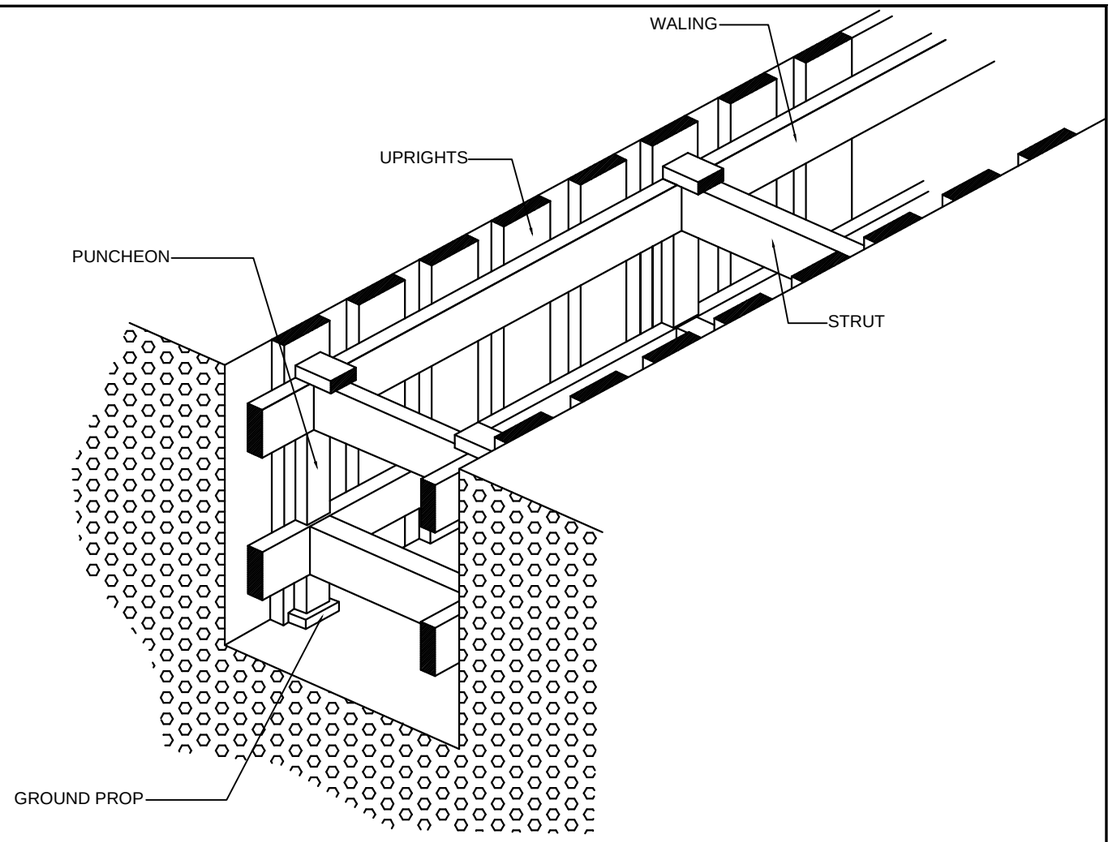


TYPICAL ARRANNGEMENT OF
STEEL SHORING MORE THAN 2.4m
DEEP EXCAVATION





SHORING PLATES - PLATE GUIDE



TYPICAL ARRANNGEMENT OF OPEN TRENCH TIMBER SHORING
UPTO 2.4m DEEP EXCAVATION

SCHEDULE OF COMPONENTS OF TIMBER SHORING

S. No.	Upright		Struts			Wales (Walling)	
	Minimum Dimension (mm)	Max. Spacing (mm)	Minimum Dimension (mm)	Max. Spacing (mm)		Minimum Dimension (mm)	Max. Vertical Spacing (mm)
				Vertical	Horizontal		
For Ordinary Soils (Firm Soils to Soils likely to crack and crumble)							
1	40x200	600	100x100	1200	600	100x150	1200
For loose and Soft Soils							
2	40x200	600	100x100	900	600	150x200	1000

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT
(PHASE 2)

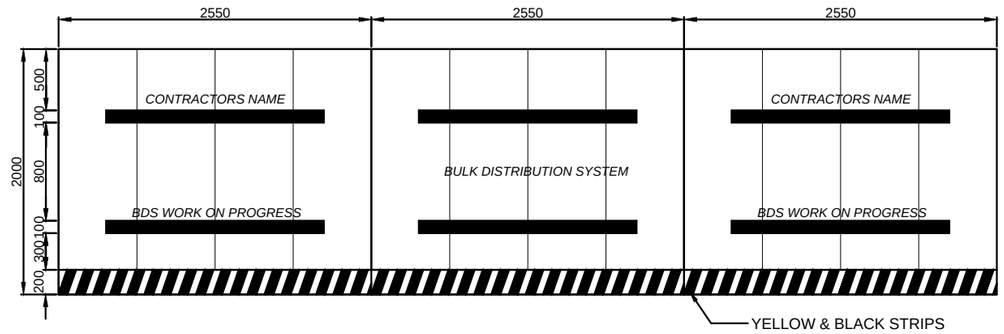
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

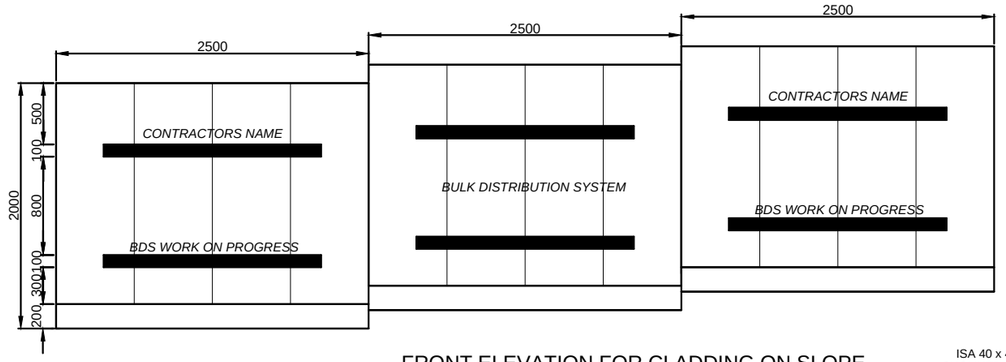
PACKAGE:
PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE:
SORING DETAILS
TYPICAL DRAWING
DETAIL DESIGN

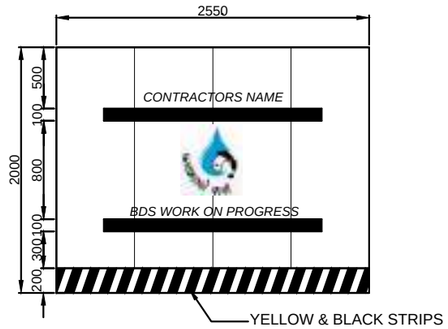
		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRAVO BES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	TP-17-1	5	



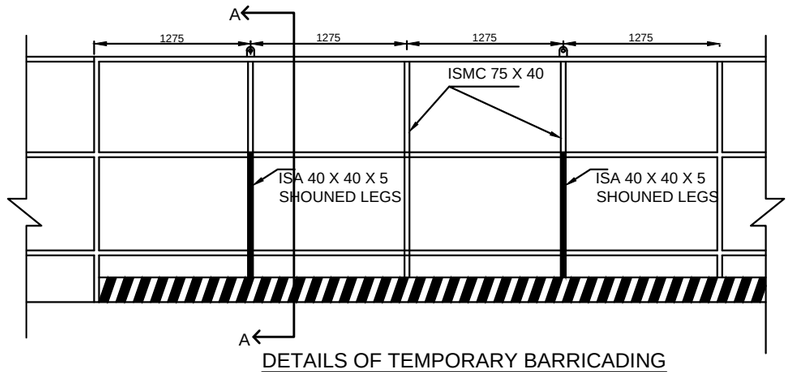
ELEVATION OF ONE UNIT OF TEMPORARY BARRICADING



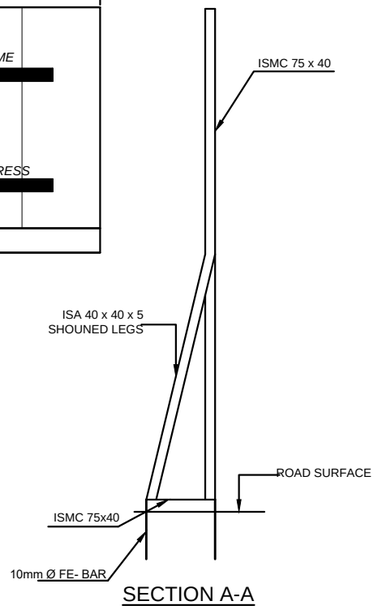
FRONT ELEVATION FOR CLADDING ON SLOPE



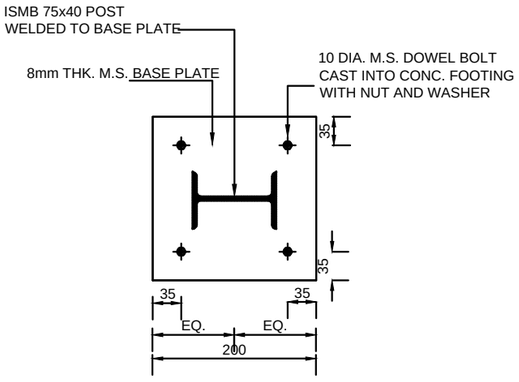
ELEVATION OF ONE SET TEMPORARY BARRICADING



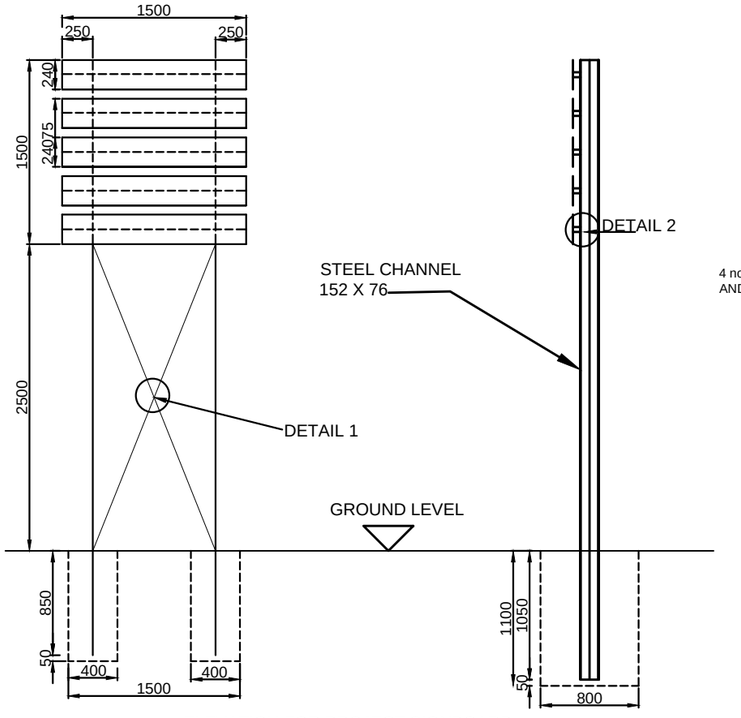
DETAILS OF TEMPORARY BARRICADING



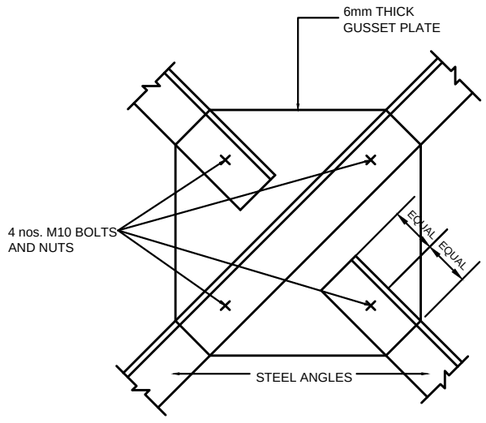
SECTION A-A



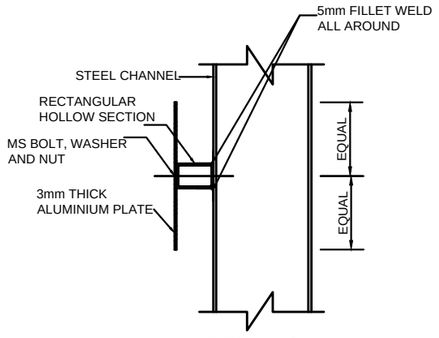
BASE PLATE



ELEVATION FOR PROJECT SIGNBOARD



DETAIL 1



DETAIL 2

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

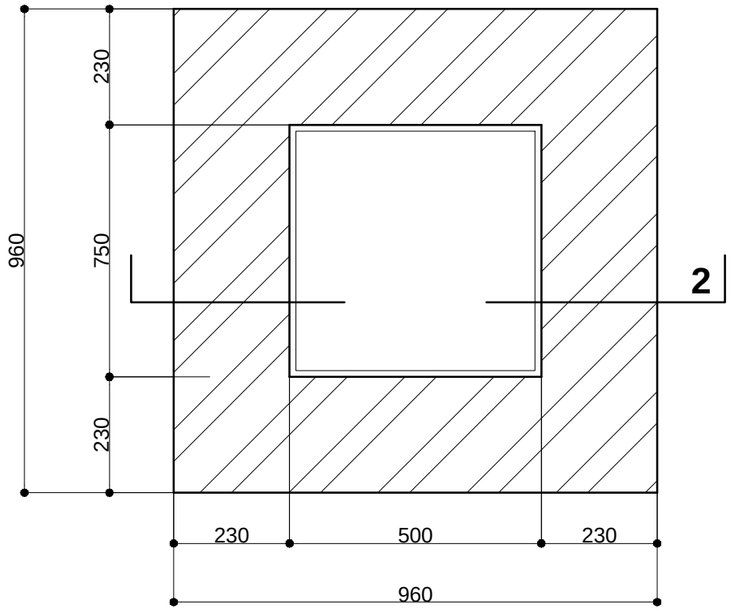
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

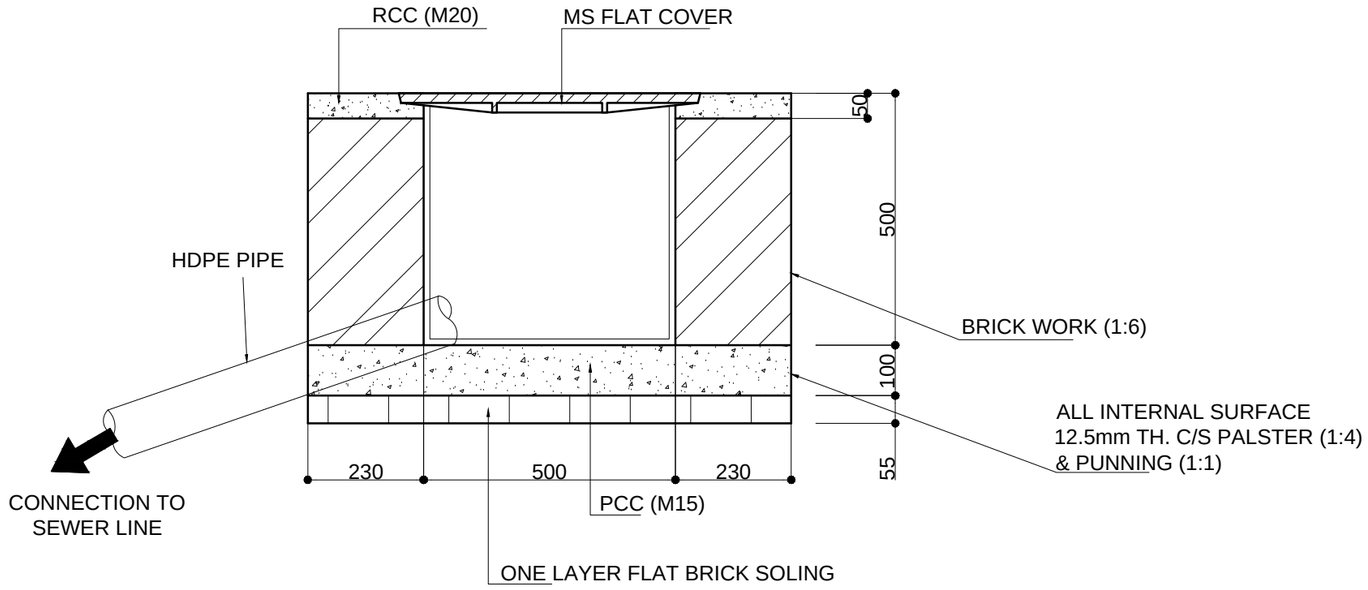
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: SORING DETAILS
TYPICAL DRAWING
DETAIL DESIGN

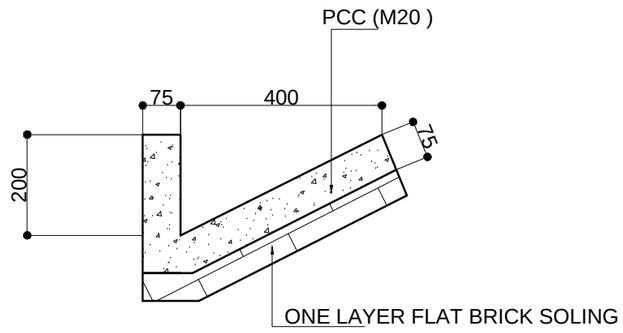
		Rev.	DATE
DRAWN:	P.N.K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	TP-17-2	5	



PLAN OF CATCHPIT 1



SECTION OF CATCHPIT 2



75mm THICK "TICK" TYPE ROAD SIDE DRAIN 3

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: CATCH PIT DRAWING TYPICAL DRAWING

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	TP-18	5	

DISTRIBUTION NETWORK IMPROVEMENT WORKS IN KIRTIPUR

CONTRACT No.: PID/SKV/DNI2-KIRTIPUR

CIVIL STRUCTURES



NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHSE 2)

IN ASSOCIATION WITH:

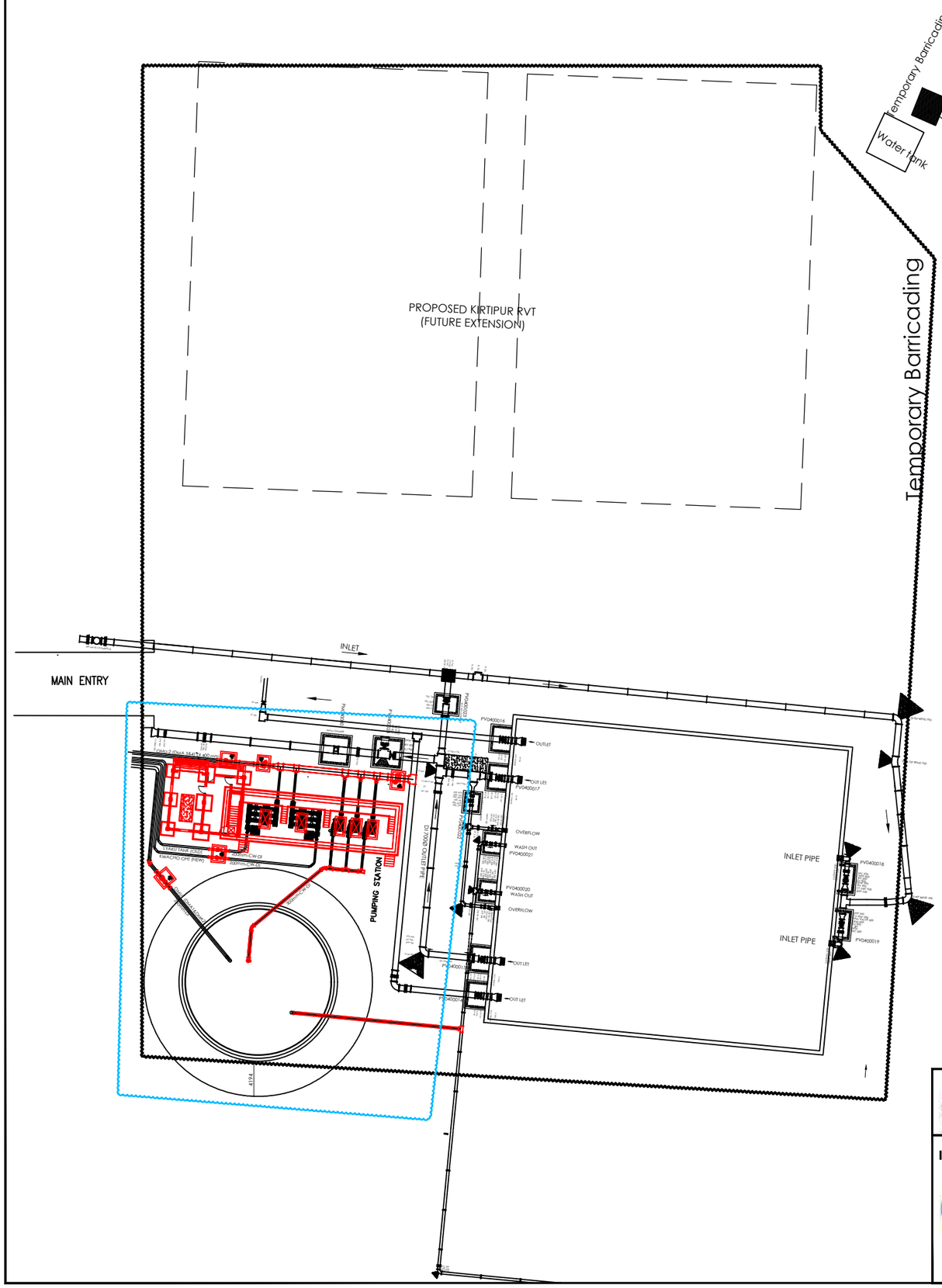
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
SITE LAYOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:700	4	
DRAWING No.	OHT-1	5	



NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHSE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
GENERAL LAYOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:600	4	
DRAWING No.	OHT-2	5	

General Note:

1. DO NOT SCALE FROM THE DRAWINGS

2. STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH RELEVANT ARCHITECTURAL AND SERVICES DRAWINGS.

3. UNLESS SPECIFIED OTHERWISE, ALL LEVELS SHOWN IN STRUCTURAL DRAWINGS ARE STRUCTURAL LEVELS ONLY.

4. DO NOT SCALE FOLLOW WRITTEN DIMENSION ONLY

5. ALL DIMENSION & LEVEL ARE IN FEET INCHES UNLESS NOTED OTHERWISE. ALL DIMENSION TO BE VERIFIED ON SITE & APPROVED BY THE ENGINEER

6. GRADE OF CONCRETE MIX SHALL BE M-30 FOR TANK SHAFT, TANK WALLS, BEAMS, DOME SLABS, RAFT-SLAB, FOUNDATION WALLS ETC. CONFORMING TO IS:456-2000.

7. REINFORCEMENT SHALL BE HIGH STRENGTH DEFORMED BARS OF GRADE Fe:500D CONFORMING IS 1786:2008

8. CLEAR COVER TO BARS
   a. FOR CONCRETE MEMBERS IN CONTACT WITH SOIL = 50mm
   b. FOR LONGITUDINAL (VERTICAL) BARS IN COLUMN, WALL = 50mm
   c. FOR MAIN BARS IN BEAMS = 40mm
   d. FOR OUTER BARS IN SLAB = 25mm

9. BARS IN COLUMNS SHALL BE SPLICED ONLY AT MID HEIGHT OF COLUMN.

10. BARS SPLICING IN BEAM SHALL BE AVOIDED IN THE SPAN WHERE INTERMEDIATE BEAM IS CONNECTED AND SHALL BE ONLY AS SHOWN ON DWG.

11. DEVELOPMENT / LAP LENGTH (Ld.) FOR BARS.
    FOR LIQUID RETAINING STRUCTURES/TANKS:

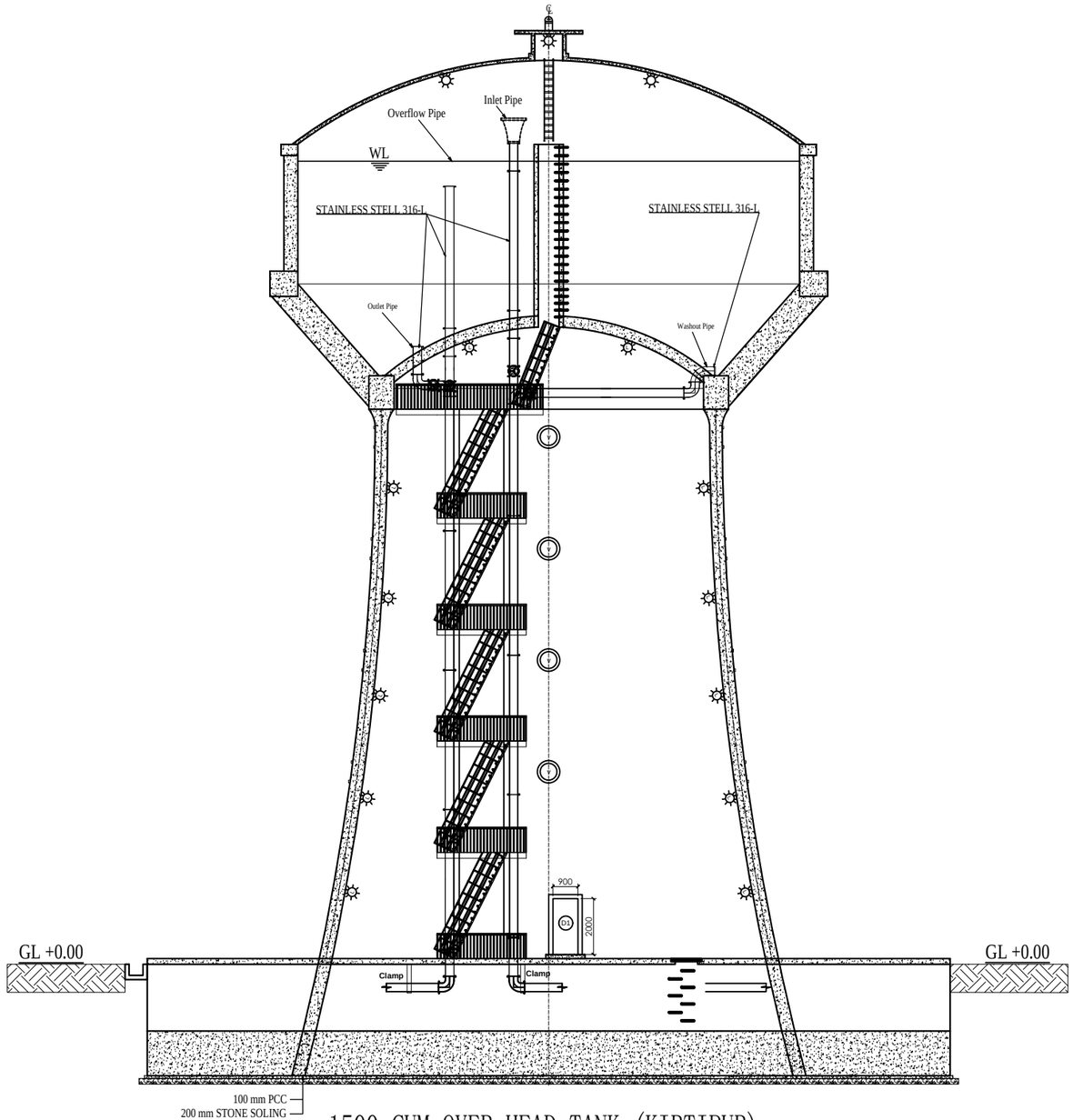
BAR DIA (mm)	8	10	12	16	20	25	28	32
FOR M30 Ld(mm)	260	325	390	520	650	820	910	1040

FOR OTHER STRUCTURAL MEMBERS:

BAR DIA (mm)	8	10	12	16	20	25	28	32
FOR M30 Ld(mm)	370	460	560	740	920	1150	1290	1480

12. TEMP./DISTRIBUTION REINFORCEMENT FOR SLAB - TMT 8Ø @ 200 C/C
13. MIN CLEAR VERTICAL DISTANCE BETWEEN TWO ROWS (LAYERS) OF BARS=25mm.
14. PROVIDE SHEAR REINFORCEMENT AT 100mm C/C AT LAP LOCATIONS.
15. ANY DISCREPANCY FOUND ON DESIGN, DRAWINGS, SPECIFICATIONS SHALL BE CLEARIFY BEFORE EXCECUTION OF CONSTRUCTION.
16. FOOT REST SHOULD BE PLASTIC ENCAPSULATED as per IS standard on 25mm dia steel bar.
17. PLATFORMS OF STAIRCASE CAN BE WELDED AS A ONE UNIT BEFORE BOLTING TO FRAME.
18. STRUCTURAL STEEL SHALLBE MILD STEEL GRADE & ALL NUT-BOLTS SHALL BE PROPERTY CLASS 8.8 .
19. THE THICKNESS OF SLAB SHALL BE 250 mm WHERE THE COLUMNS OF STAIRCASE RESTS.

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.



1500 CUM OVER HEAD TANK (KIRTIPUR)

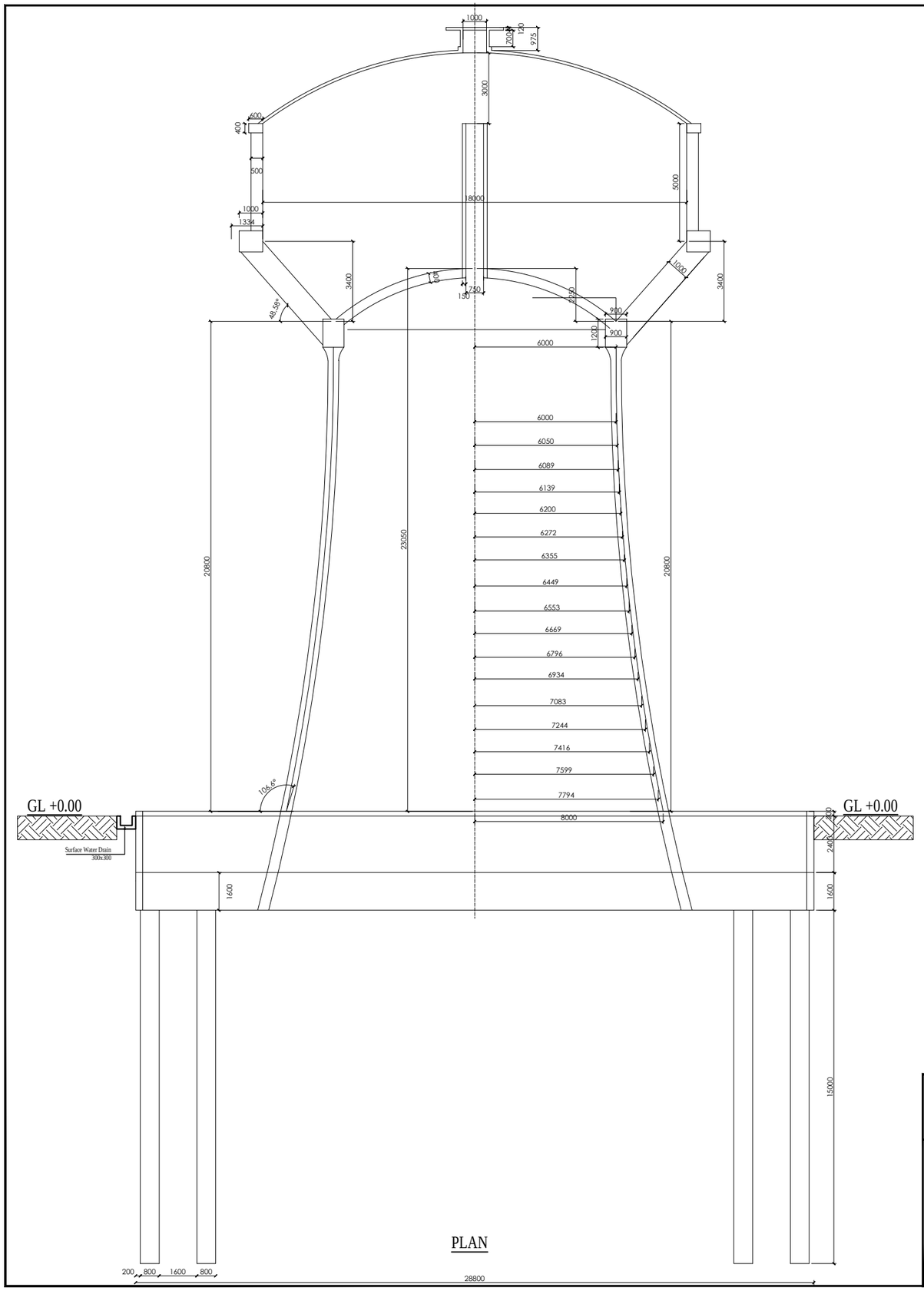
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHSE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: SKV/ S2- KIRTIPUR
DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
GENERAL NOTES

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRIAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:200	4	
DRAWING No.	OHT-3	5	



NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHSE 2)

IN ASSOCIATION WITH:

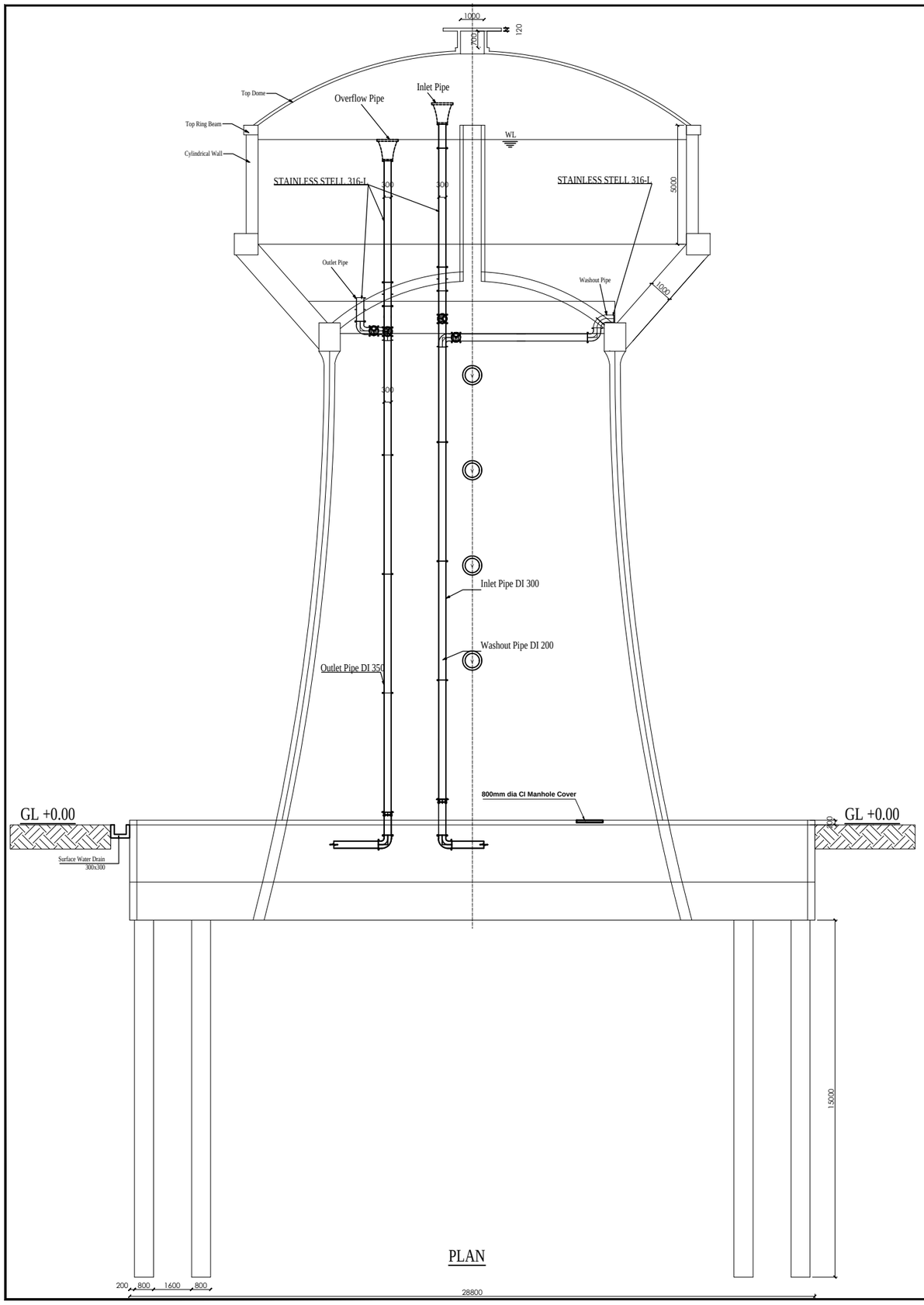
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

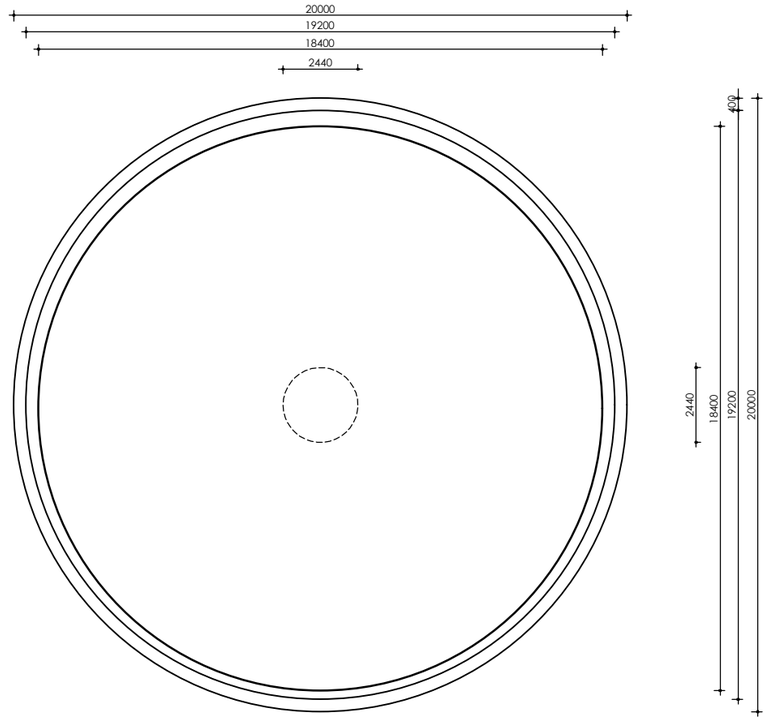
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:200	4	
DRAWING No.	OHT-4	5	



PLAN



TOP PLAN

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

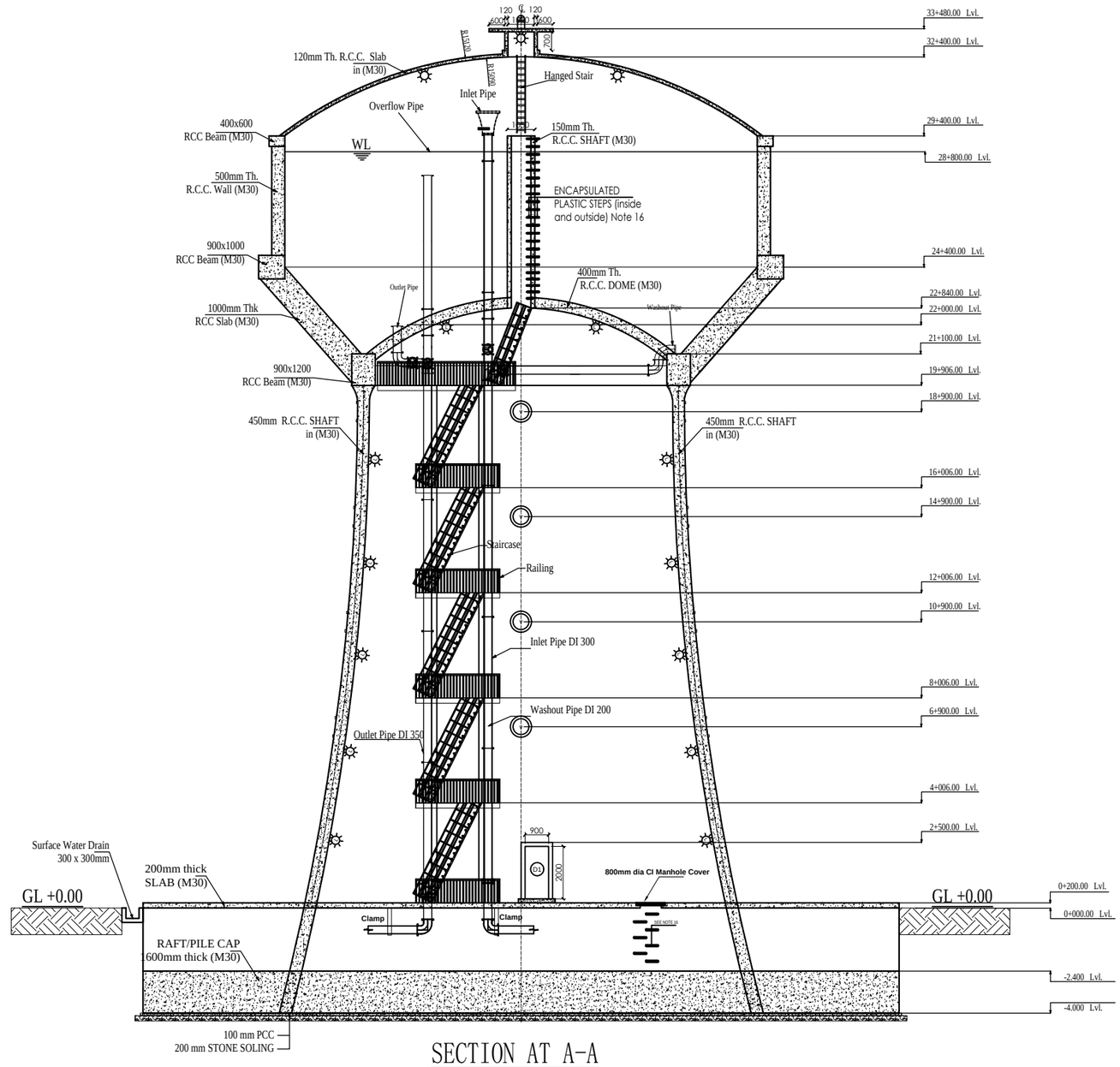
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:200	4	
DRAWING No.	OHT-5	5	



SECTION AT A-A

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

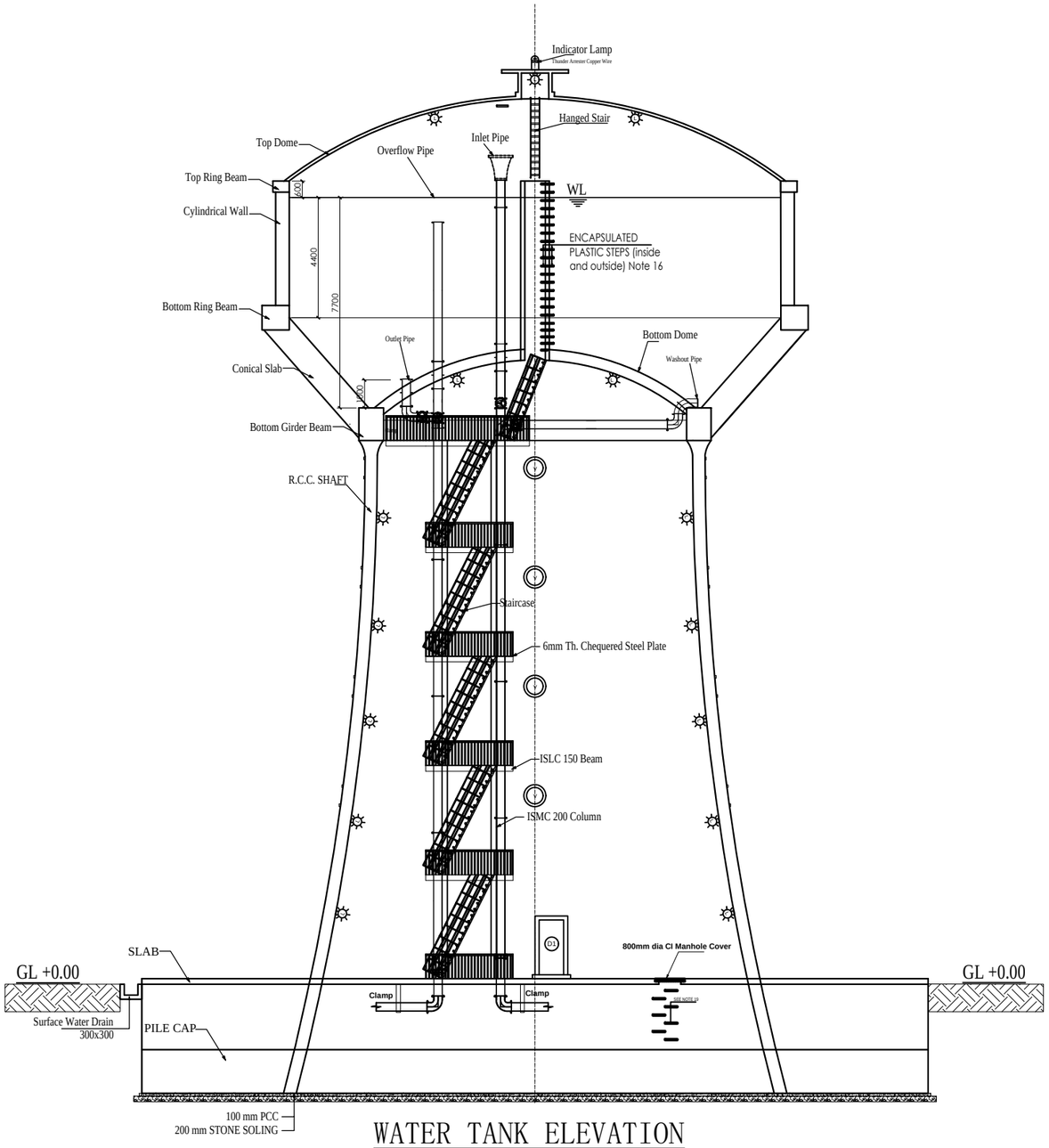
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: SKV/ S2- KIRTIPUR

DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
SECTION AT A - A

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES -	2	
DATE:	Jan-2024	3	
SCALE:	1:200	4	
DRAWING No.	OHT-6	5	



WATER TANK ELEVATION

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

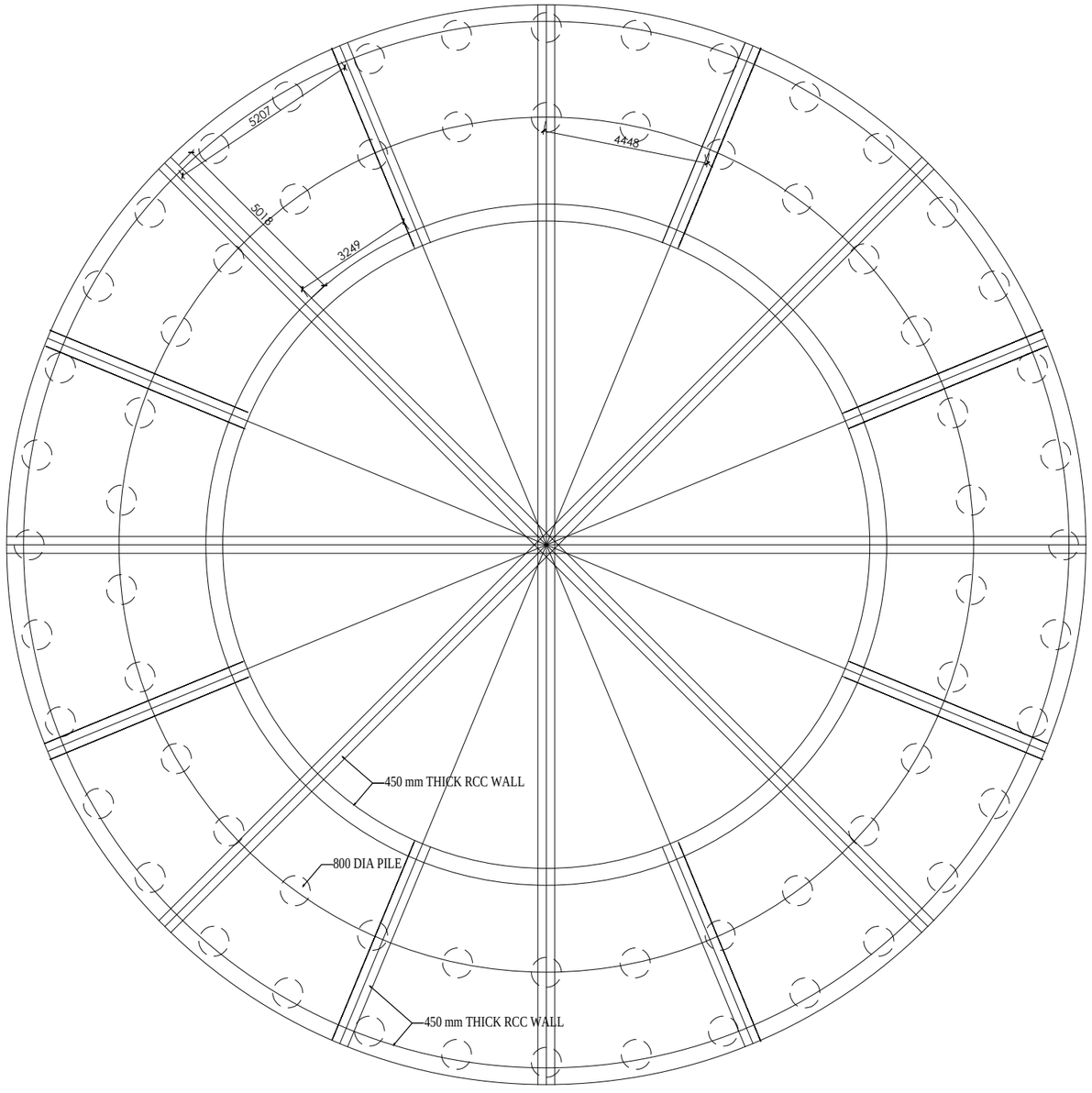
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: SKV/ S2- KIRTIPUR

DRAWING TITLE: KRITIPUR OVER HEAD TANK CIVIL STRUCTURE ELEVATION

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:200	4	
DRAWING No.	OHT-7	5	



FOUNDATION PLAN

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

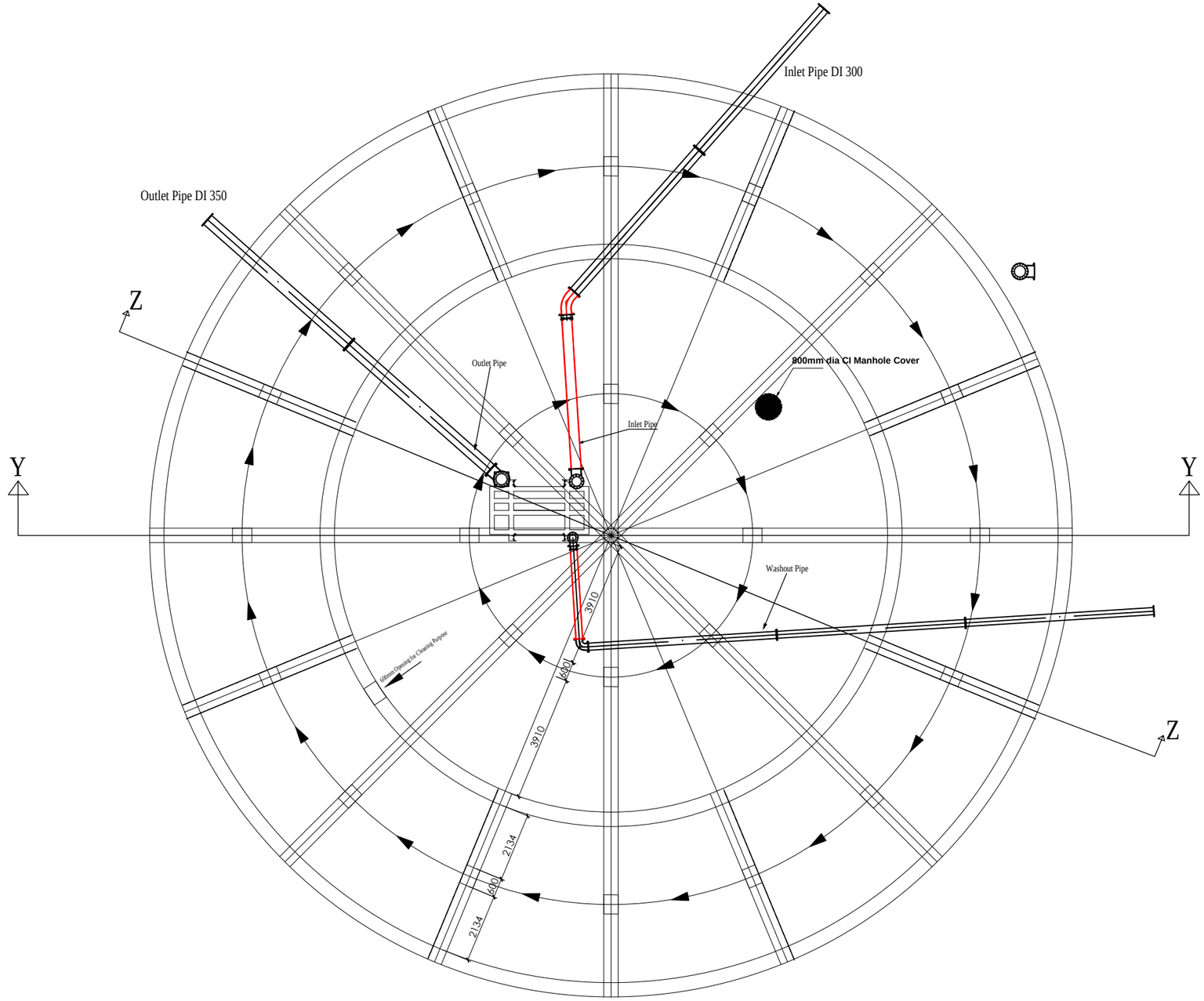
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
FOUNDATION PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:150	4	
DRAWING No.	OHT-8	5	



BRACING WALL LAYOUT PLAN

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

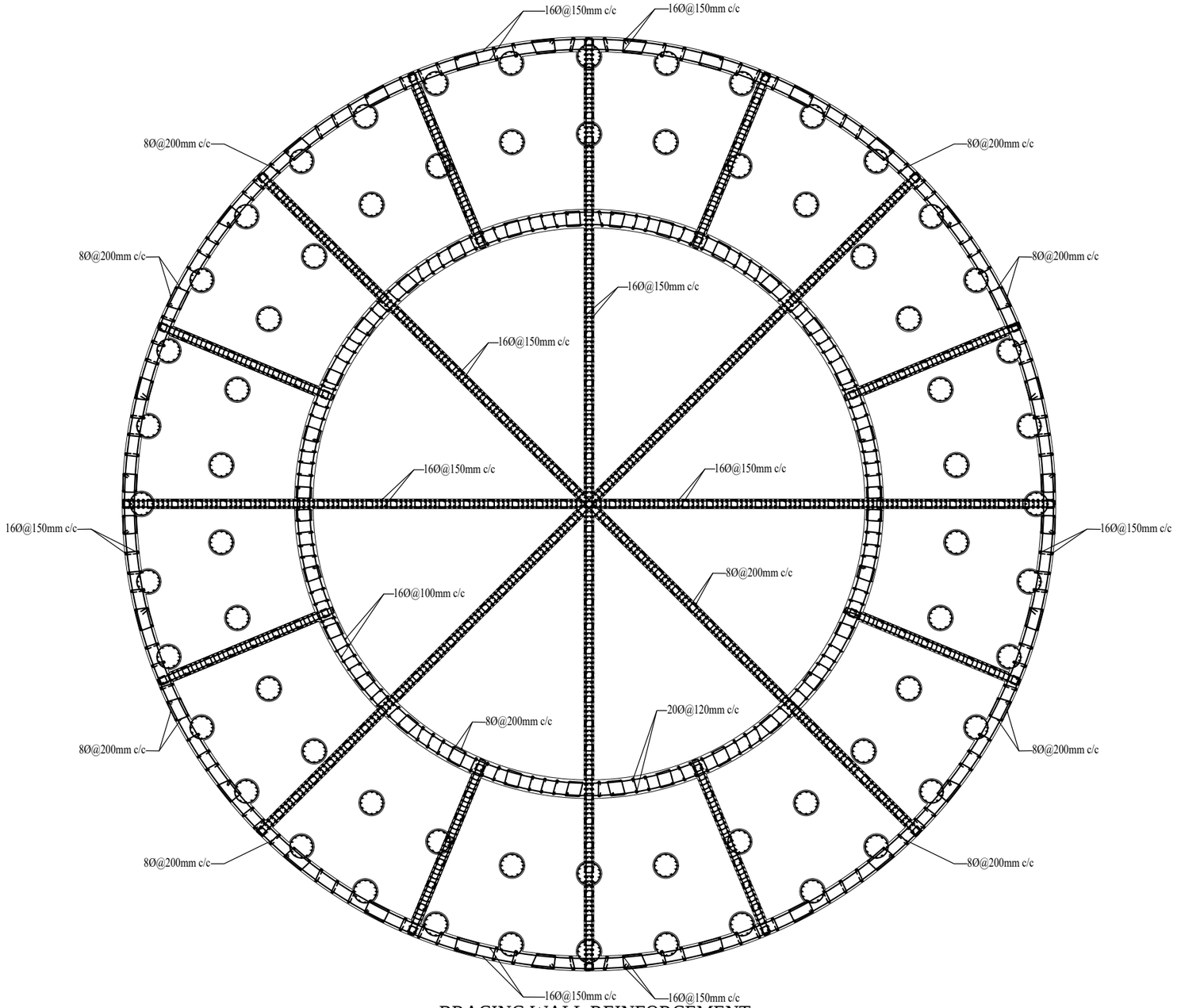
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
SERVICE HOLE IN FOUNDATION

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:150	4	
DRAWING No.	OHT-9	5	



BRACING WALL REINFORCEMENT
(PLAN)

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

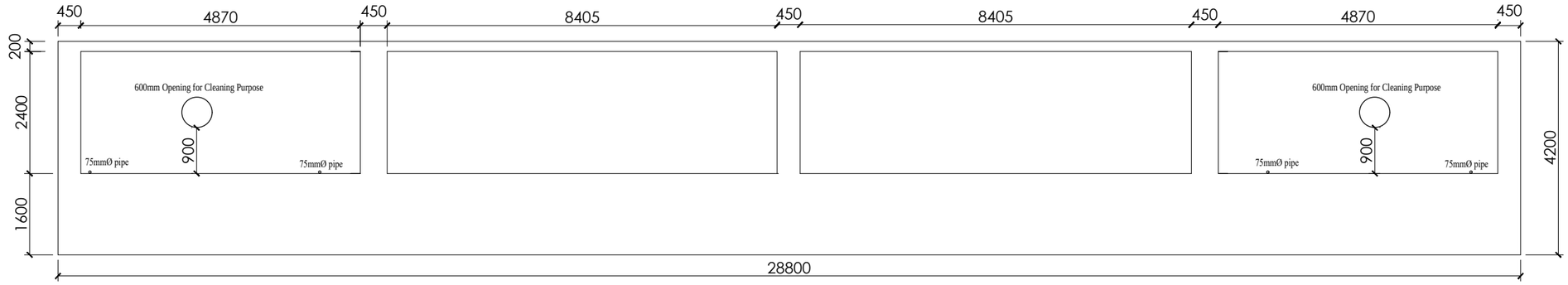
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

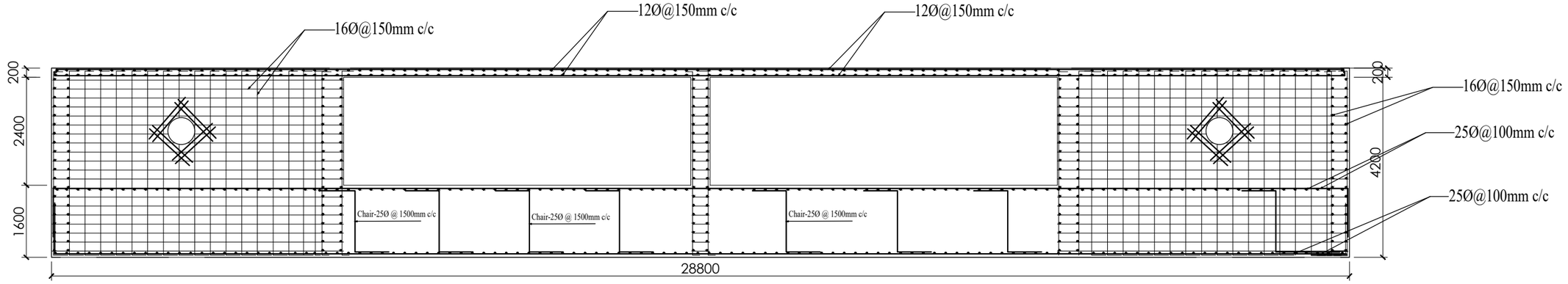
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
REINFORCEMENT DETAILS FOUNDATION

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:150	4	
DRAWING No.	OHT-10	5	



BRACING WALL SECTION AT Z-Z



BRACING SHEAR WALL SECTION AT Y-Y

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

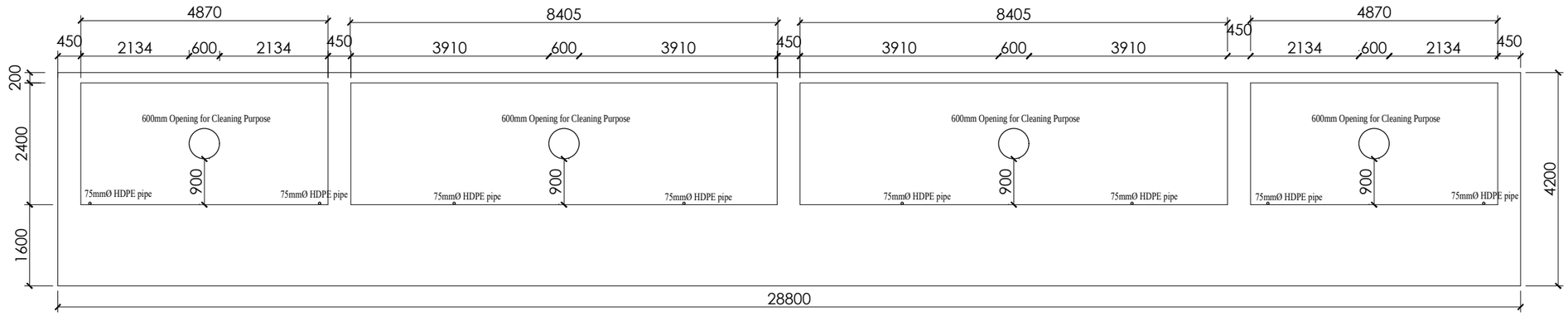
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

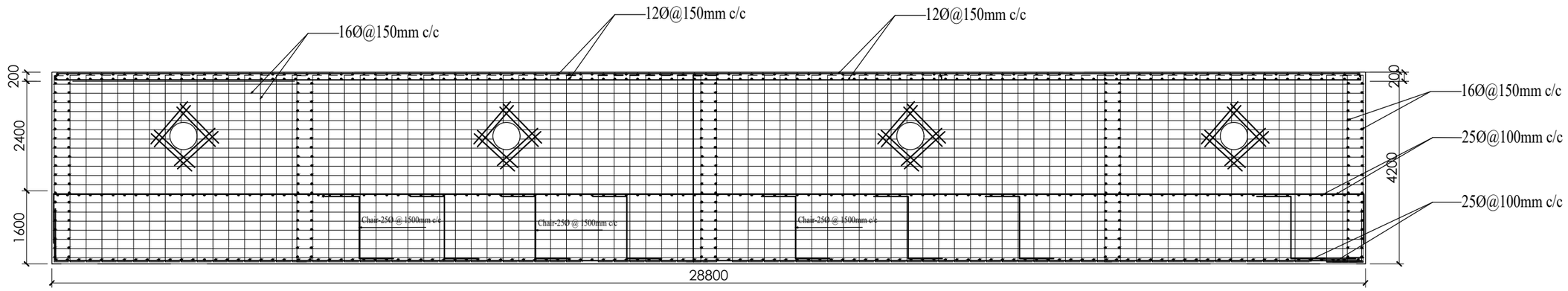
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
BRACING SHEAR WALL DETAILS

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	OHT-11	5	



BRACING WALL SECTION AT Y-Y



BRACING WALL AND FOUNDATION REINFORCEMENT (SECTION AT Y-Y)

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

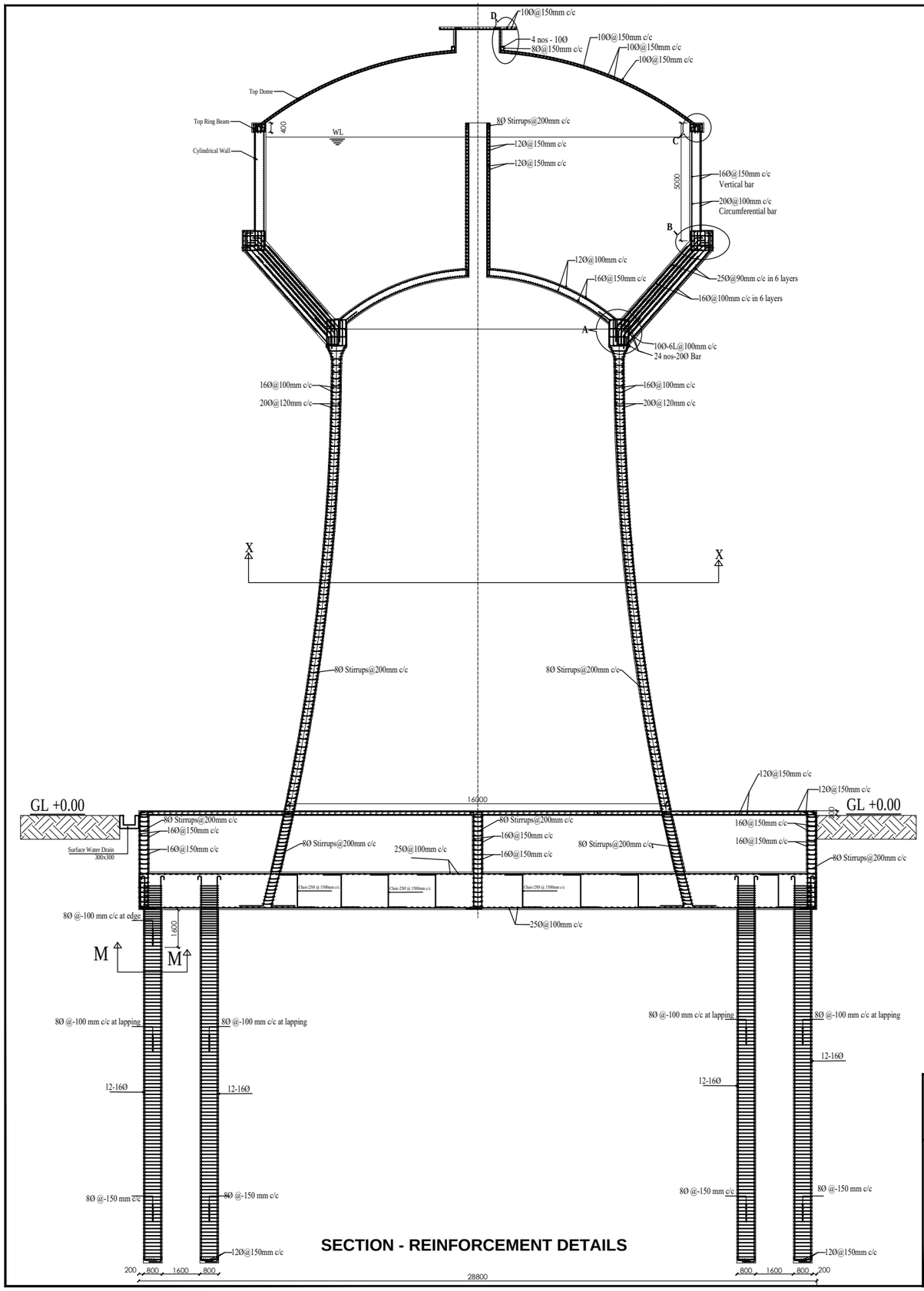
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

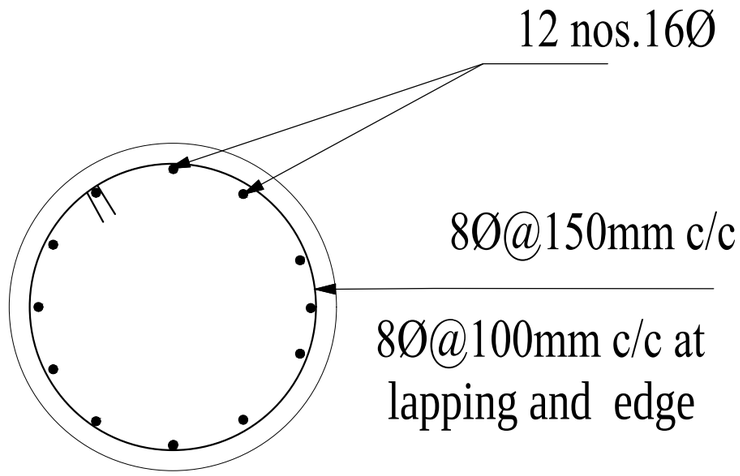
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
BRACING SHEAR WALL DETAILS

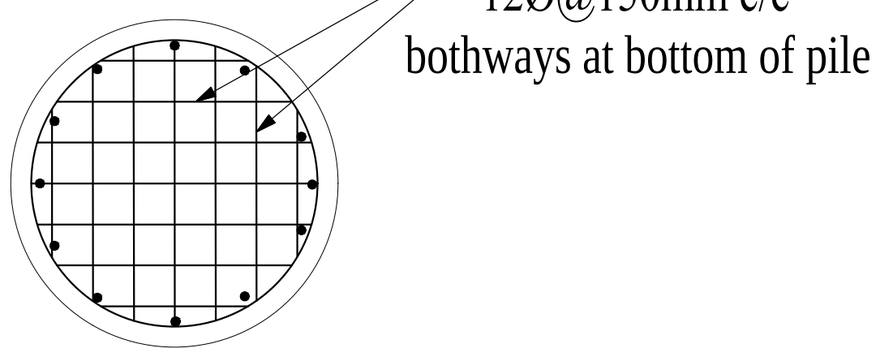
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO ES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	OHT-12	5	



SECTION - REINFORCEMENT DETAILS



PILE SECTION AT M-M



NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

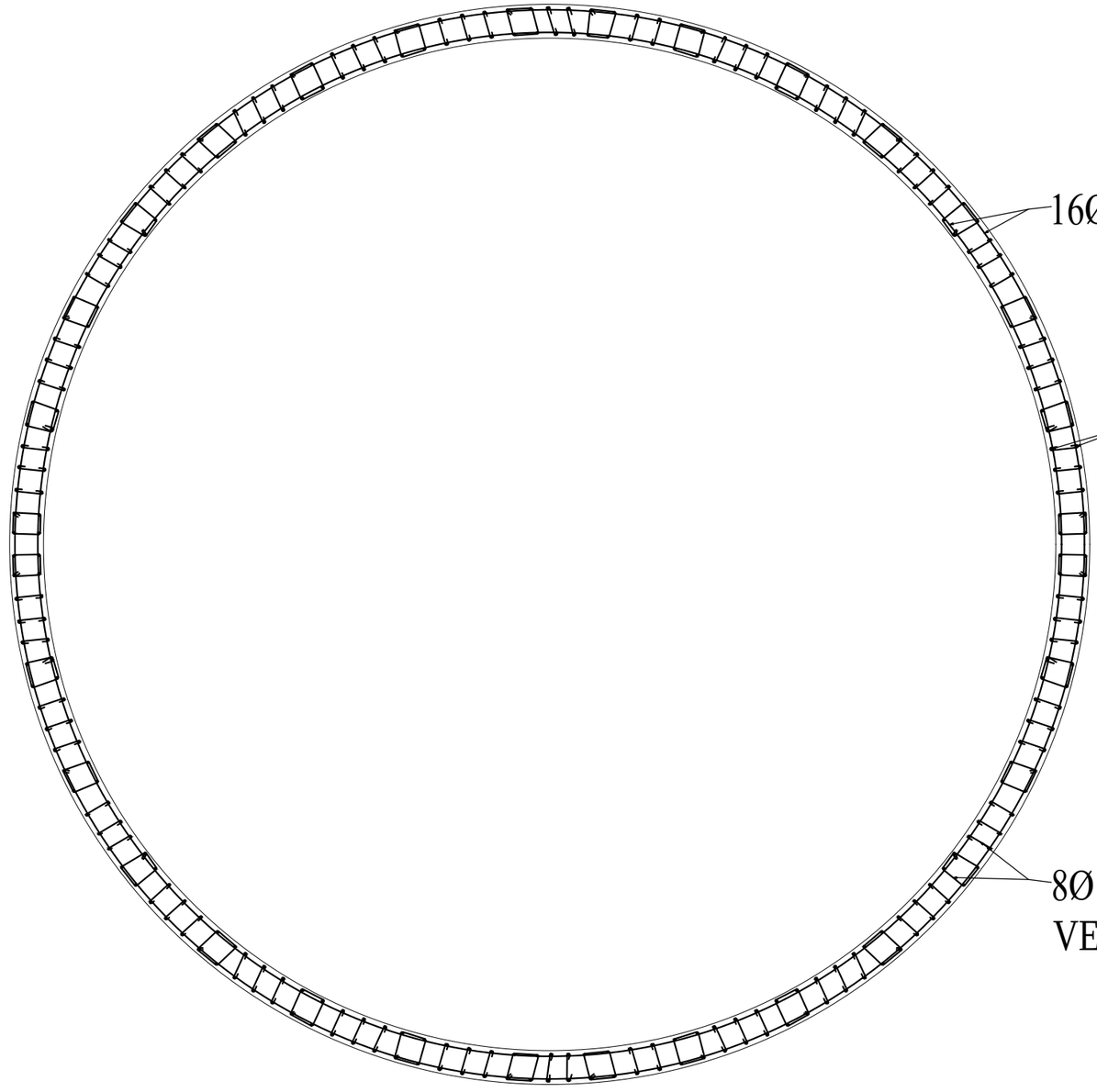
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
SECTION - REINFORCEMENT DETAILS

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:200	4	
DRAWING No.	OHT-13	5	



RC SHAFT SECTION AT X-X

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

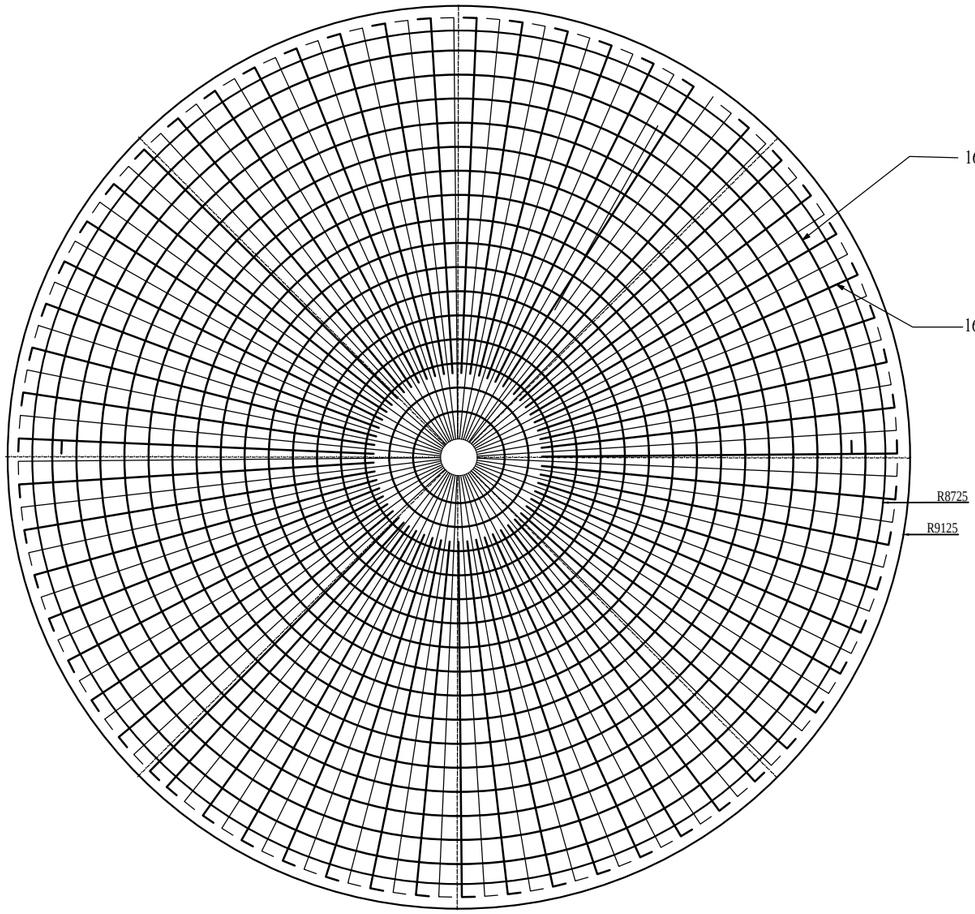
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

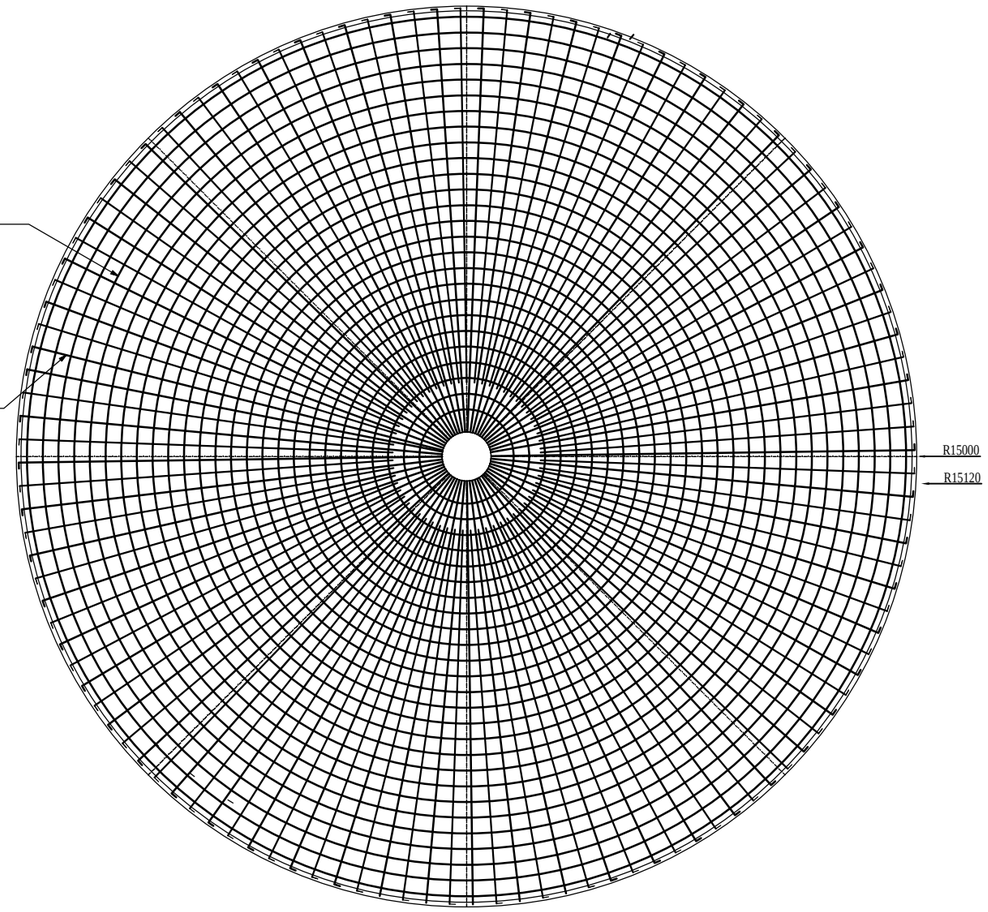
IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
RC SHAFT SECTION AT X-X

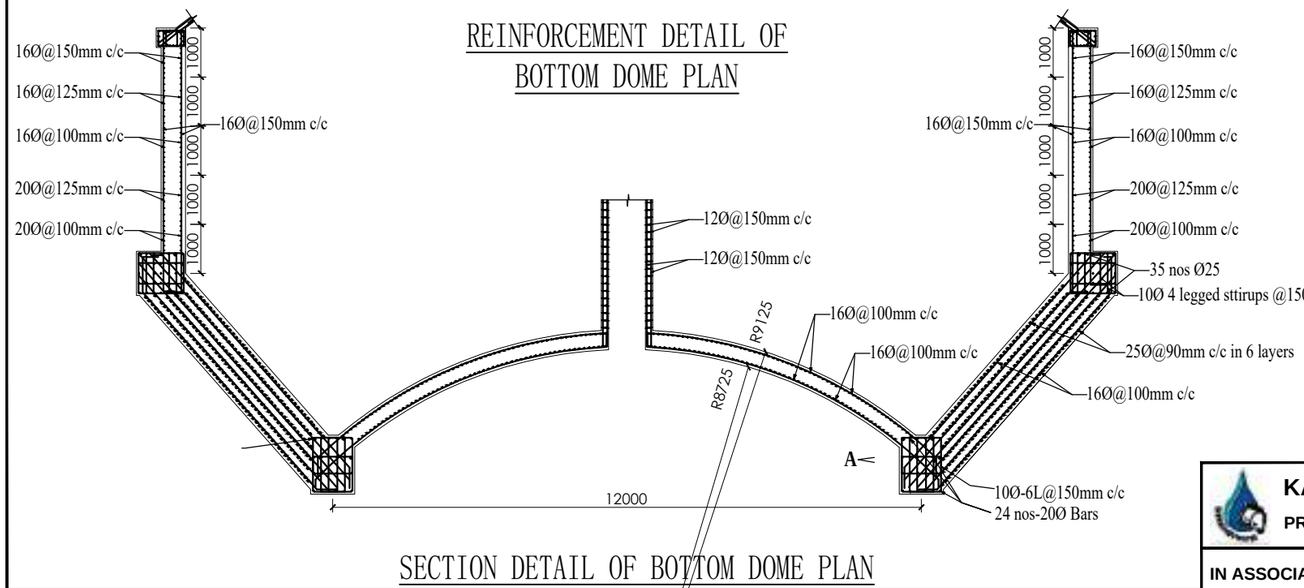
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:75	4	
DRAWING No.	OHT-14	5	



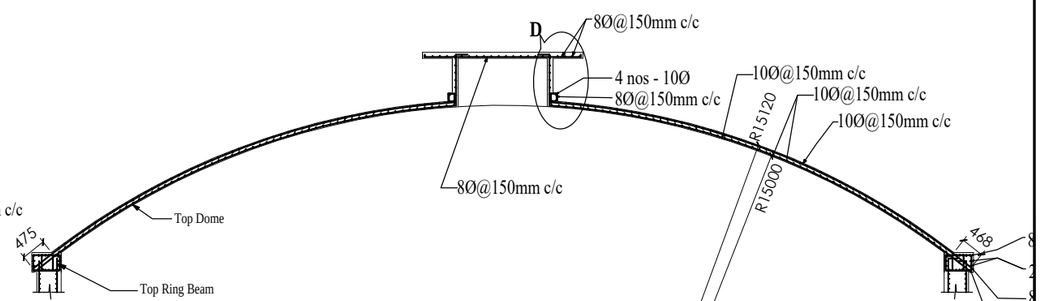
REINFORCEMENT DETAIL OF
BOTTOM DOME PLAN



REINFORCEMENT DETAIL OF
TOP DOME PLAN



SECTION DETAIL OF BOTTOM DOME PLAN



SECTION DETAIL OF TOP DOME PLAN

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

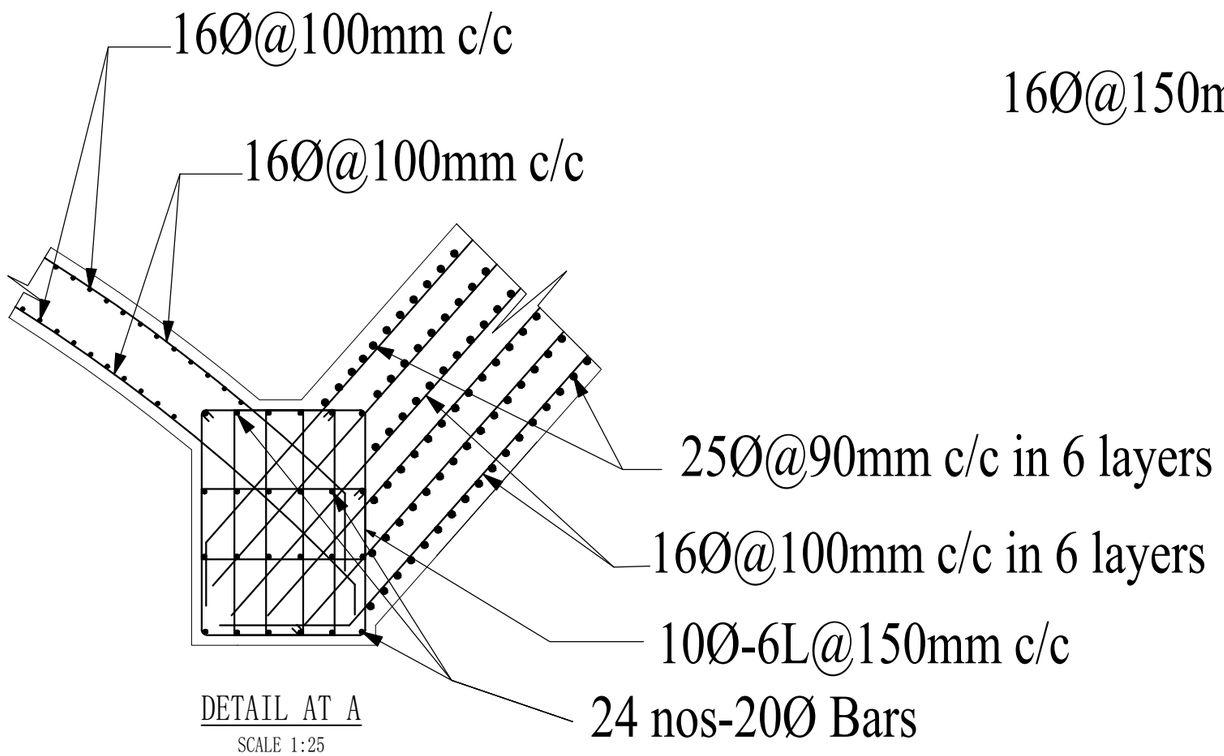
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

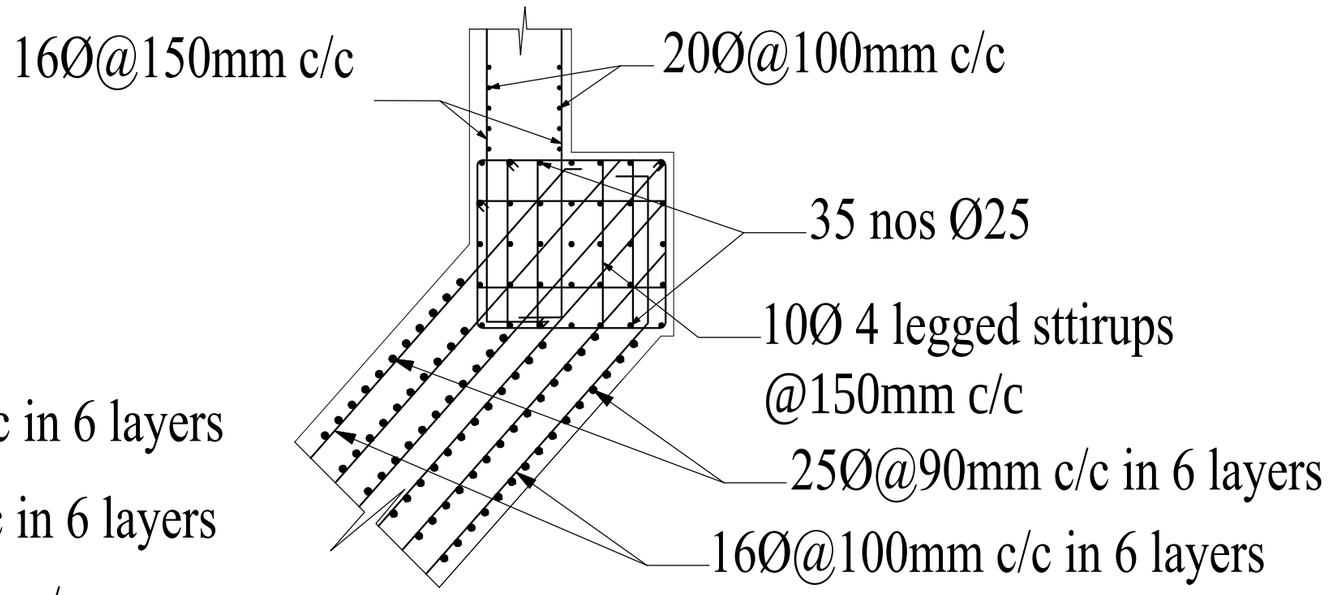
IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: SKV/ S2- KIRTIPUR
DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
BOTTOM & TOP DOME DETAIL

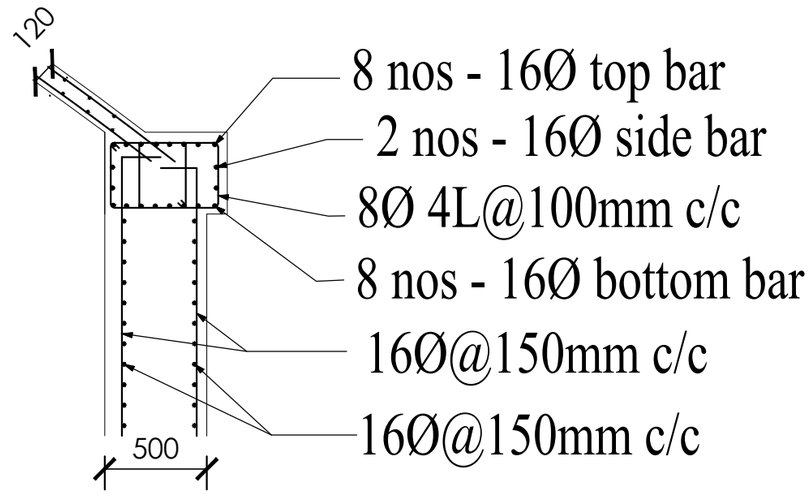
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:125	4	
DRAWING No.	OHT-15	5	



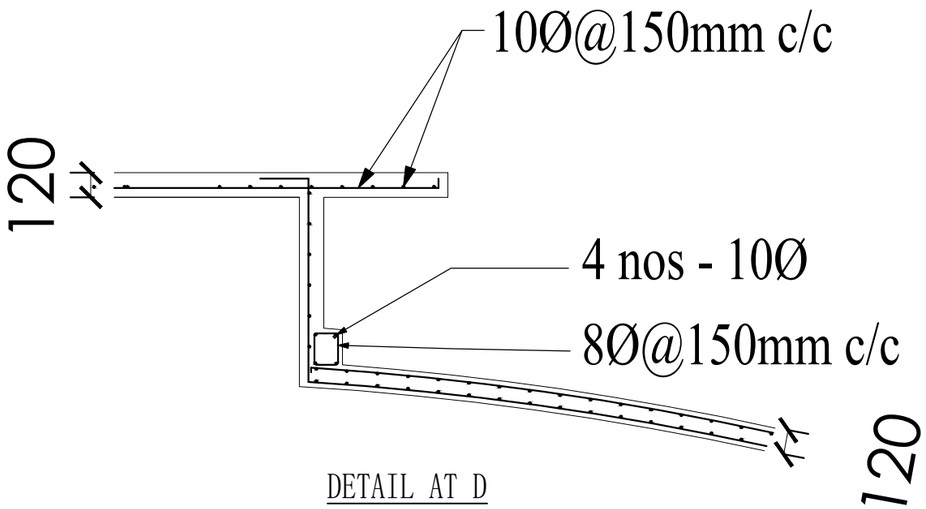
DETAIL AT A
SCALE 1:25



DETAIL AT B
SCALE 1:25



DETAIL AT C
SCALE 1:25



DETAIL AT D
SCALE 1:25

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

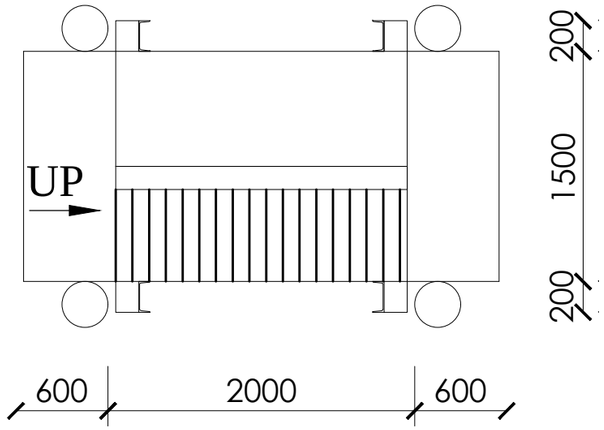
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

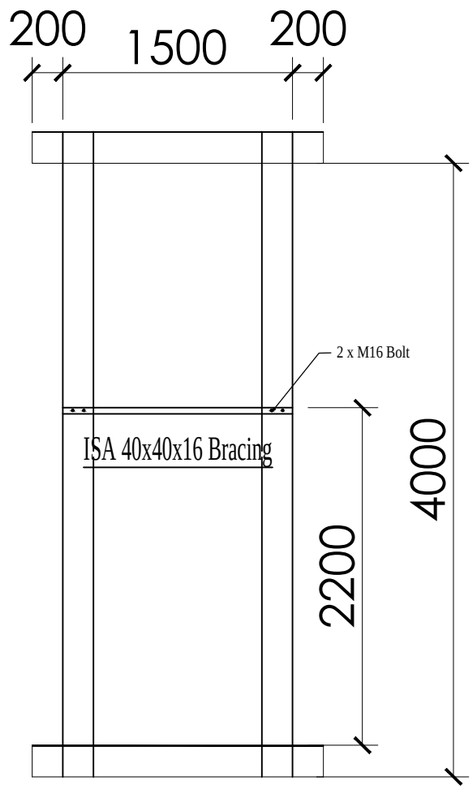
PACKAGE: SKV/ S2- KIRTIPUR

DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
CONNECTION DETAIL

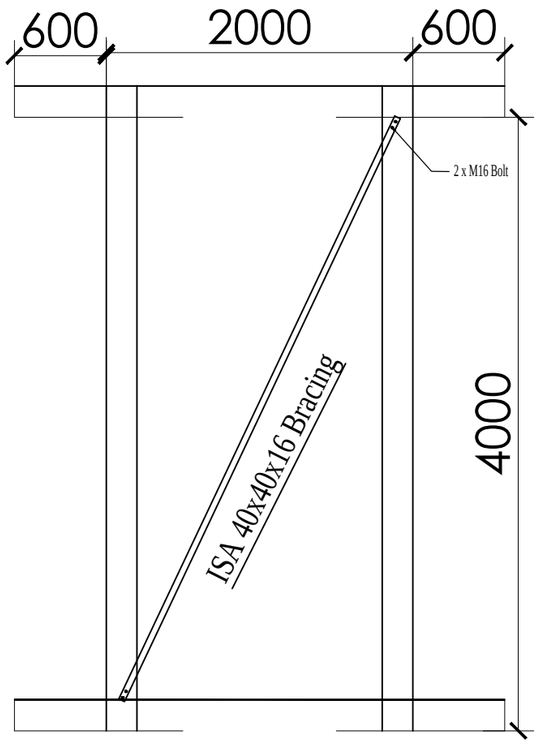
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:30	4	
DRAWING No.	OHT-16	5	



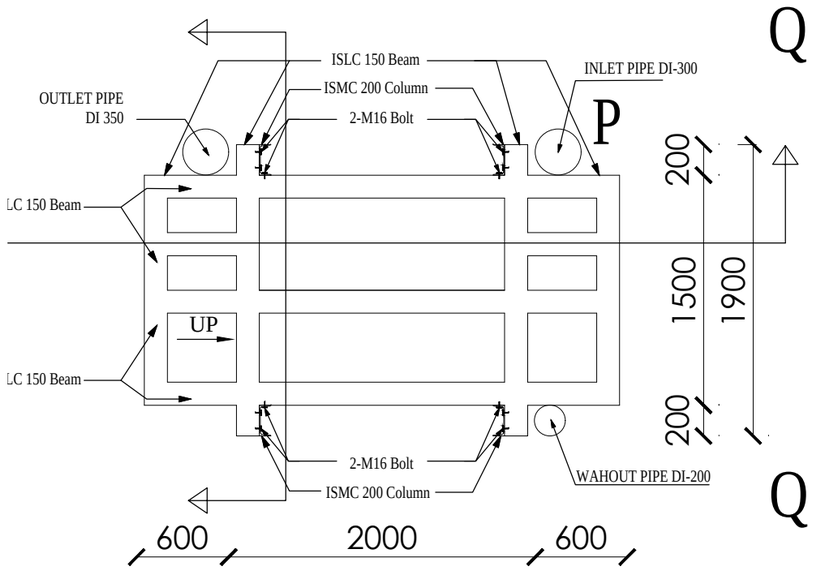
STAIR PLAN



SECTION at Q-Q



SECTION at P-P



STAIR BEAM AND COLUMN PLAN

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

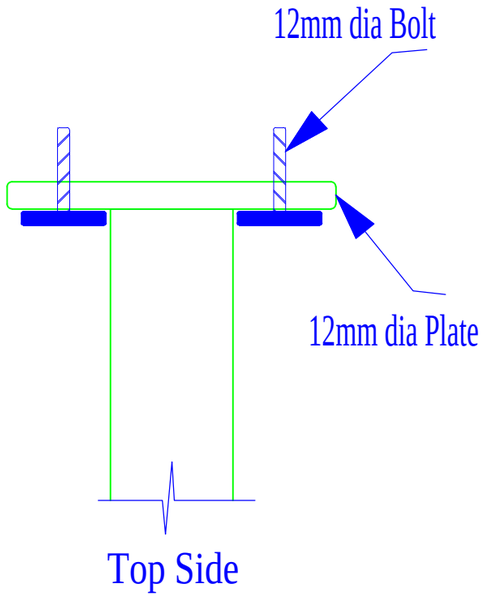
KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

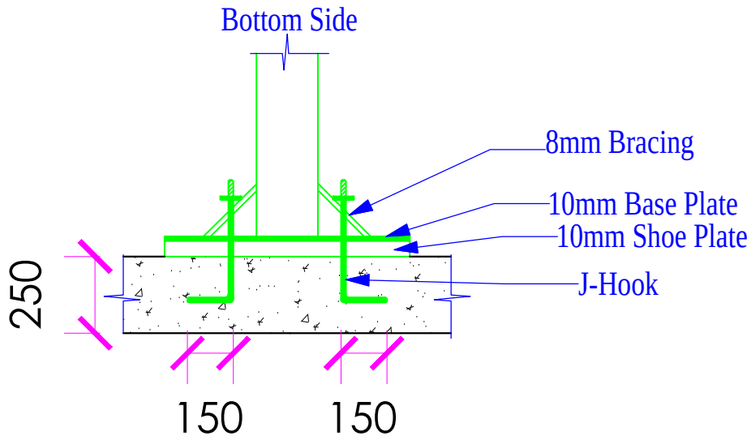
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:	Jan-2024
PACKAGE:	PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE:	KRITIPUR OVER HEAD TANK CIVIL STRUCTURE CONNECTION DETAILS

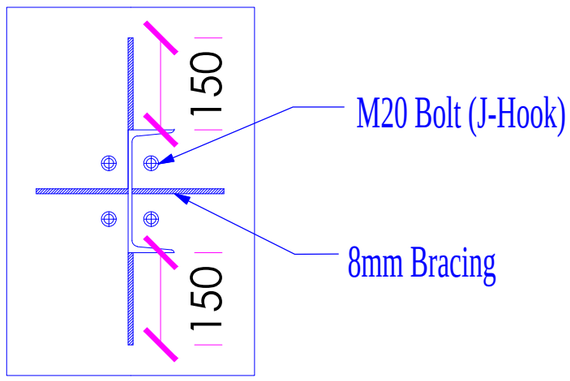
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO-DES	2	
DATE:	Jan-2024	3	
SCALE:	1:40	4	
DRAWING No.	OHT-17	5	



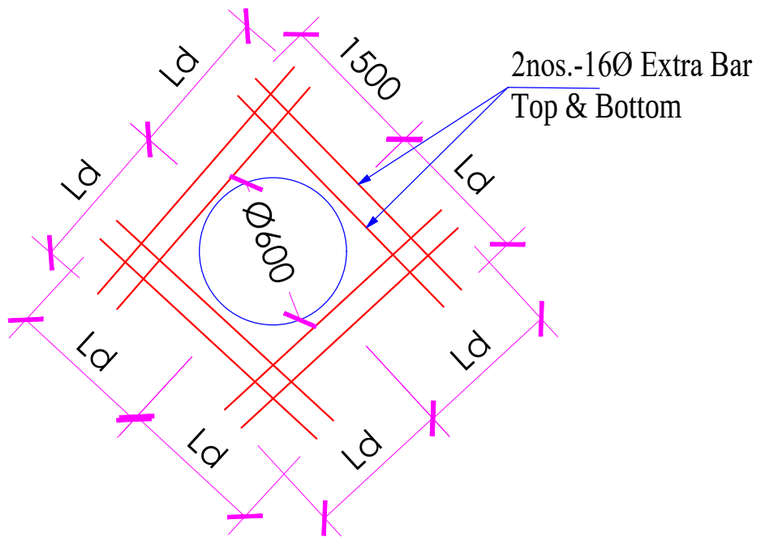
Stair Connection Details



Stair Connection Details



Connection Details at Foundation



Typical Drawing of Opening

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

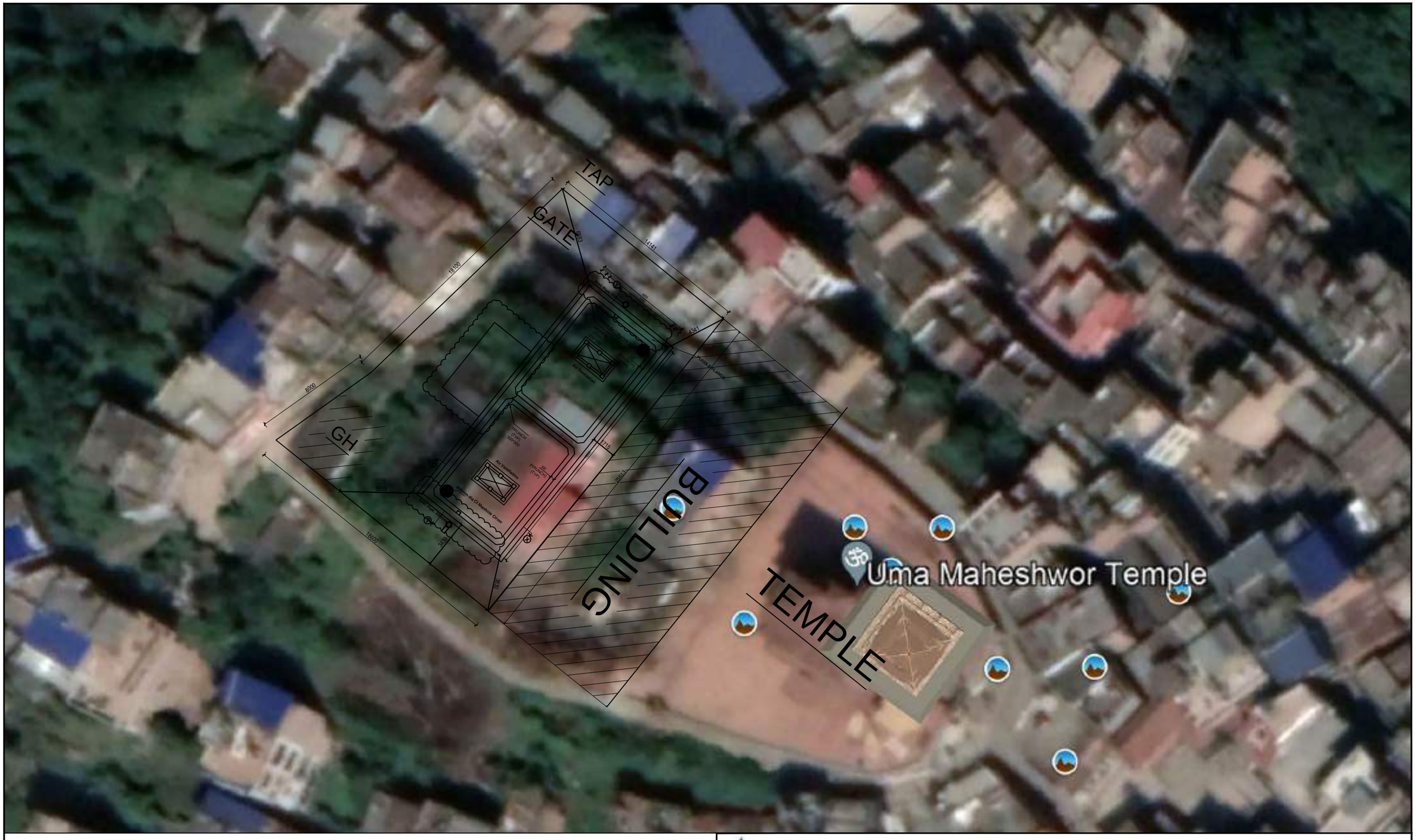
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHSE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KRITIPUR OVER HEAD TANK
CIVIL STRUCTURE
TYPICAL DETAILS

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:10	4	
DRAWING No.	OHT-18	5	



NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

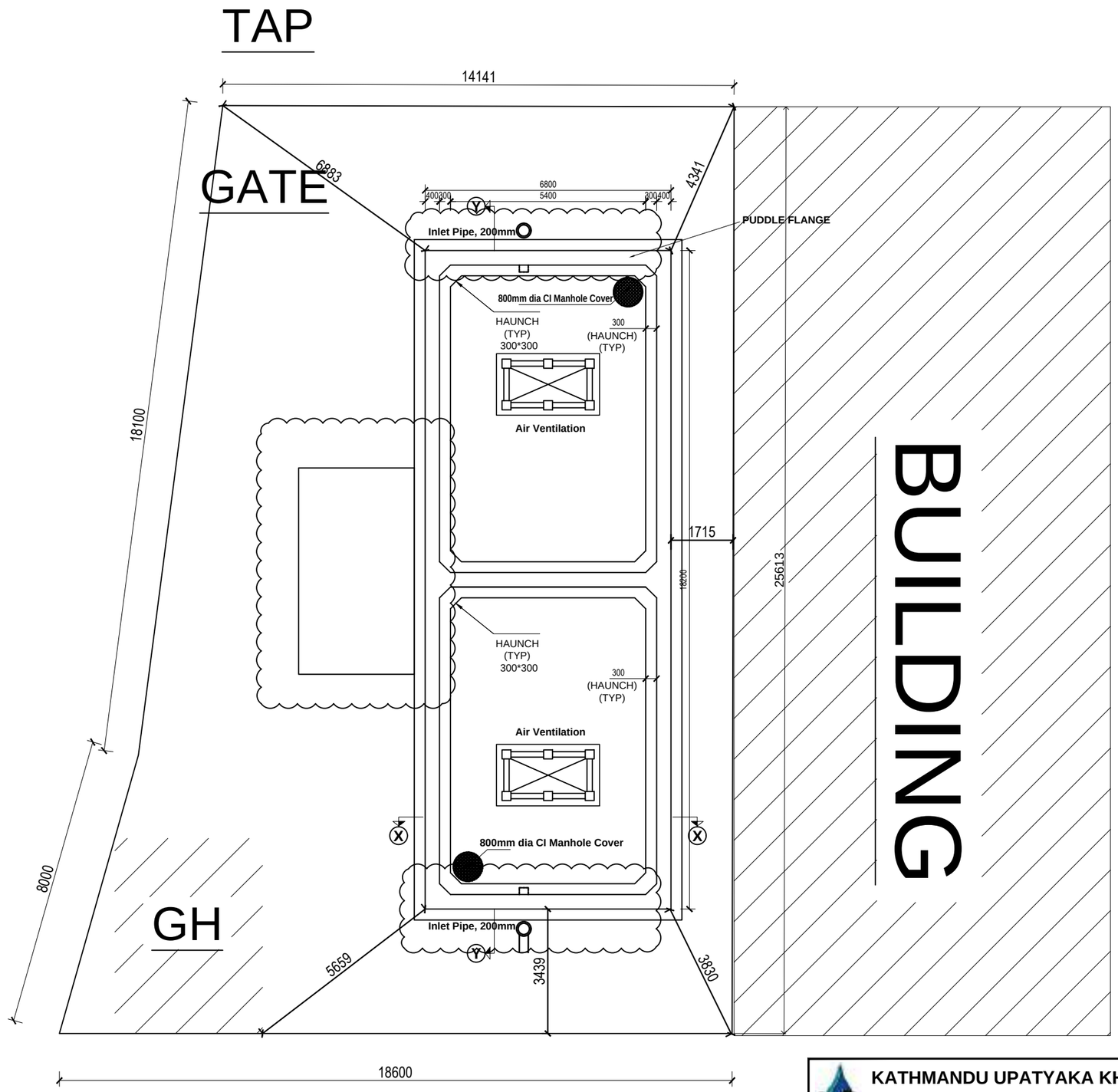
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KWACHO RVT SITE PLAN LAYOUT PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRIA[illegible]ES	2	
DATE:	Jan-2024	3	
SCALE:	1:250	4	
DRAWING No.	RVTK-1	5	



TEMPLE

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KWACHO RVT
LAYOUT PLAN
STRUCTURAL DRAWING

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:130	4	
DRAWING No.	RVTK-2	5	

General Notes:

1. STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH RELEVANT ARCHITECTURAL DRAWINGS AND IN ANY CONFLICT HAVE TO SETTLED WITH CONSULTANT BEFORE EXCECUTION OF CONSTRUCTION WORK.
2. UNLESS SPECIFIED OTHERWISE, ALL LEVELS SHOWN IN STRUCTURAL DRAWINGS ARE STRUCTURAL LEVELS ONLY.
3. DO NOT SCALE FOLLOW WRITTEN DIMENSION ONLY
4. ALL DIMENSION & LEVEL ARE IN MILIMETERS UNLESS NOTED OTHERWISE. ALL DIMENSION TO BE VERIFIED ON SITE & APPROVED BY THE ENGINEER
5. GRADE OF CONCRETE MIX SHALL BE M-30 FOR RAFT, BEAM, WALL, SLAB ETC UNLESS NOTED, CONFORMING TO IS:456-2000.
6. REINFORCEMENT SHALL BE HIGH STRENGTH STEEL OF GRADE Fe:500D CONFORMING TO IS: 1786-2008.
7. CLEAR COVER TO BARS
   a. FOR CONCRETE MEMBERS IN CONTACT WITH SOIL = 50mm
   b. FOR LONGITUDINAL (VERTICAL) BARS IN COLUMN = 40mm
   c. FOR MAIN BARS IN BEAMS = 35mm
   d. FOR OUTER BARS IN SLAB = 25mm
   e. FOR SHEAR WALL = 40mm
9. BARS SPLICING IN BEAM SHALL BE AVOIDED IN THE SPAN WHERE INTERMEDIATE BEAM IS CONNECTED AND SHALL BE ONLY AS SHOWN ON DWG.
10. DEVELOPMENT / LAP LENGTH (Ld.) FOR BARS.

BAR DIA-(mm)	8	10	12	16	20	25	28	32
FOR M30 Ld	260	325	390	520	650	820	910	1040

11. CLEAR VERTICAL DISTANCE BETWEEN TWO ROWS (LAYERS) OF BARS=25mm.
12. FOOT REST, PLASTIC ENCAPSULATED as per IS:10910 on 12mm dia steel bar conforming to IS 15:1789.
13. ANY DISCREPANCY NOTED BETWEEN DETAILS IN THE DRAWINGS/SPECIFICATIONS, THE MATTER SHALL BE BROUGHT TO THE NOTICE OF CONCERNED ENGINEER PRIOR TO CONSTRUCTION AND GOT RECONCILED BEFORE EXECUTION.

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

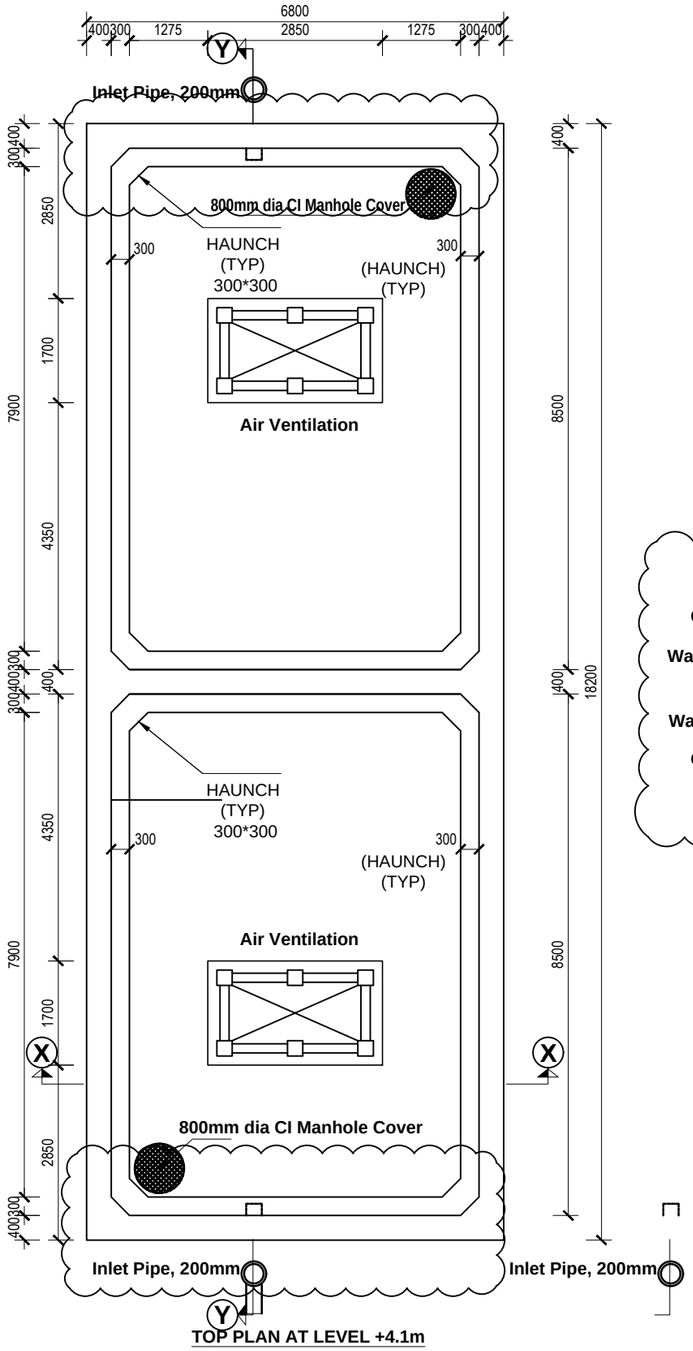
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

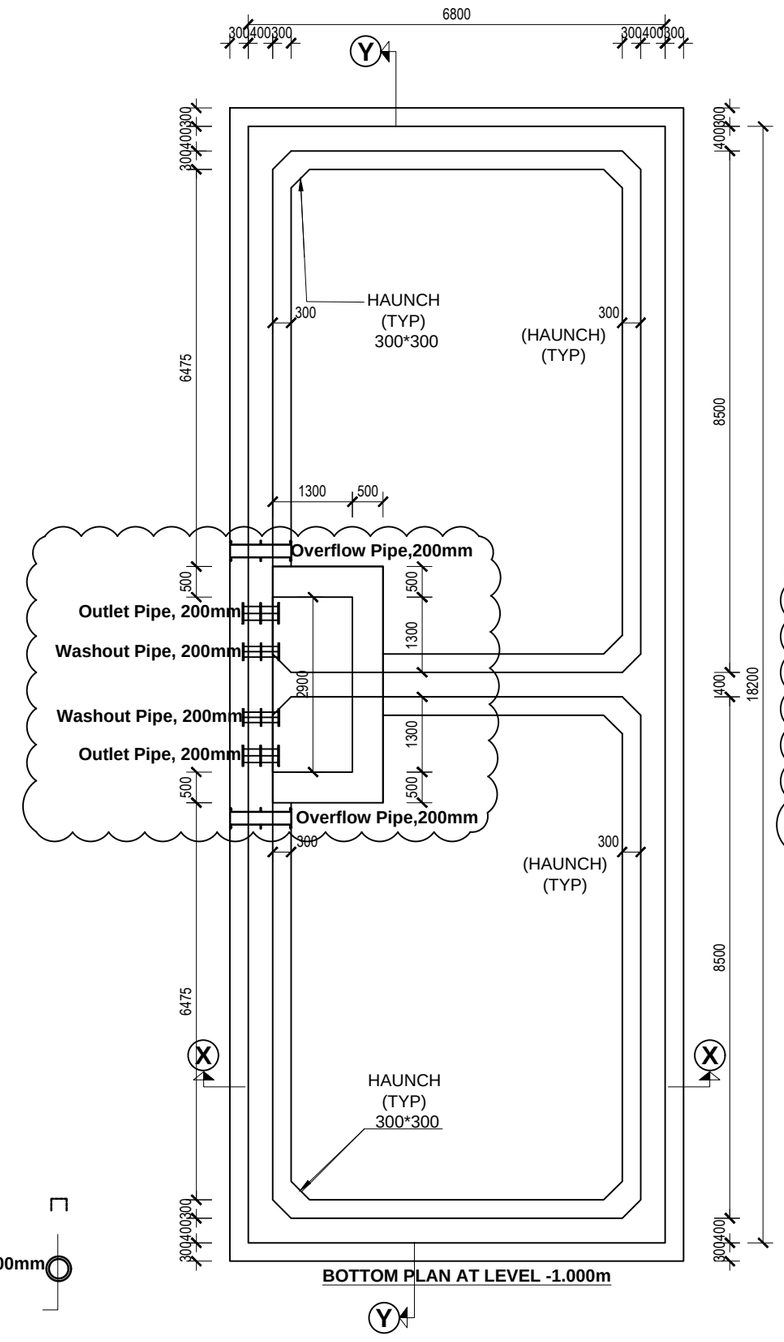
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KWACHO RVT GENERAL NOTES ARCHITECTURAL DRAWING

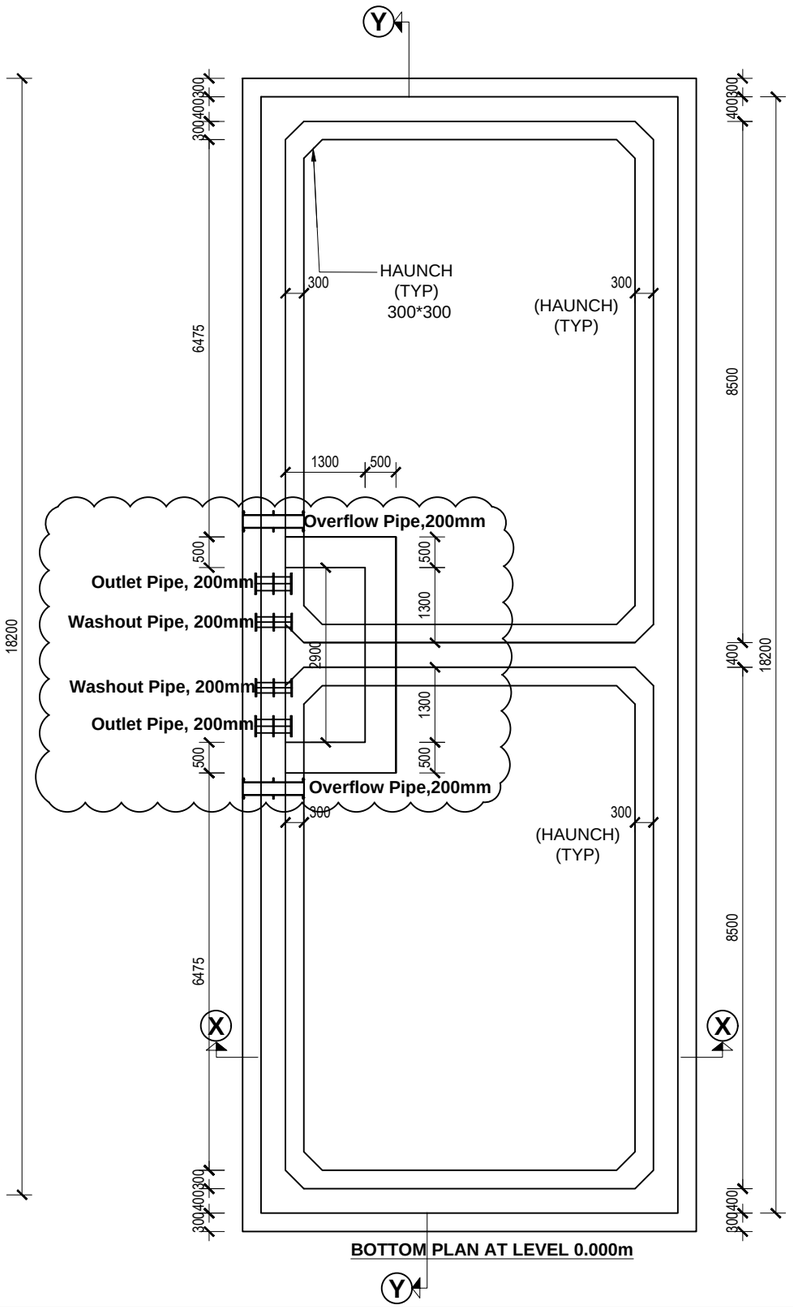
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	RVTK-3	5	



TOP PLAN AT LEVEL +4.1m



BOTTOM PLAN AT LEVEL -1.000m



BOTTOM PLAN AT LEVEL 0.000m

NOTE:
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

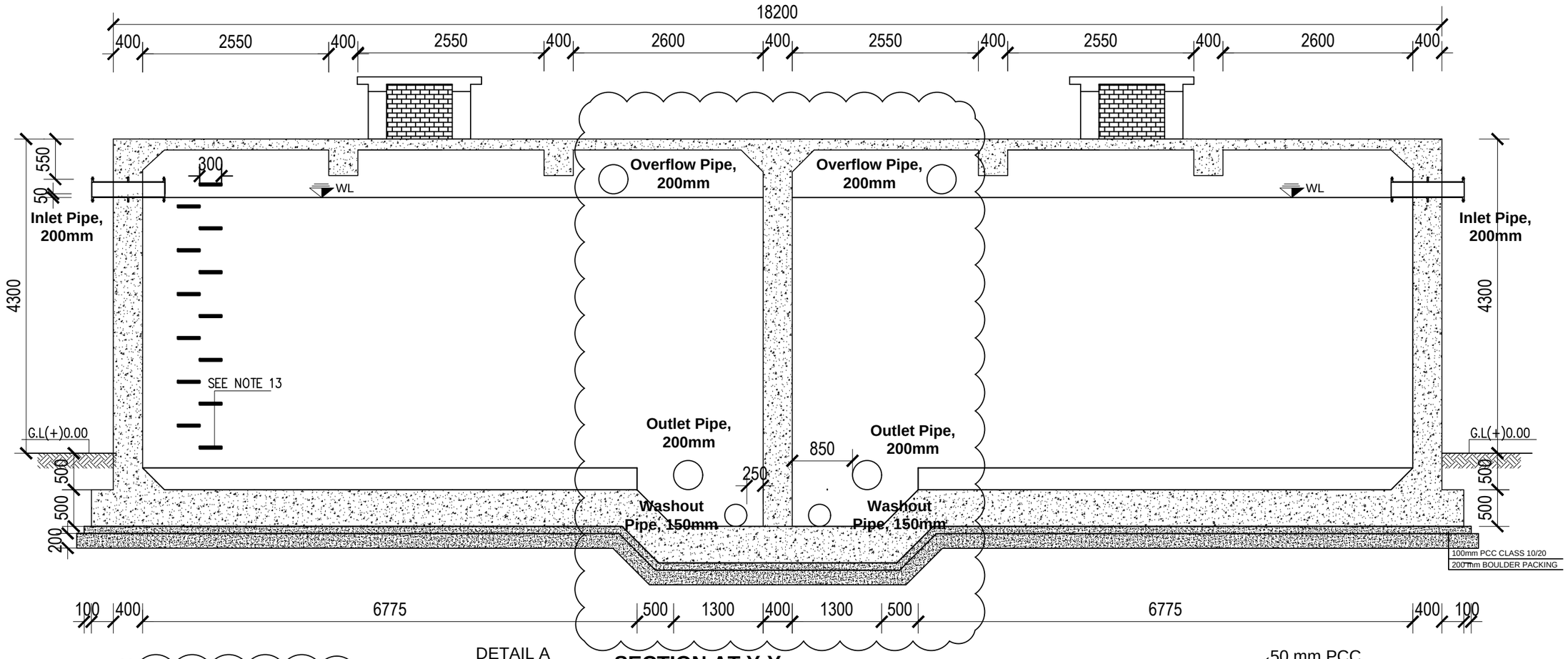
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

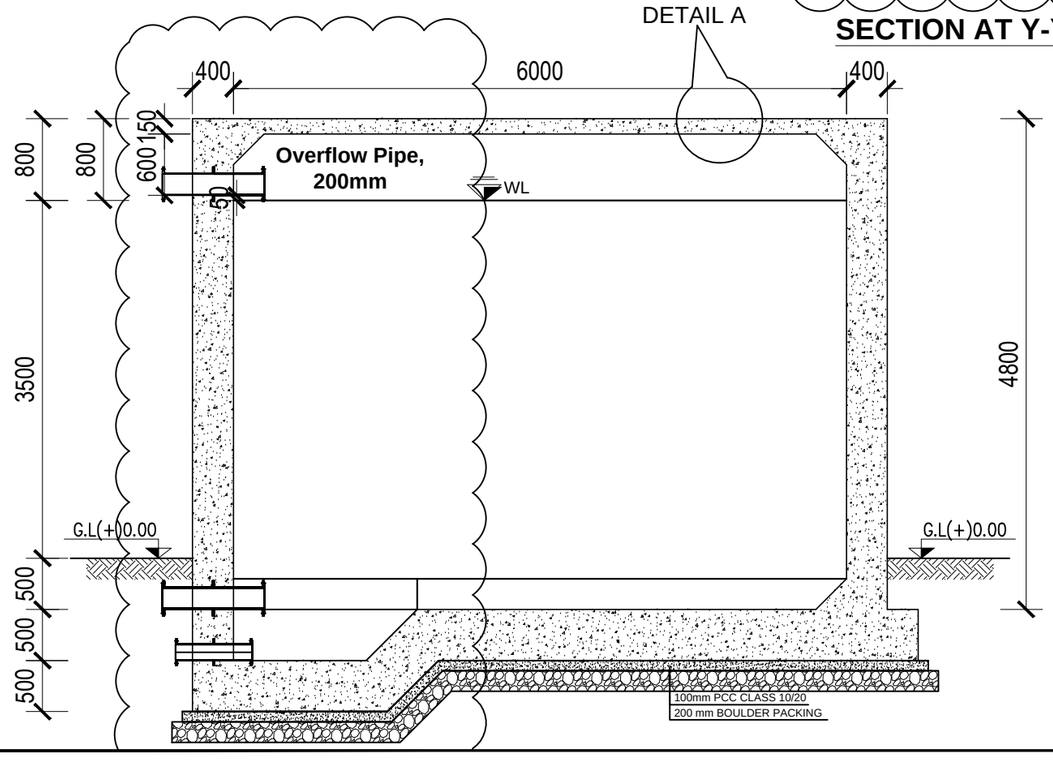
PACKAGE: PID/SKV/DNI2- KIRTIPUR

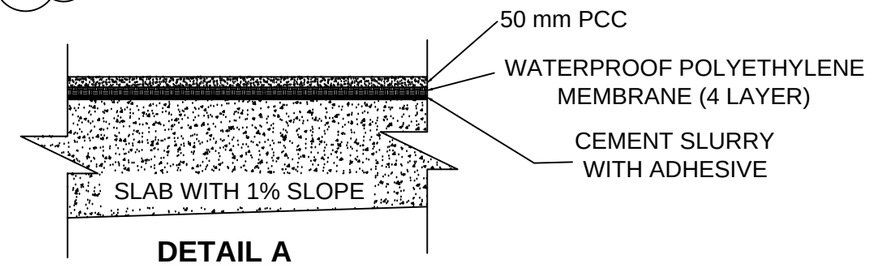
DRAWING TITLE: KWACHO RVT
PLAN VIEW
ARCHITECTURAL DRAWING

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	RVTK-4	5	



SECTION AT Y-Y





DETAIL A

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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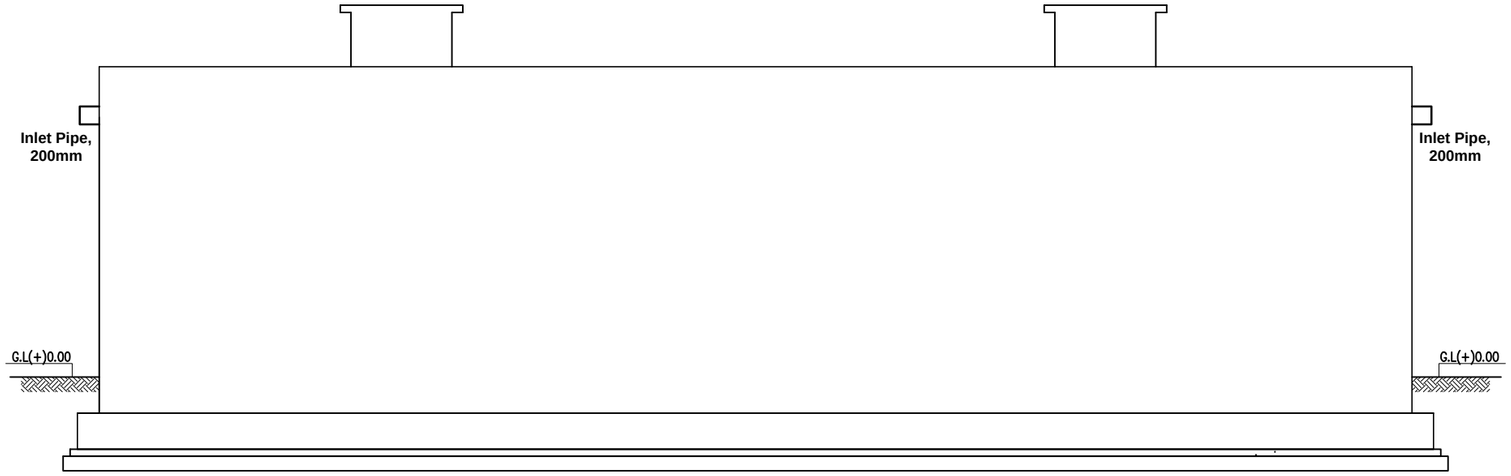
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

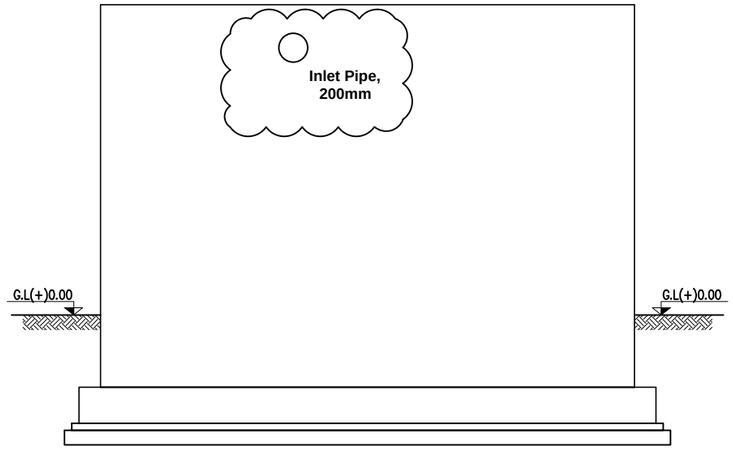
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KWACHO RVT
SECTION VIEW
ARCHITECTURAL DRAWING

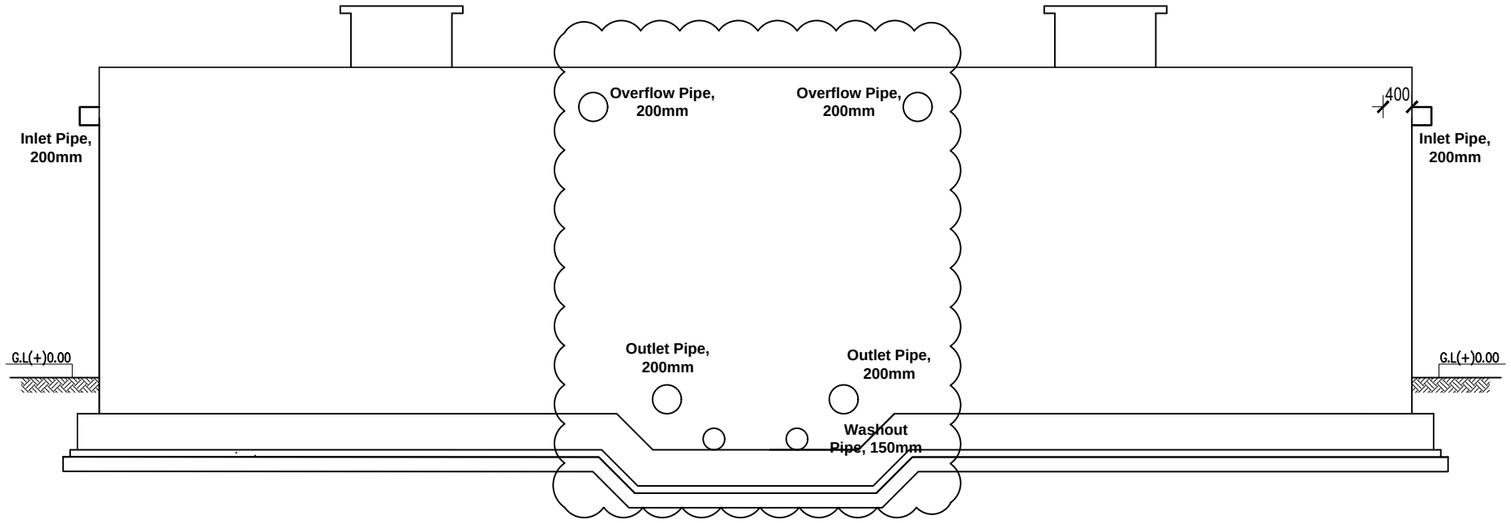
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:60	4	
DRAWING No.	RVTK-5	5	



EAST ELEVATION



NORTH ELEVATION



WEST ELEVATION

SOUTH ELEVATION

NOTE:
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KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

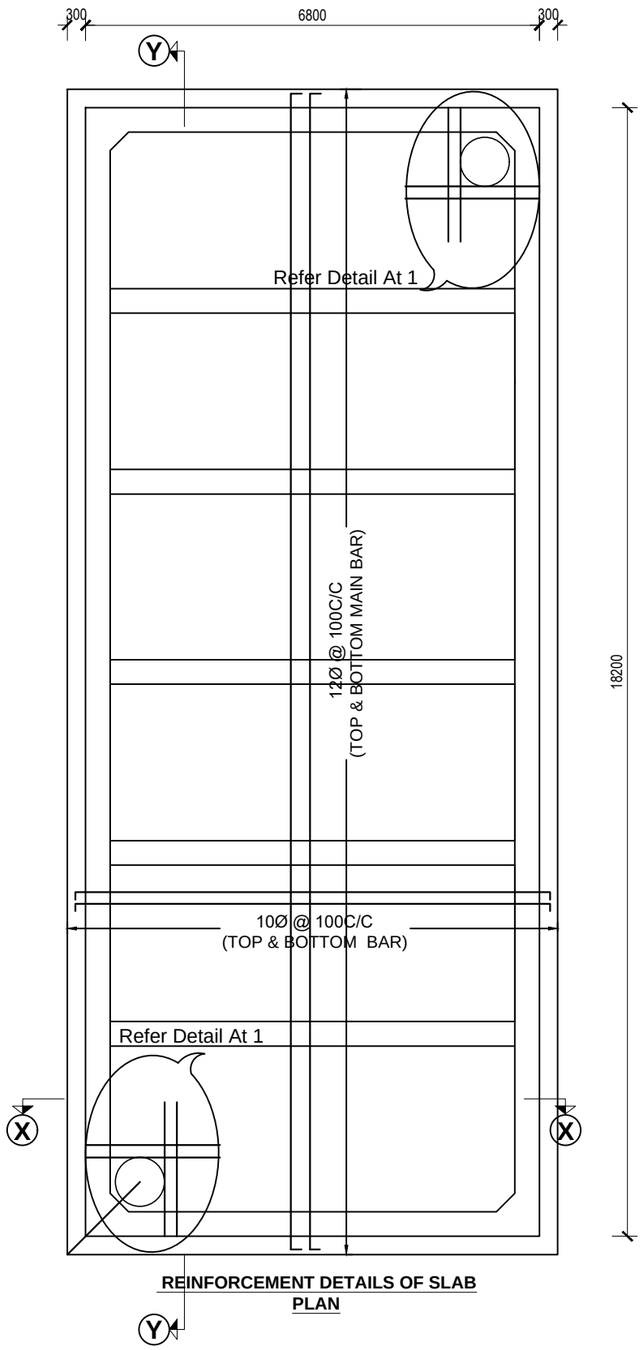
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

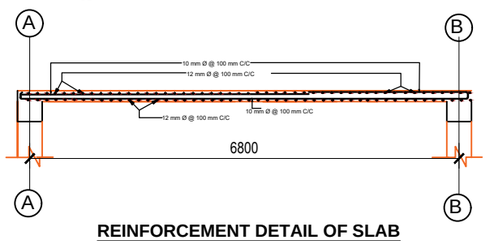
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DRAWING TITLE: KWACHO RVT
SECTION VIEW
ARCHITECTURAL DRAWING

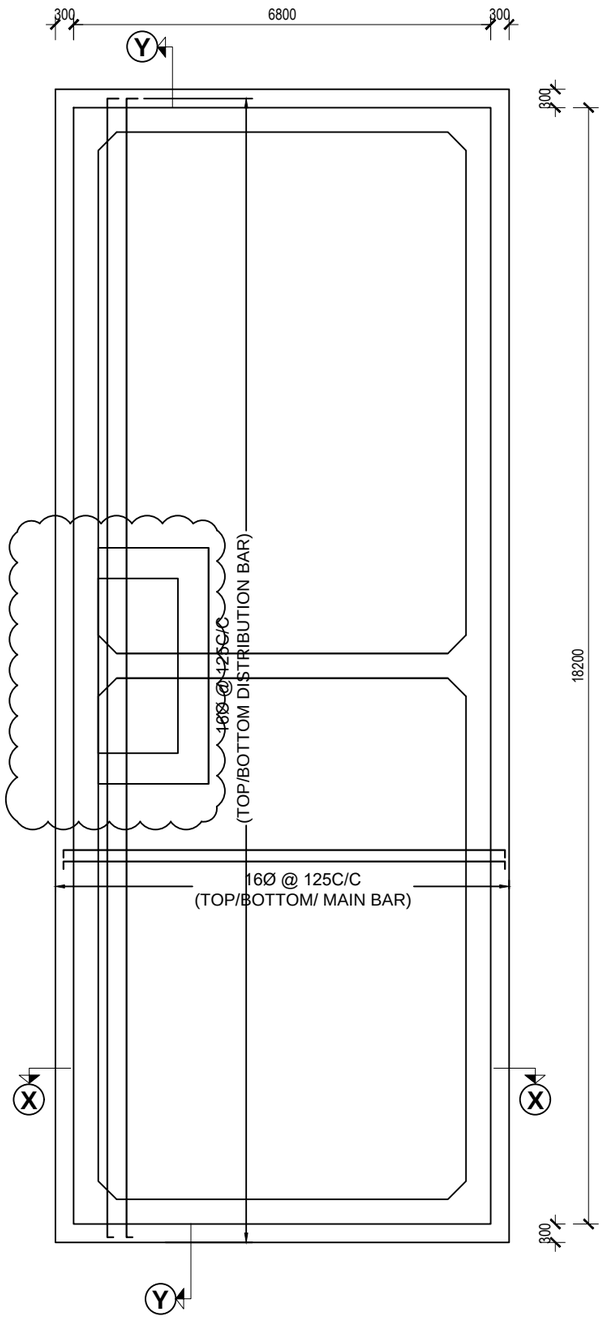
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BERMÚDES	2	
DATE:	Jan-2024	3	
SCALE:	1:85	4	
DRAWING No.	RVTK-6	5	



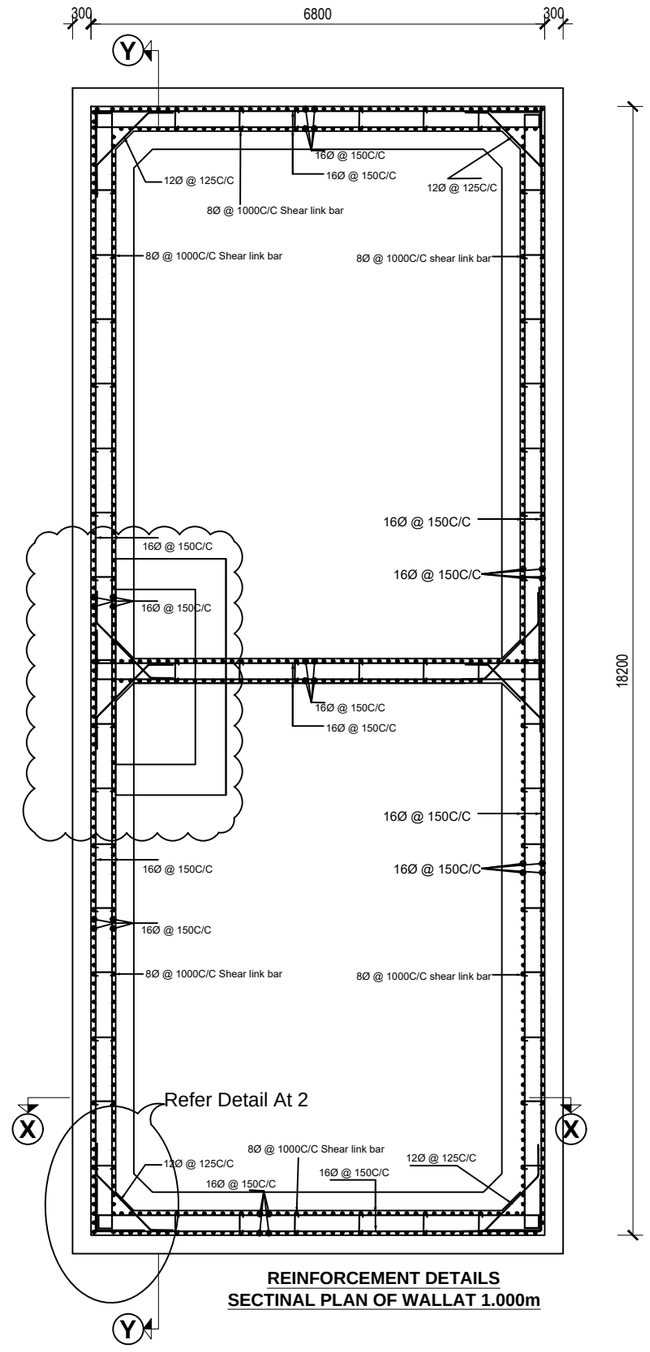
REINFORCEMENT DETAILS OF SLAB PLAN



REINFORCEMENT DETAIL OF SLAB SECTION X-X



BASE SLAB REINFORCEMENT DETAIL



REINFORCEMENT DETAILS SECTINAL PLAN OF WALLAT 1.000m

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHSE 2)

IN ASSOCIATION WITH:

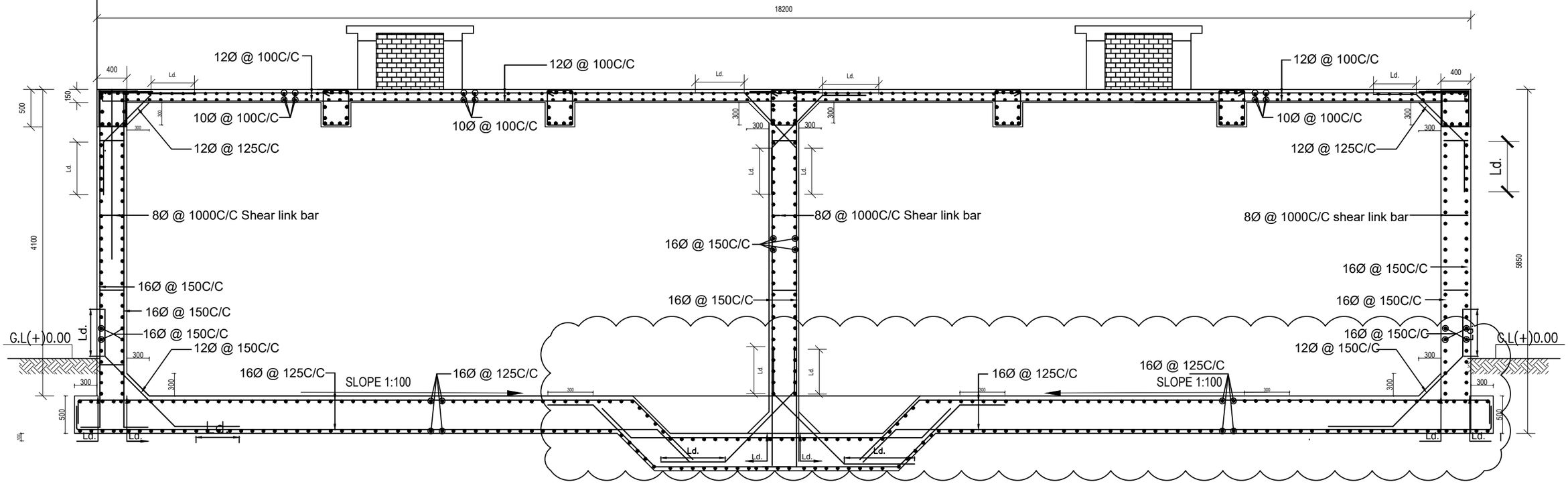
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

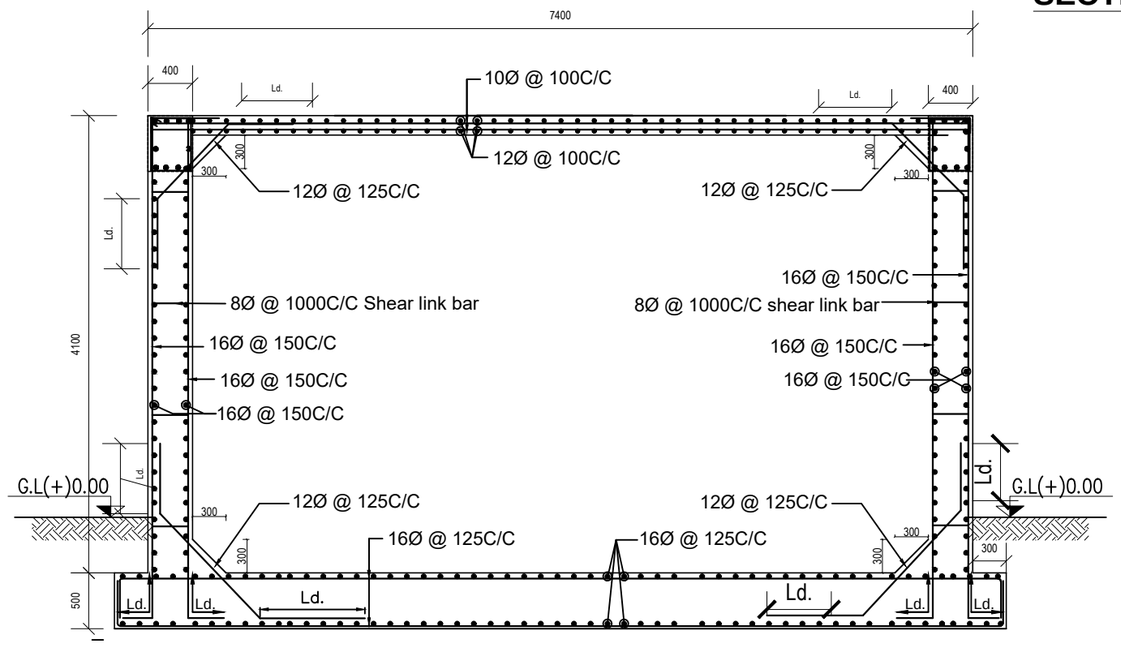
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KWACHO RVT
REINFORCEMENT DETAILS
STRUCTURAL DRAWING

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	RVTK-7	5	



SECTION AT Y-Y



SECTION AT X-X

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

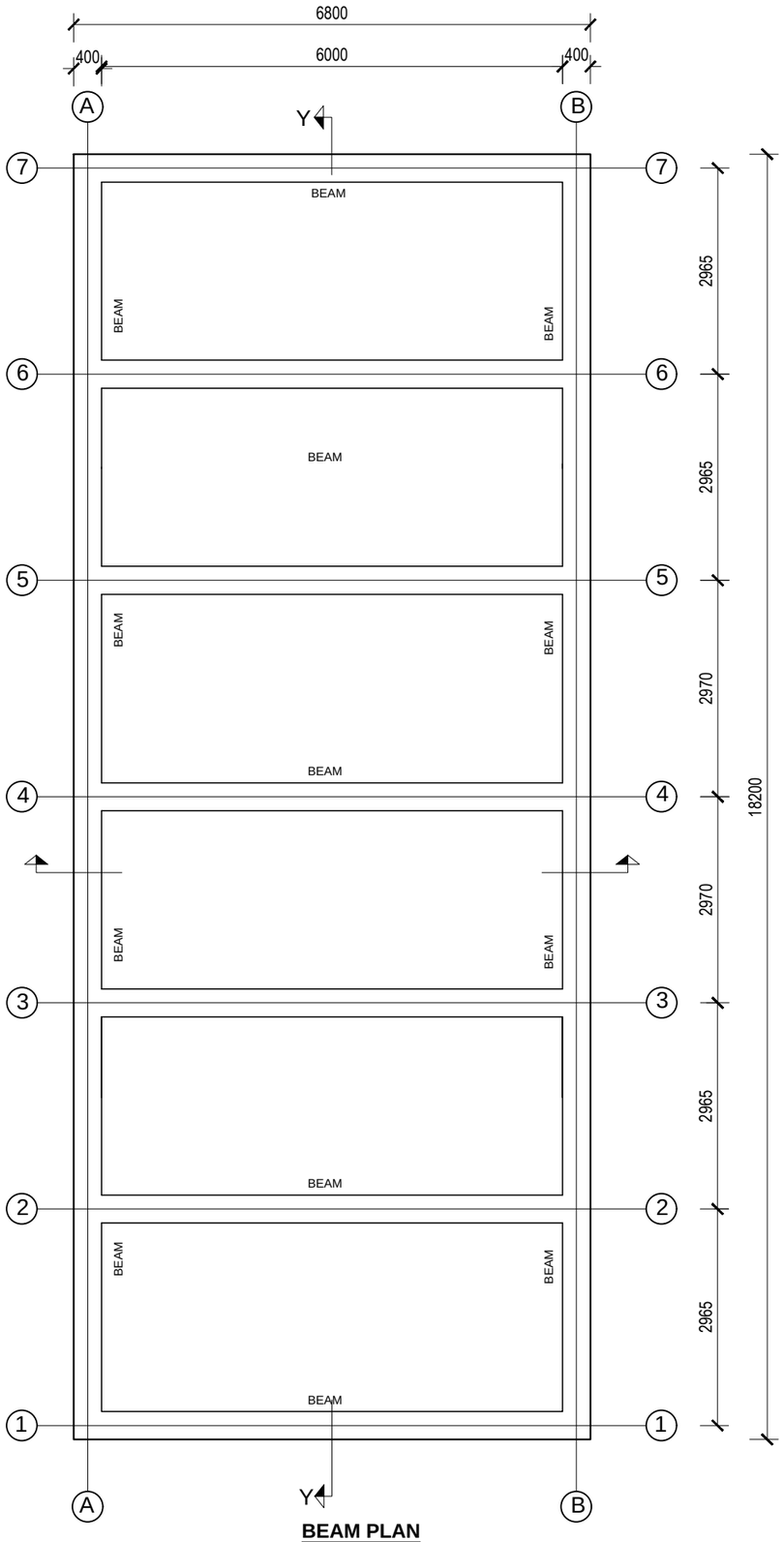
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHSE 2)

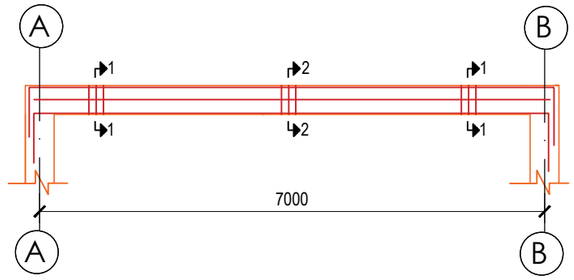
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KWACHO RVT
SECTION DETAILS
STRUCTURAL DRAWING

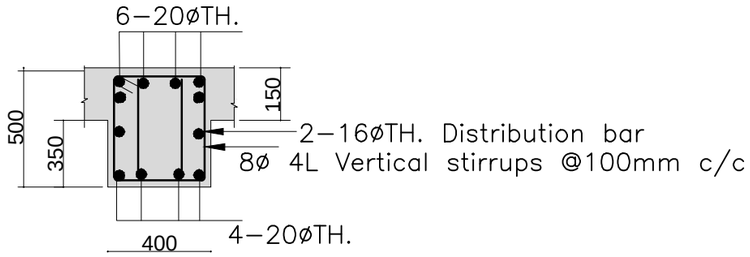
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DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:55	4	
DRAWING No.	RVTK-8	5	



BEAM PLAN

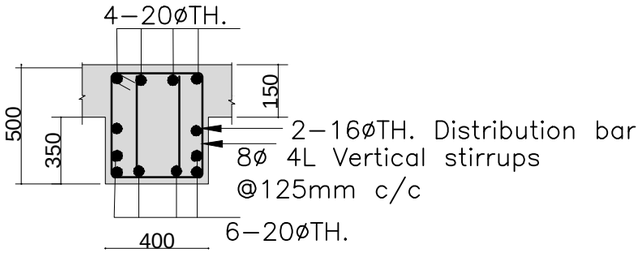


INTERMEDIATE BEAM ALONG 2-2,3-3,5-5 & 6-6



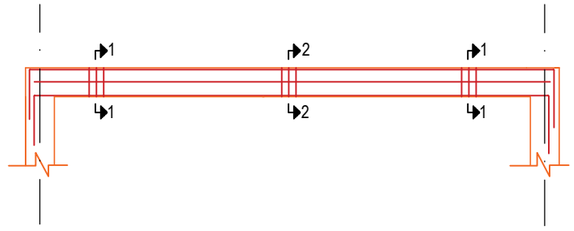
SECTION 1-1

SCALE 1:50

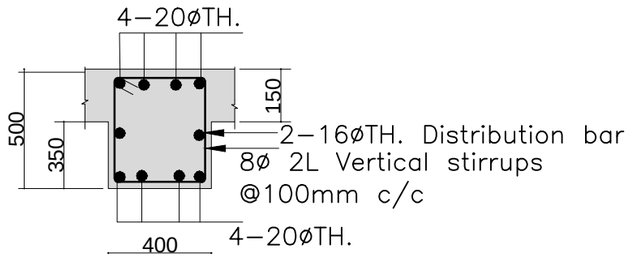


SECTION 2-2

SCALE 1:50

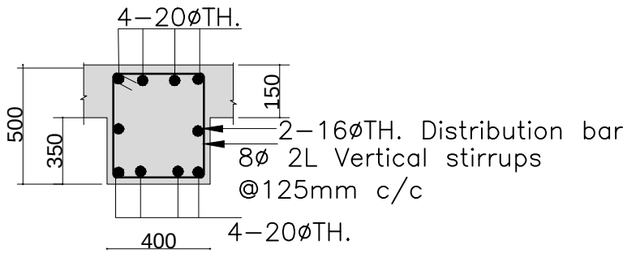


EDGE BEAM ALONG 1-1, 4-4, 7-7, A-A & B-B



SECTION 1-1

SCALE 1:50



SECTION 2-2

SCALE 1:50

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

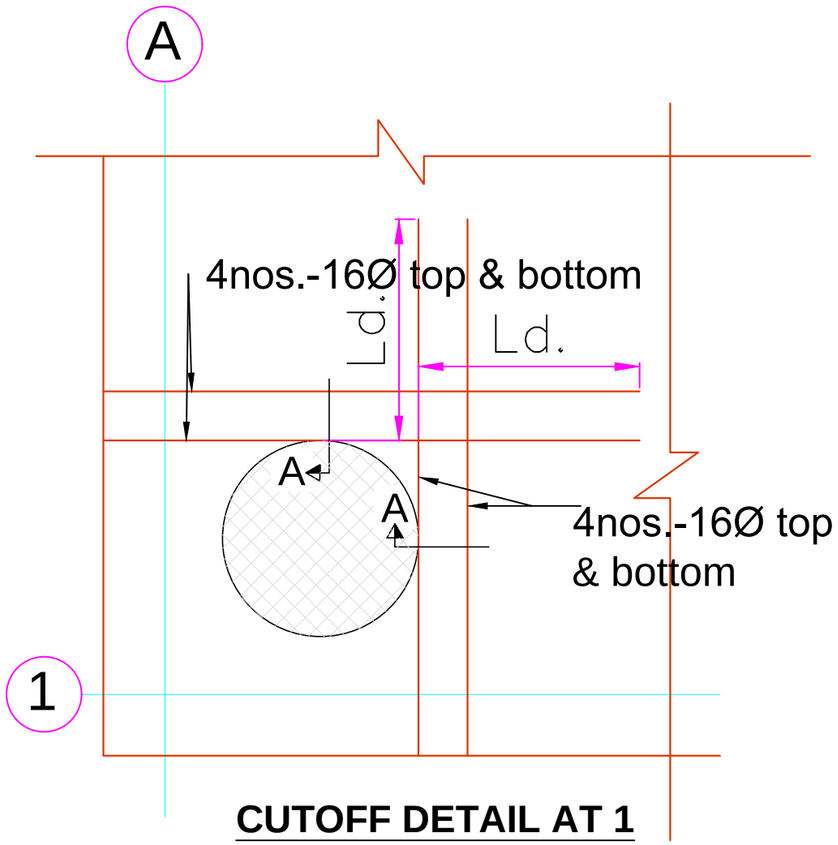
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

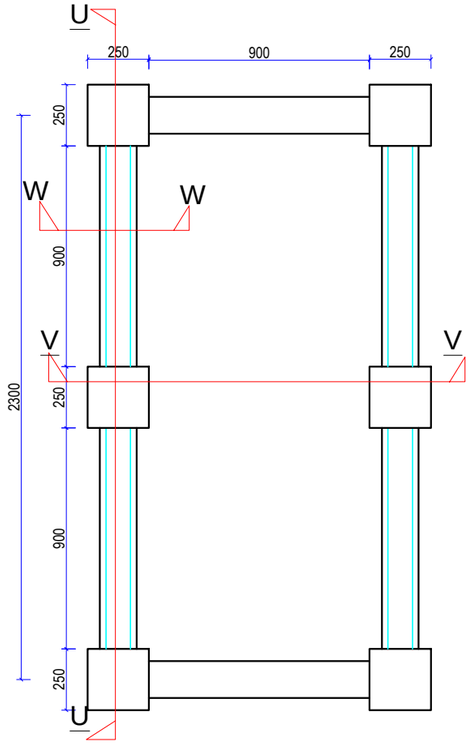
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KWACHO RVT
BEAM DETAILS
STRUCTURAL DRAWING

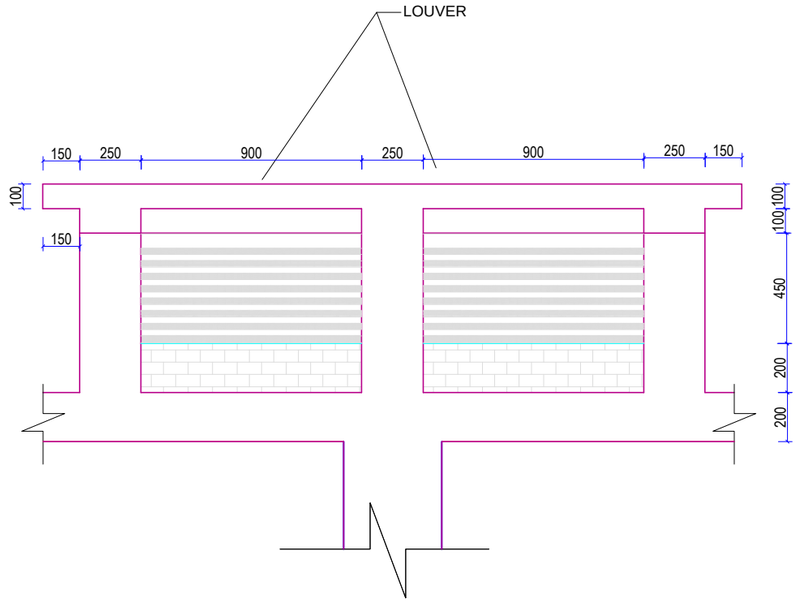
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:85	4	
DRAWING No.	RVTK-9	5	



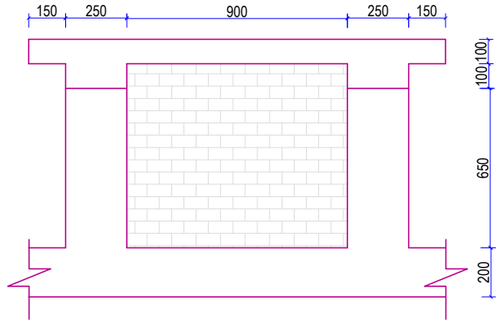
CUTOFF DETAIL AT 1
SCALE 1:20



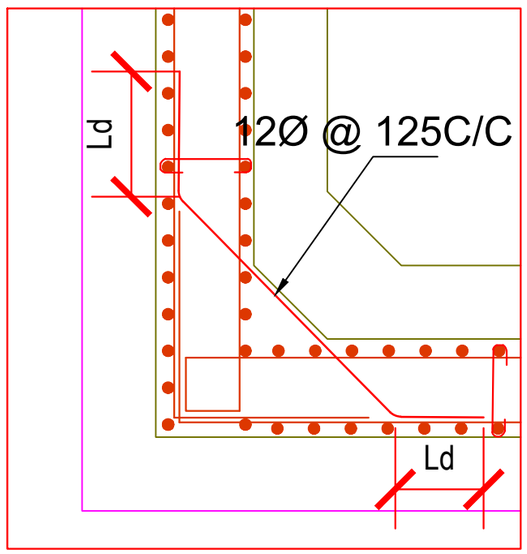
SECTIONAL PLAN OF VENTILATION



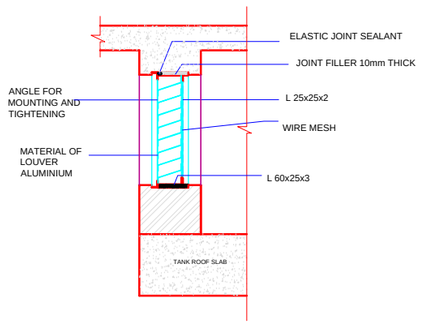
SECTION U-U



SECTION V-V



TYPICAL DETAIL OF WALL CORNER AT 2



SECTION W-W

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHSE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KWACHO RVT
VENTILATION, CUTOFF & WALL DETAILS
STRUCTURAL DRAWING

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:25	4	
DRAWING No.	RVTK-10	5	

NOTES

1	All dimensions are in millimeters unless & otherwise mentioned and Do not dimension the drawing.
2	Unless & otherwise mentioned, all brick should be of First Class Brick in 1:6 C:S mortar
3	All the PCC for RCC element should be M30 and all PCC work should be M10 (1:3:6)
4	All internal walls & RCC elements of Valve Chamber should be Water Proofed (Epoxy Layer)
5	All internal walls & RCC elements of Valve Chamber should be Plastered 20mm thick of 1:3 Ratio
6	All outer exposed walls & RCC elements should be Plastered with 12.5 mm thick Cement Sand Plaster of 1:6 ratio.
7	Outer wall of Valve chamber should be painted Two Coat Water Proof Paint
8	All floors, steps & roof surface should be rendered with 3 to 4 mm thick C/S punning of ratio of 1:1.
8	For Door & Window refer 'Detail of Door & Window' Drawing Sheet.
10	Seamless Steel Pipe of dia 50mm should be used for Railing Works

NOTE

1. The construction company shall discuss with the civil and construction supervisors before the construction phase in order to prevent any possible issues from equipment and pipeline works.
2. The pipeline works shall be performed after the discussion with mechanical supervisor. And the construction company shall discuss with the mechanical supervisor depending on the site conditions.
3. The dimensions of flange for mechanical pipeline might be different from those of civil pipeline. Therefore, the construction company shall discuss with the mechanical supervisorbefore the pipeline works.
4. The specification and type of equipment applied to the drawings is varied by the manufacturers.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

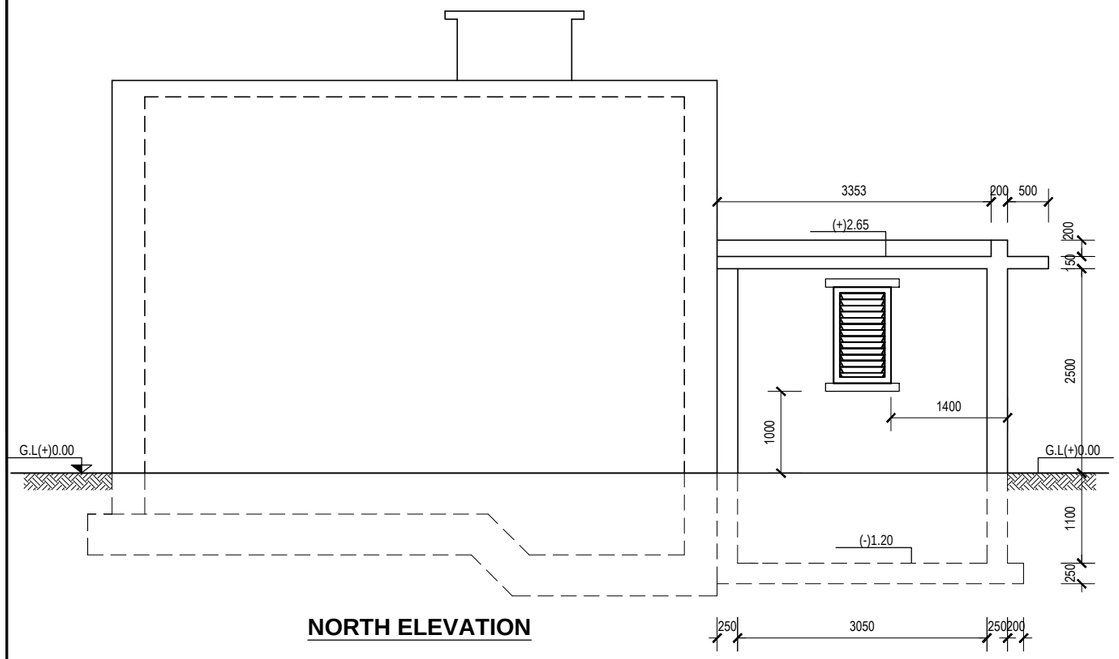
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

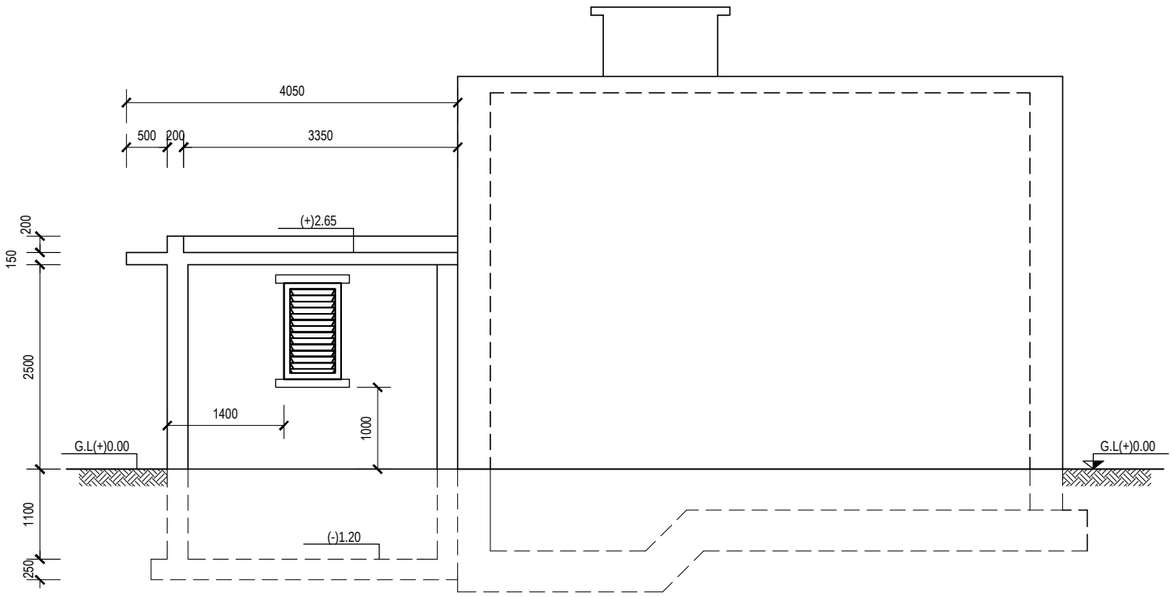
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: VALVE CHAMBER KWACHO RVT
GENERAL NOTES
CIVIL STRUCTURE DRAWING

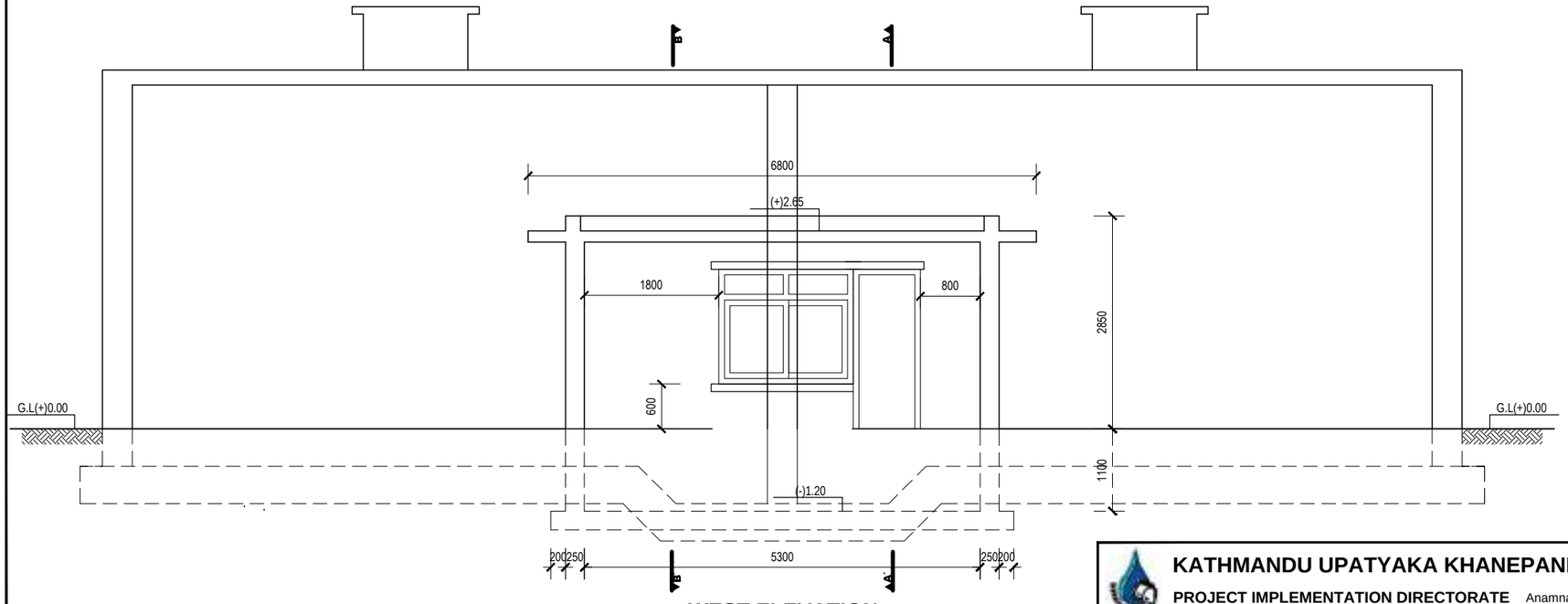
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	VCK-1	5	



NORTH ELEVATION



SOUTH ELEVATION



WEST ELEVATION

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

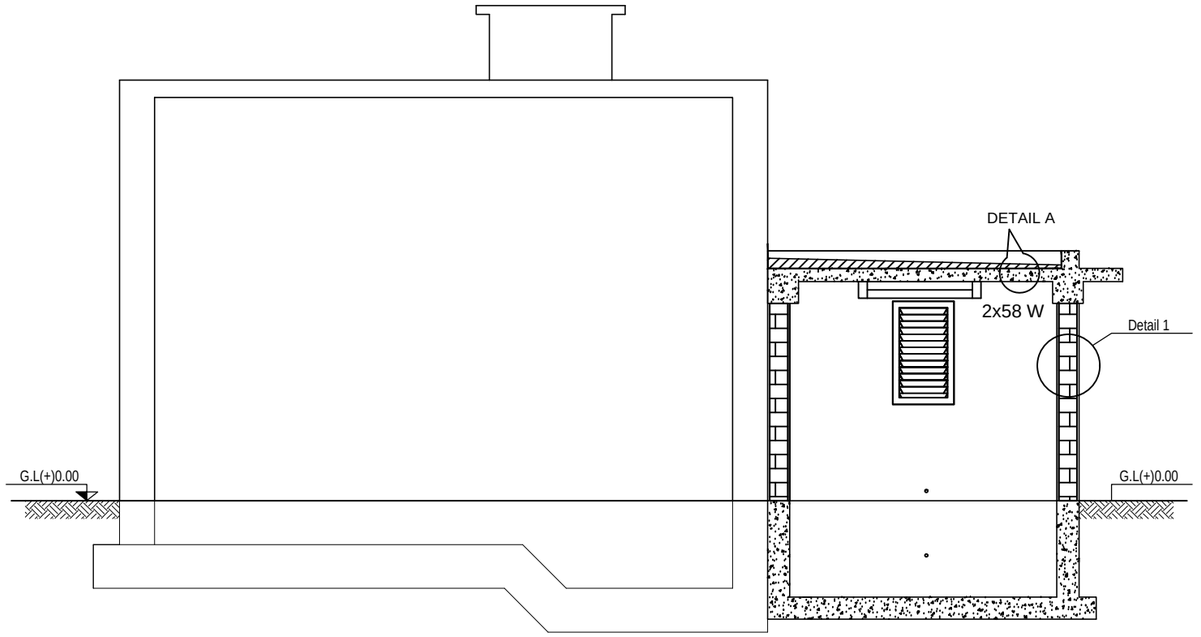
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

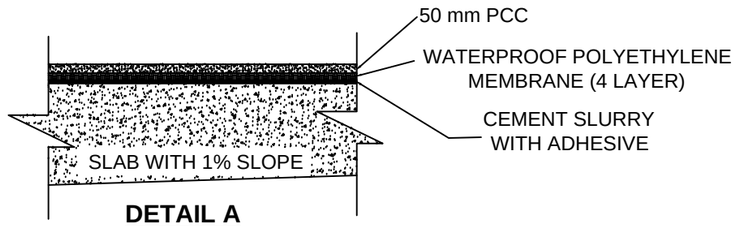
DRAWING TITLE: VALVE CHAMBER KWACHO RVT
ELEVATION VIEWS
CIVIL STRUCTURE DRAWING

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:75	4	
DRAWING No.	VCK-2	5	

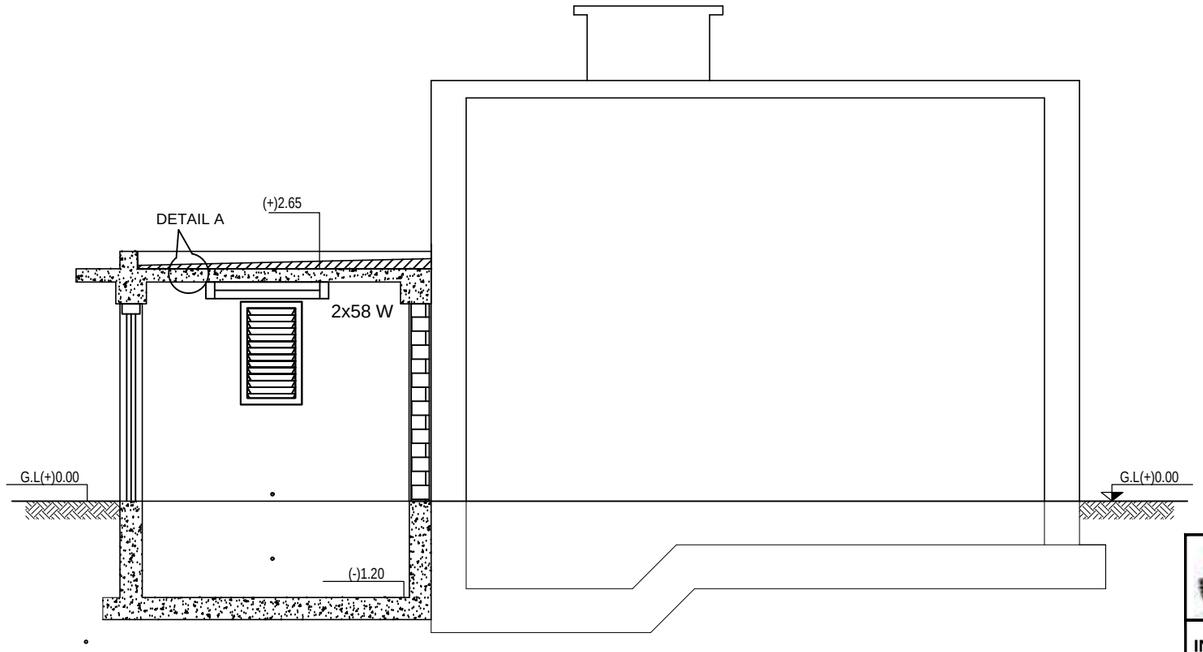


SECTION B-B´

SCALE 1:70

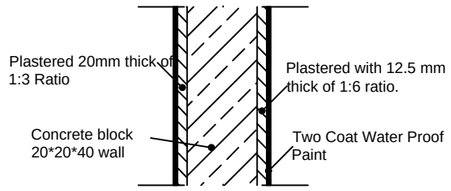


DETAIL A



SECTION A-A´

SCALE 1:70



DETAIL 1

SCALE 1:40

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

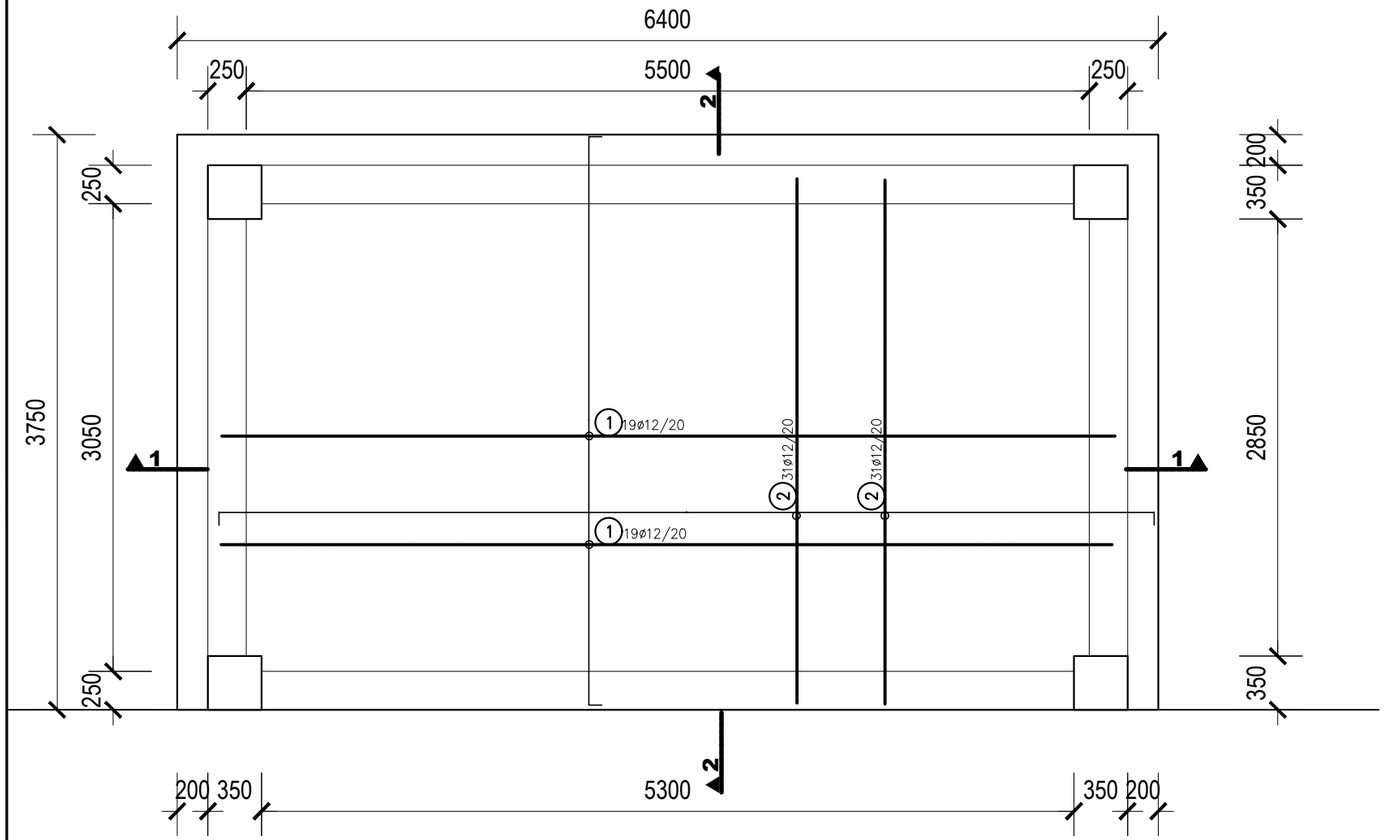
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

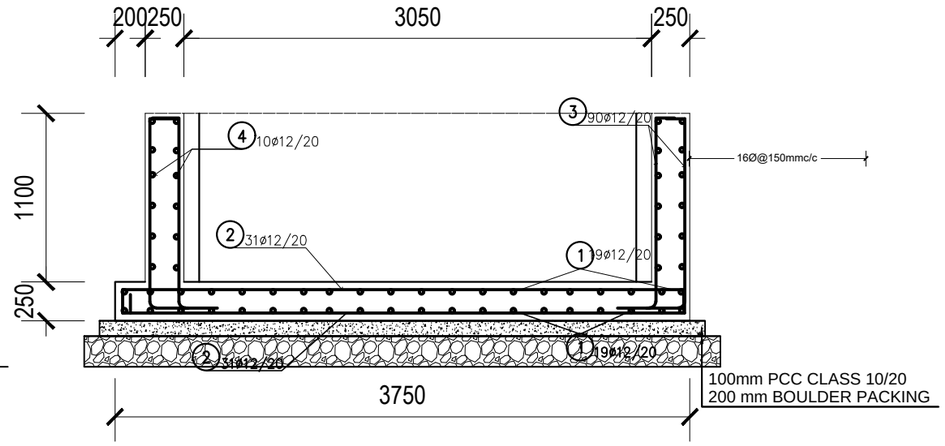
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: VALVE CHAMBER KWACHO RVT ELEVATION DETAILS CIVIL STRUCTURE DRAWING

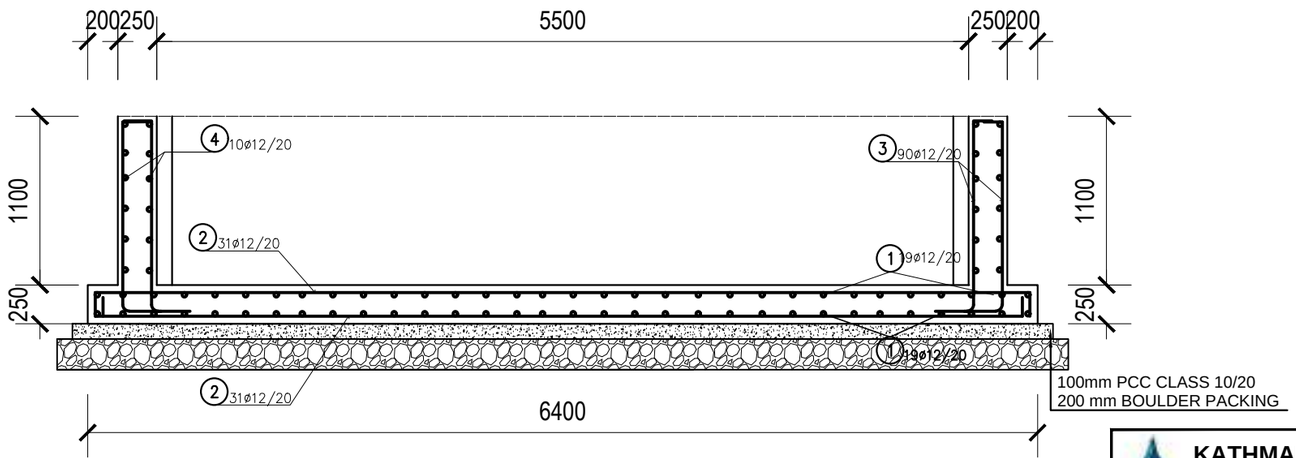
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:70	4	
DRAWING No.	VCK-3	5	



BASE SLAB REINFORCEMENT LAYOUT at LEVEL -1.10m



SECTION 2-2



SECTION 1-1

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

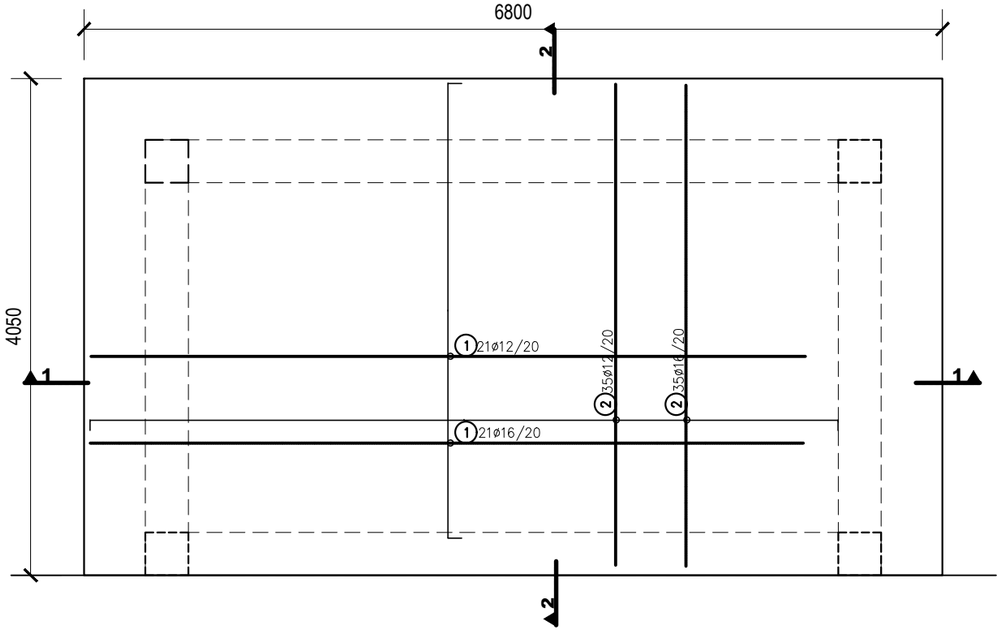
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

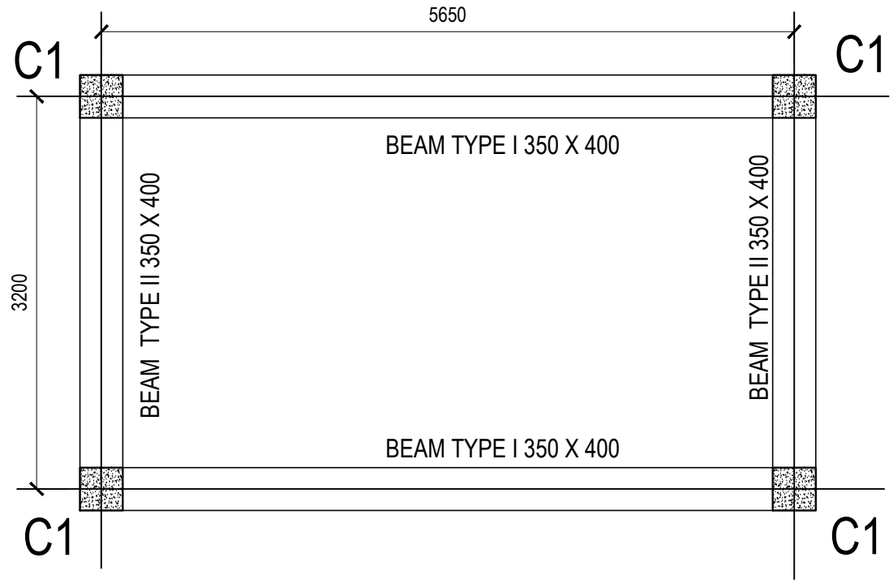
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: VALVE CHAMBER KWACHO RVT
BASE SLAB REINFORCEMENT PLAN & SECTION
CIVIL STRUCTURE DRAWING

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:40	4	
DRAWING No.	VCK-4	5	



ROOF SLAB REINFORCEMENT LAYOUT at LEVEL +2.65m



BEAM & COLUMN LAYOUT ROOF SLAB +2.65m

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

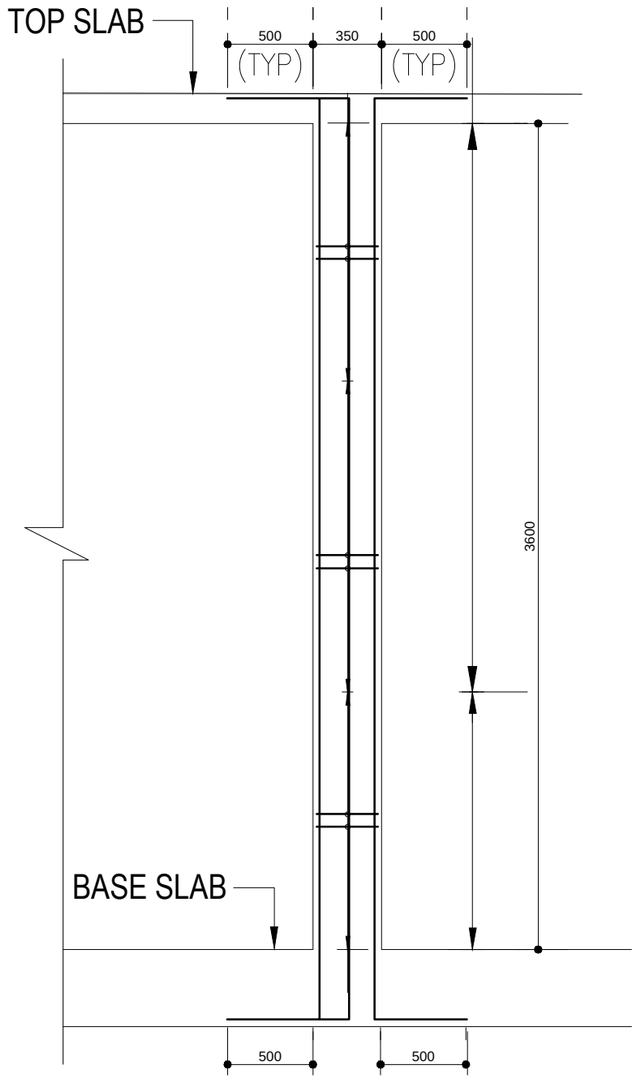
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

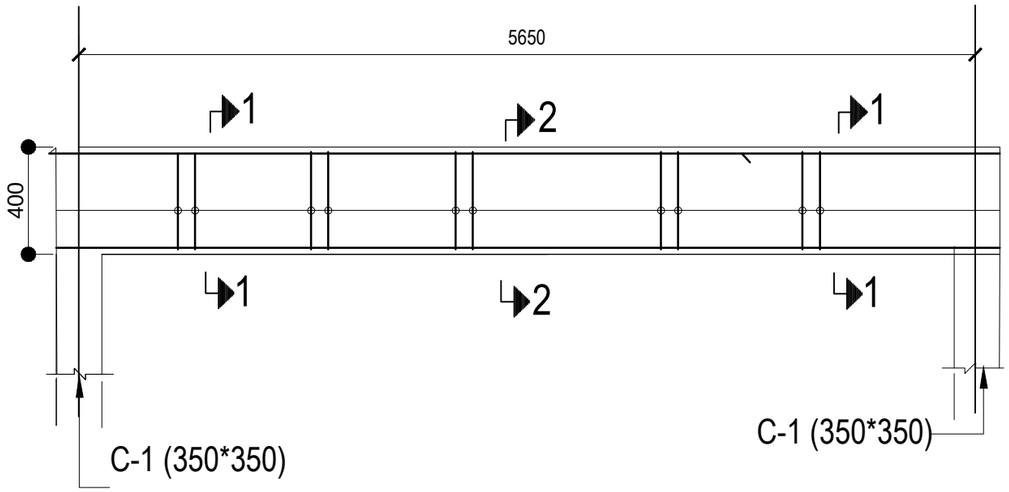
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ROOF SLAB REINFORCEMENT LAYOUT
CIVIL STRUCTURE DRAWING

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	VCK-5	5	



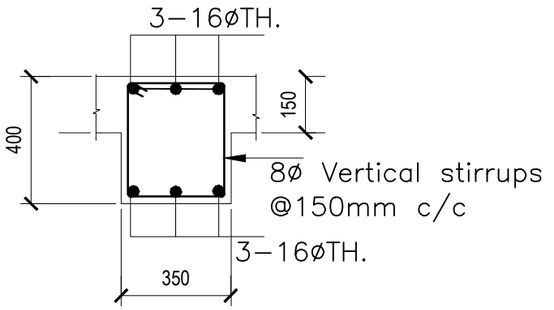
COLUMN TYPE I

SCALE 1:50



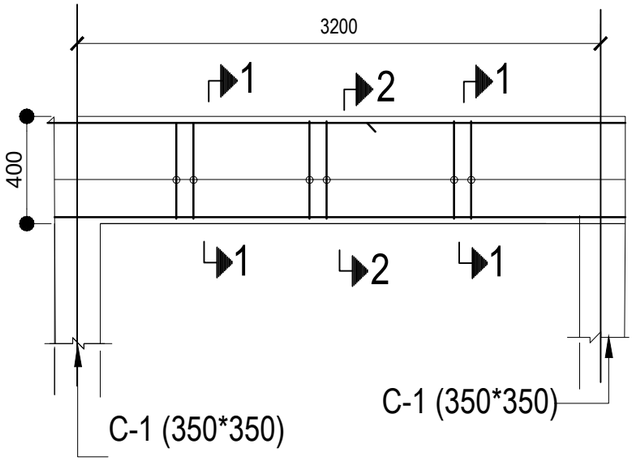
BEAM TYPE I 350*400

SCALE 1:75



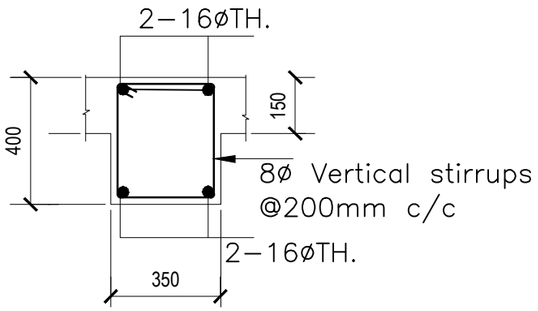
SECTION 1-1 & 2-2

SCALE 1:50



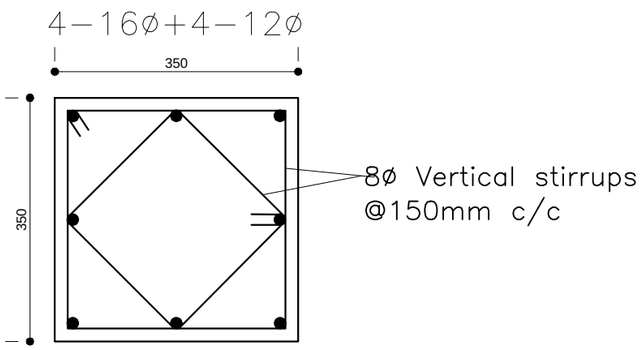
BEAM TYPE II 350*400

SCALE 1:75



SECTION 1-1 & 2-2

SCALE 1:50



COLUMN PLAN(A-A & B-B)

SCALE 1:10

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

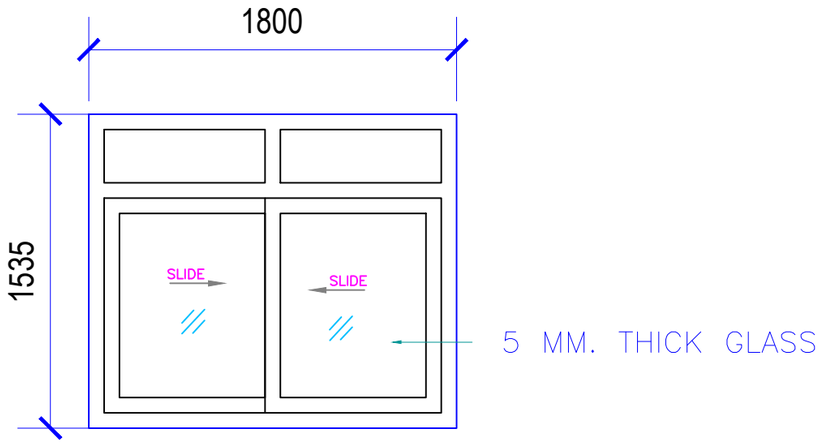
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

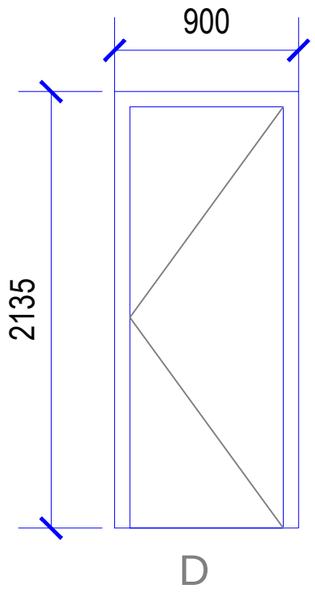
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: VALVE CHAMBER KWACHO RVT
COLUMN, BEAM & SECTION DETAILS
CIVIL STRUCTURE DRAWING

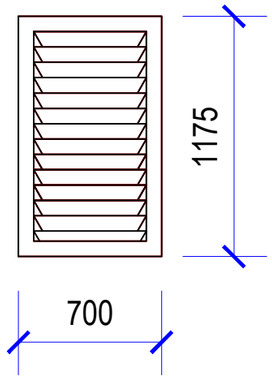
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	VCK-6	5	



DETAILS OF WINDOW (W)



DETAILS OF DOOR (D)



DETAILS OF VENTILATION (V)

OPENING SCHEDULE

SYMBOL	NOs.	WIDTH	HEIGHT	REMARK
D	1	800	2135	FLUSH DOOR, ALUMINIUM
W1	1	1800	1535	SLIDING WINDOW, ALUMINIUM
V	1	700	1175	LOUVER TYPE, ALUMINIUM

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

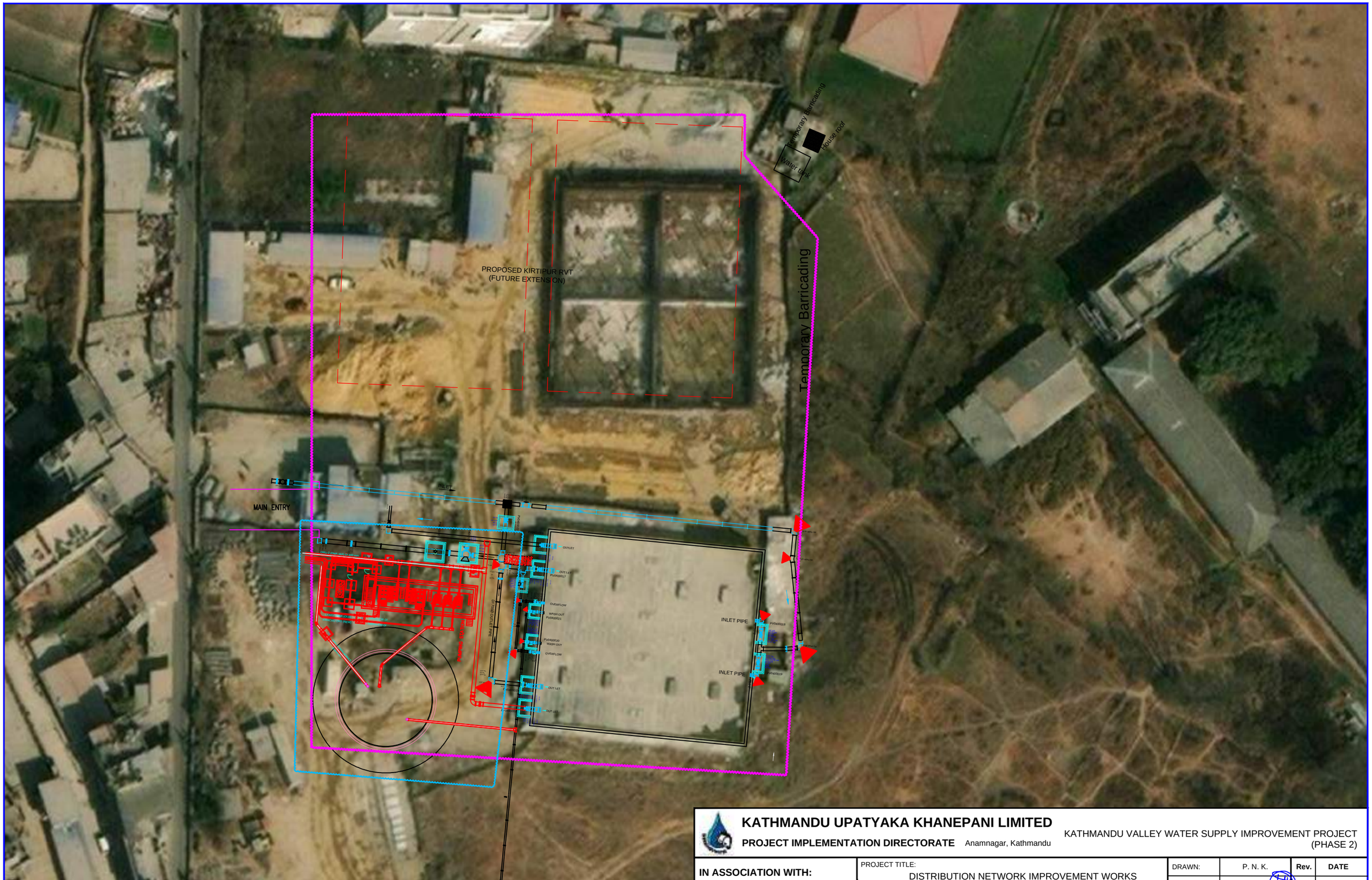
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: VALVE CHAMBER KWACHO RVT
OPENING DETAILS
CIVIL STRUCTURE DRAWING

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:30	4	
DRAWING No.	VCK-7	5	



NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

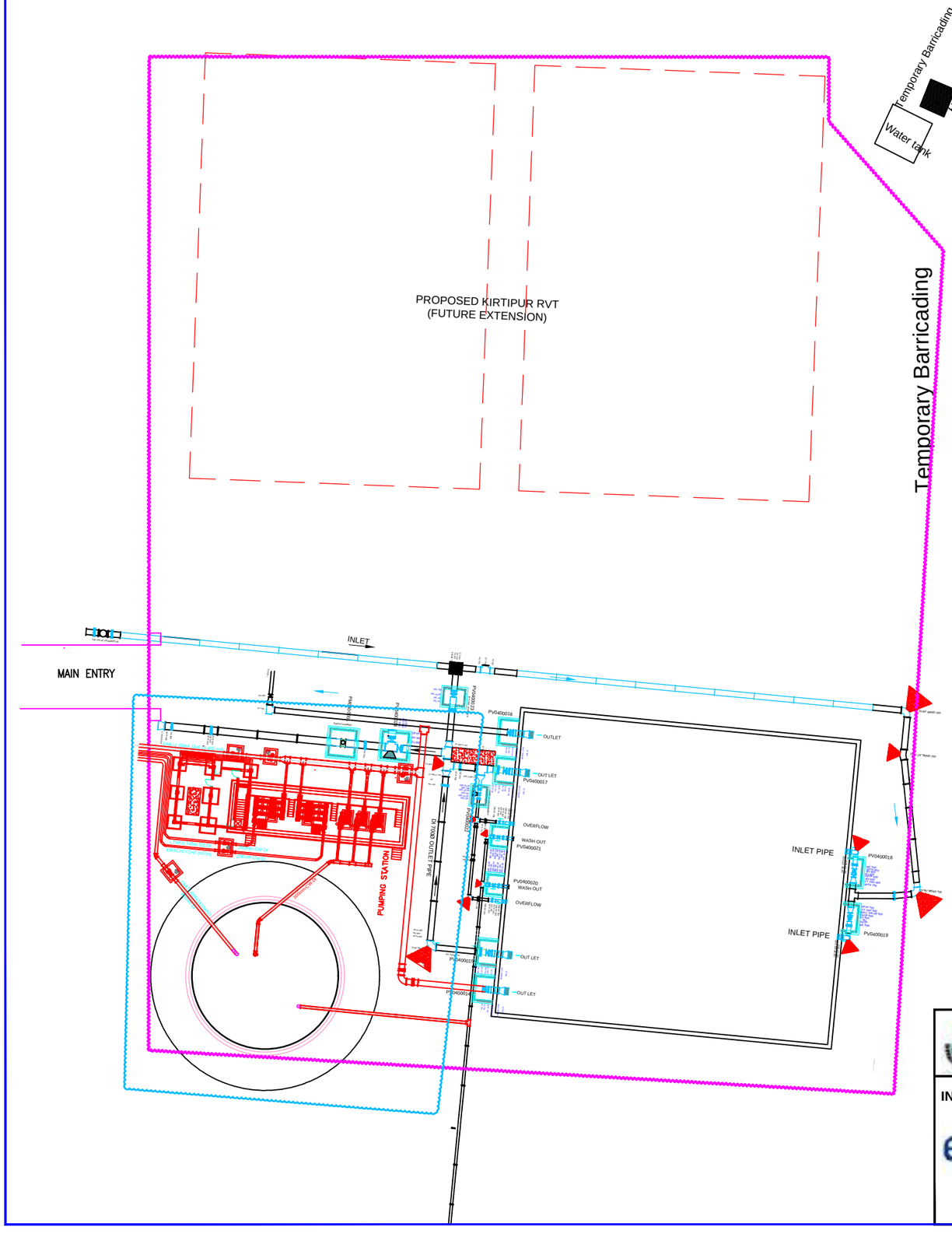
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE:
KRITIPUR PUMP STATION
CIVIL STRUCTURE
SITE LAYOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:700	4	
DRAWING No.	PS-C-1	5	



NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

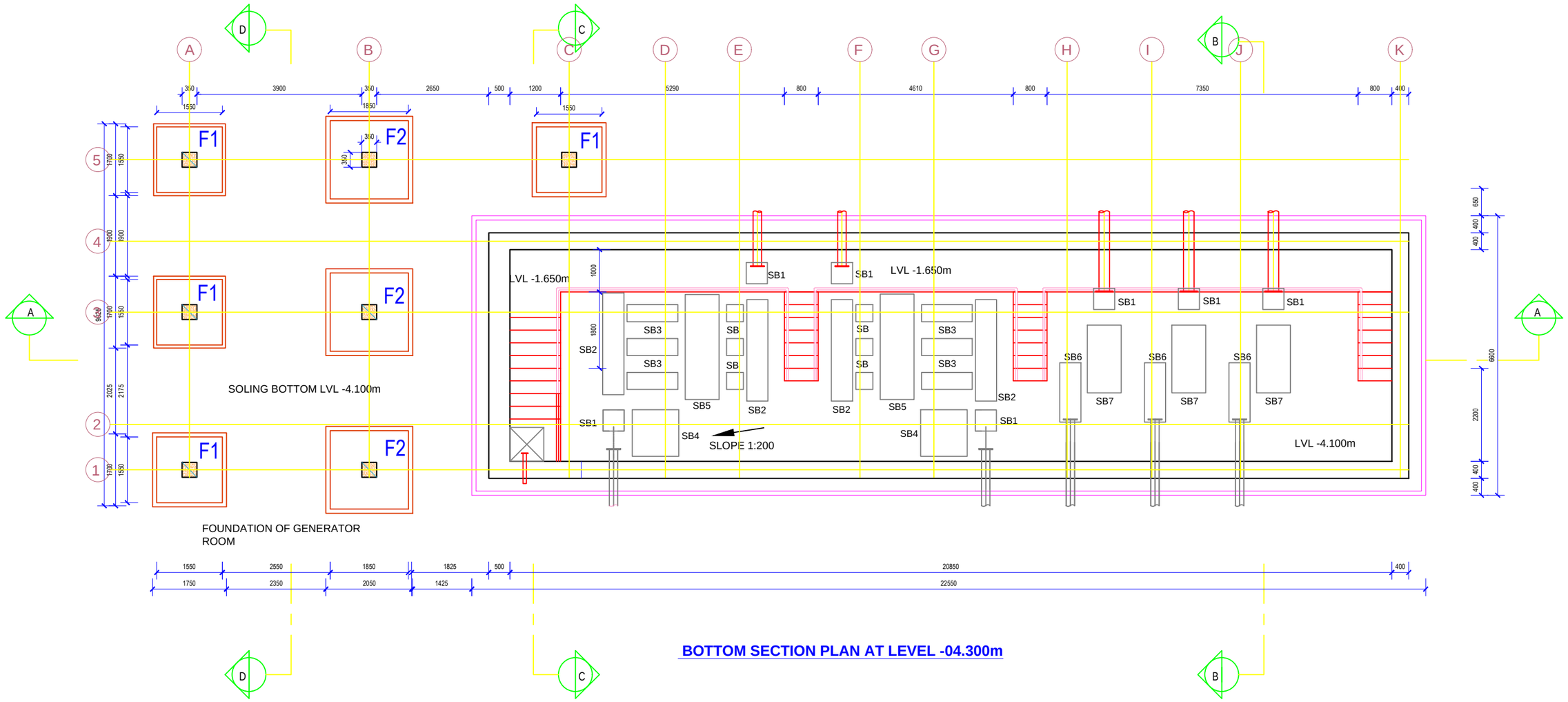
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
GENERAL LAYOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:600	4	
DRAWING No.	PS-C-2	5	



BOTTOM SECTION PLAN AT LEVEL -04.300m

OPENING SCHEDULE

SYMBOL	NOs.	WIDTH	HEIGHT	REMARK
RS	1	3073	3000	ROLLING SHUTTER, METAL
D	3	800	2135	FLUSH DOOR, ALUMINIUM
W1	2	1800	1535	CASEMENT WINDOW
V	7	1200	600	LOUVER TYPE, ALUMINIUM
V1	1	1100	1100	LOUVER TYPE, ALUMINIUM
V2	1	1200	1200	LOUVER TYPE, ALUMINIUM
CM1	5	1000	2000	METALLIC COVER OPENING, 3mm THICK

Support Block (M25 concrete)

SYMBOL	NOs.	LENGTH	WIDTH	HEIGHT	REMARK
SB1	6	400	400	560	SUPPORT BLOCK FOR PUMP
SB1	7	500	500	500	SUPPORT BLOCK FOR PUMP
SB2	4	2400	500	887	SUPPORT BLOCK FOR PUMP
SB3	6	1200	400	400	SUPPORT BLOCK FOR PUMP
SB4	2	1100	1100	000	SUPPORT BLOCK FOR GENERATOR
SB5	2	2480	800	447.5	SUPPORT BLOCK FOR GENERATOR
SB6	1	1400	500	500	SUPPORT BLOCK FOR GENERATOR
SB7	1	1600	800	300	SUPPORT BLOCK FOR GENERATOR
SB8	1	3400	1600	400	SUPPORT BLOCK FOR GENERATOR

NOTES

1. All dimensions are in millimeters unless & otherwise mentioned and Do not dimension the drawing.
2. Unless & otherwise mentioned, all brick should be of First Class Brick in 1:6 C:S mortar
3. All the PCC for RCC element should be M30 and all PCC work should be M10 (1:3:6)
4. All internal walls & RCC elements of Pump House Chamber should be Water Proofed (Epoxy Layer)
5. All internal walls & RCC elements of Pump House Chamber should be Plastered 20mm thick of 1:3 Ratio
6. All outer exposed walls & RCC elements should be Plastered with 12.5 mm thick Cement Sand Plaster of 1:6 ratio.
7. Inner Surface wall of Generator/Operator Room, Ceiling and Appron Floor should be Plastered with 12.5mm thick 1:4 C/S Ratio.
8. Outer wall of Generator/Operator Room and above GL of Pump chamber should be painted Two Coat Water Proof Paint
8. All floors, steps & roof surface should be rendered with 3 to 4 mm thick C/S punning of ratio of 1:1.
10. For Door & Window refer 'Detail of Door & Window' Drawing Sheet.
11. Seamless Steel Pipe of dia 50mm should be used for Railing Works

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

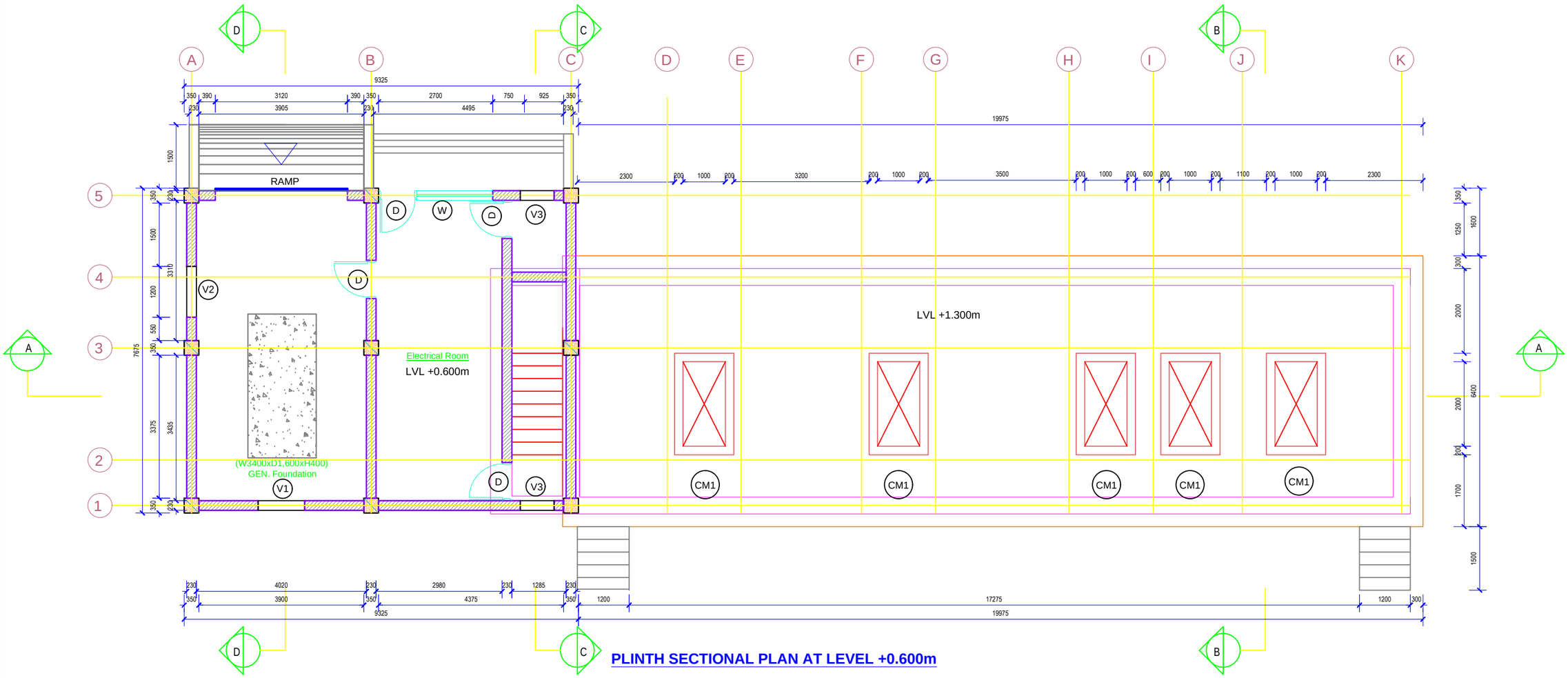
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
BOTTOM SECTION PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO ES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-3	5	



PLINTH SECTIONAL PLAN AT LEVEL +0.600m

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

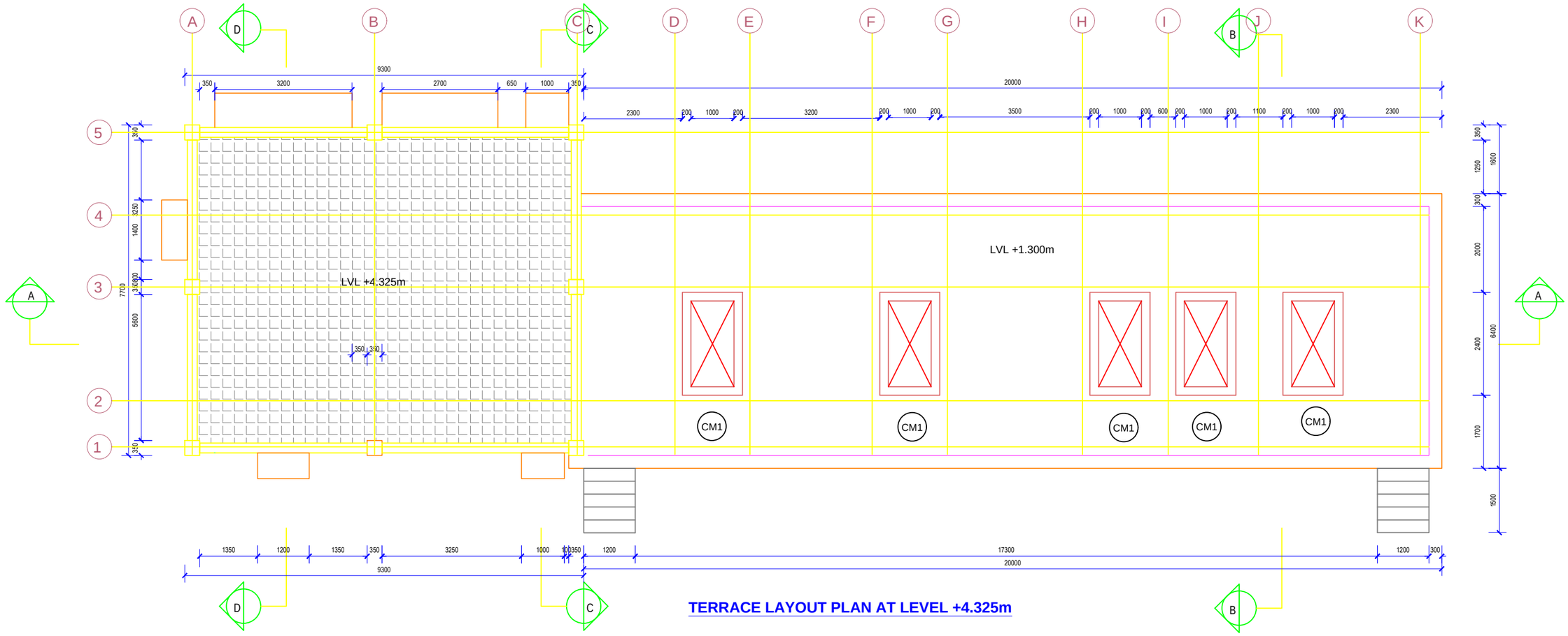
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
PLINTH SECTIONAL PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-4	5	



NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

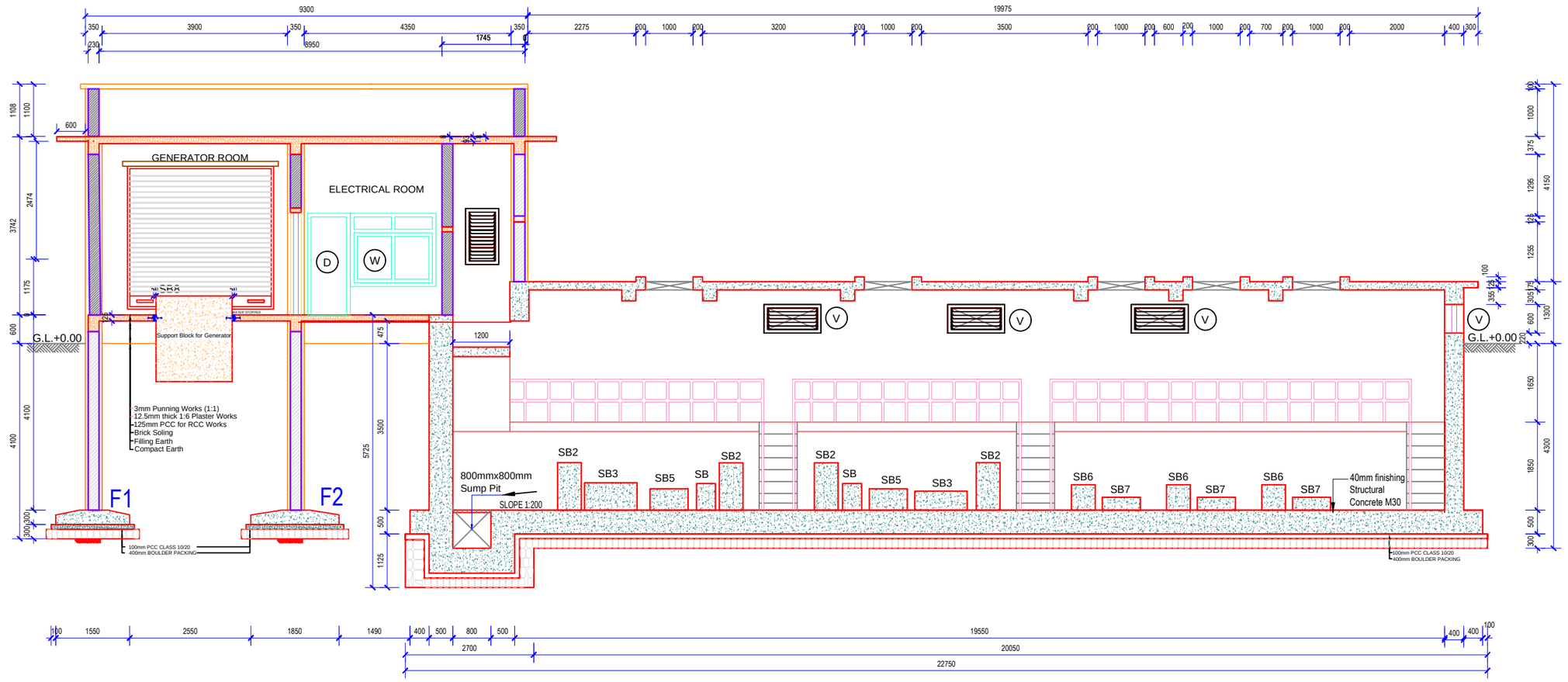
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
TERRACE LAYOUT PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-5	5	



Section at A-A

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

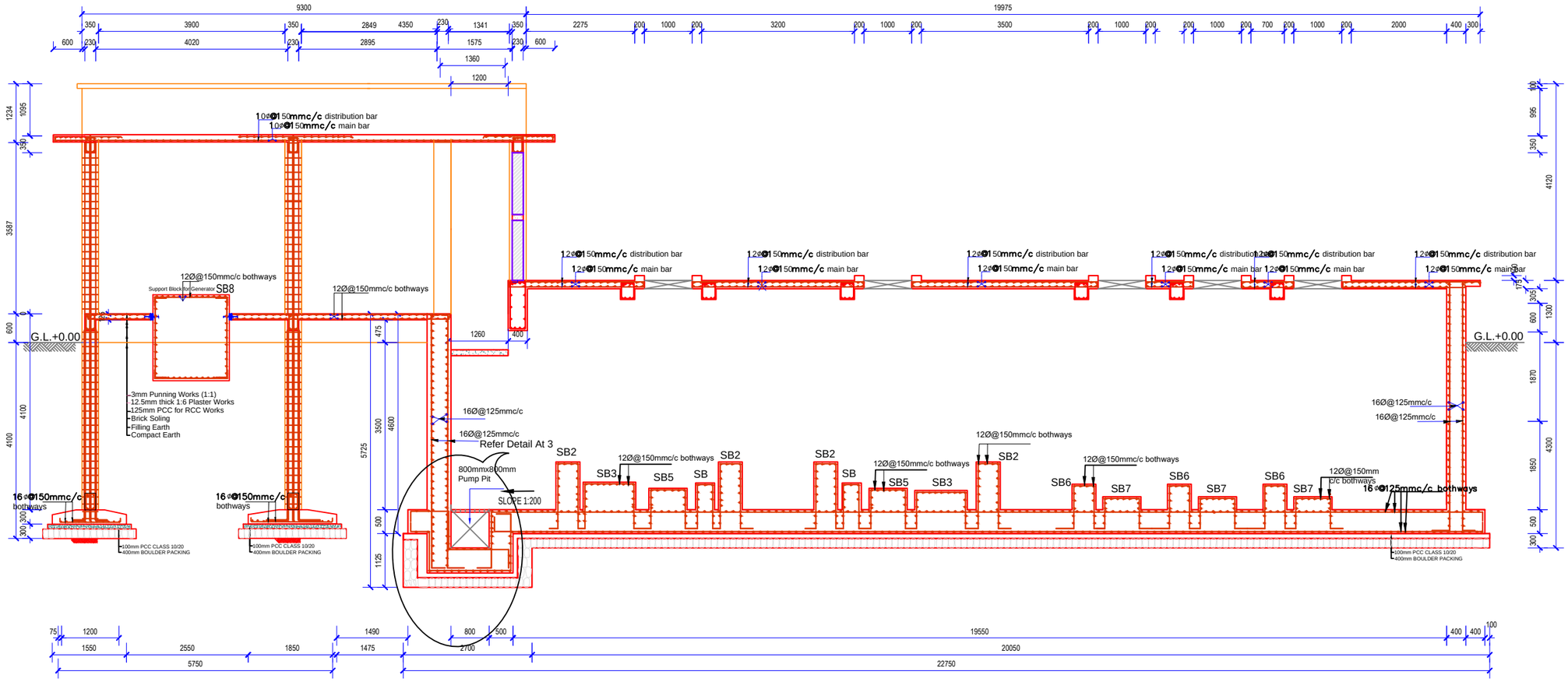
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
LONGITUDIAL SECTION AT A-A

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-6	5	



Section at A-A

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

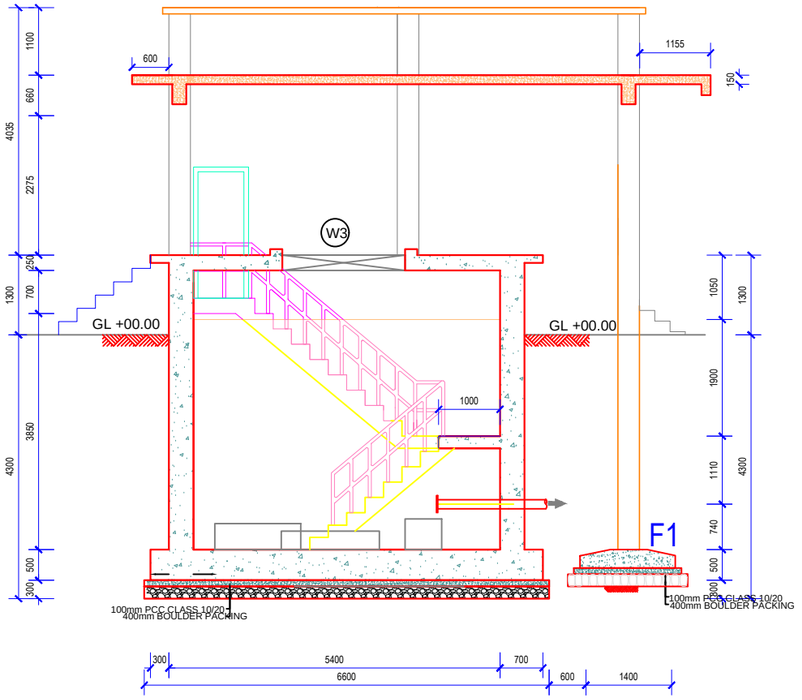
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

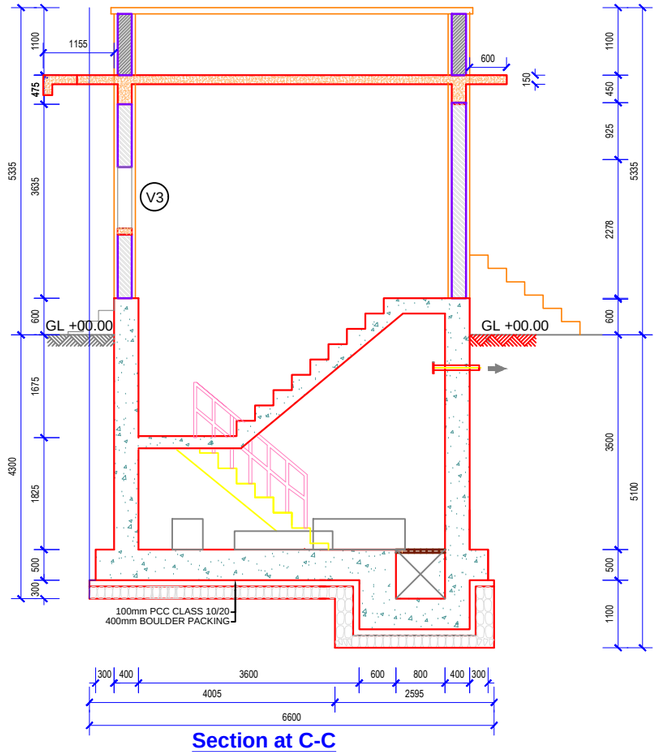
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
SECTION DETAIL AT A-A

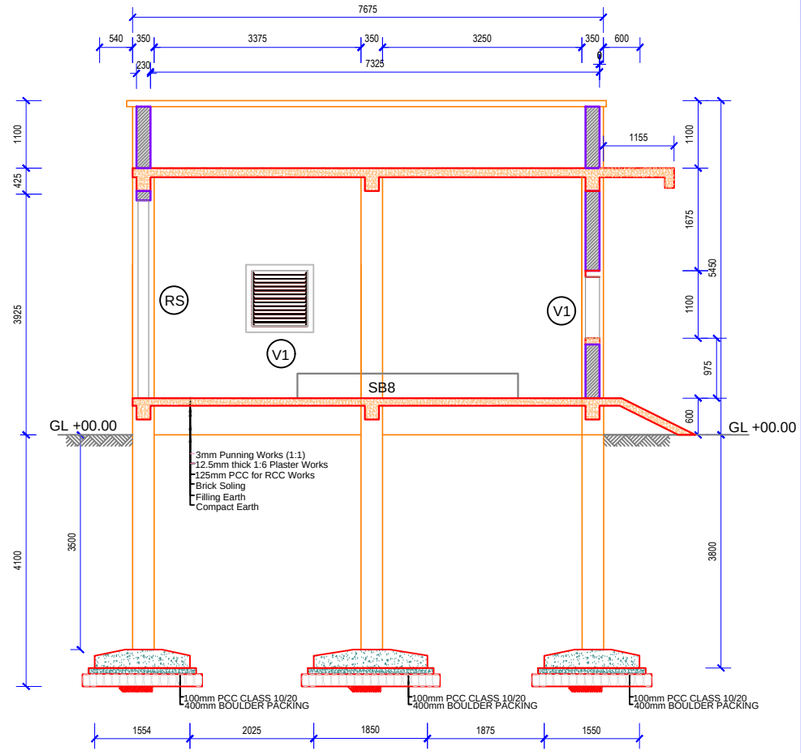
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BERMÚDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-7	5	



Section at B-B



Section at C-C



Section at D-D

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

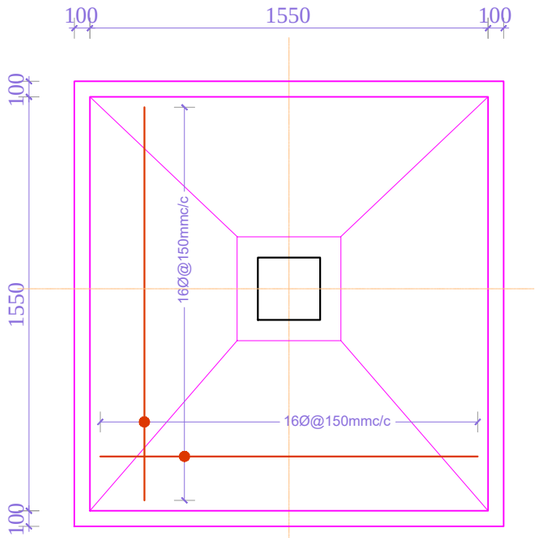
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

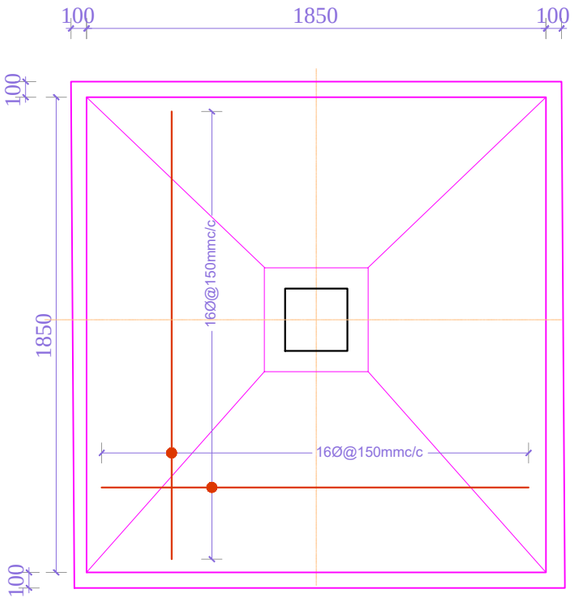
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
SECTIONS

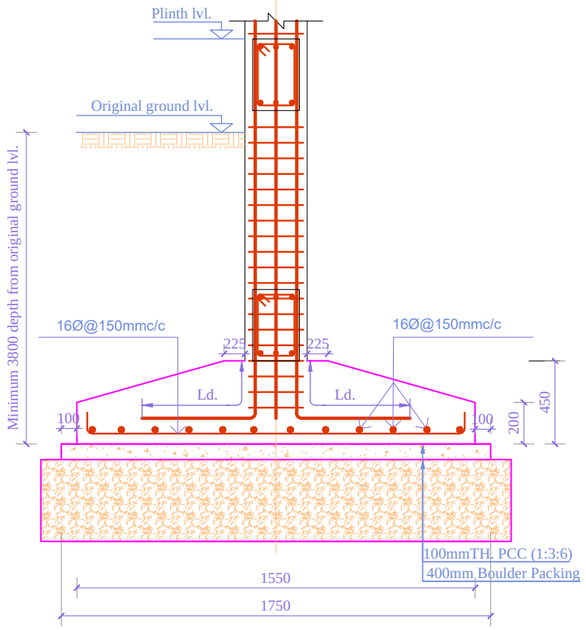
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-8	5	



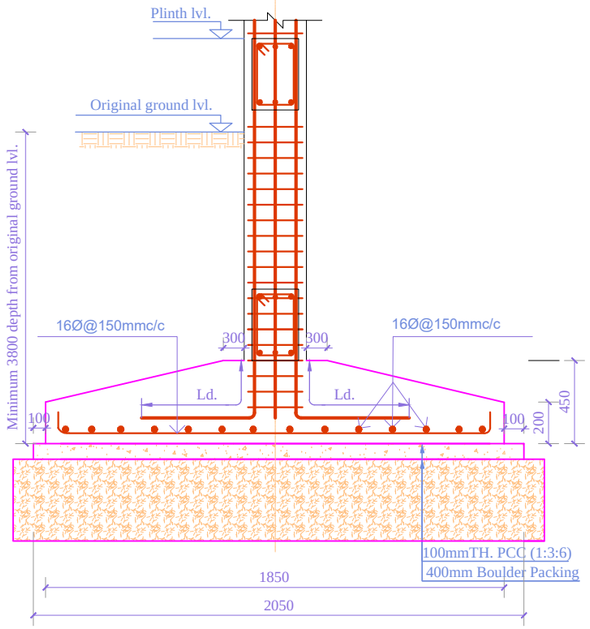
TYPICAL FOOTING PLAN



TYPICAL FOOTING PLAN



TYPICAL FOOTING SECTION OF FOUNDATION F1



TYPICAL FOOTING SECTION OF FOUNDATION F2

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

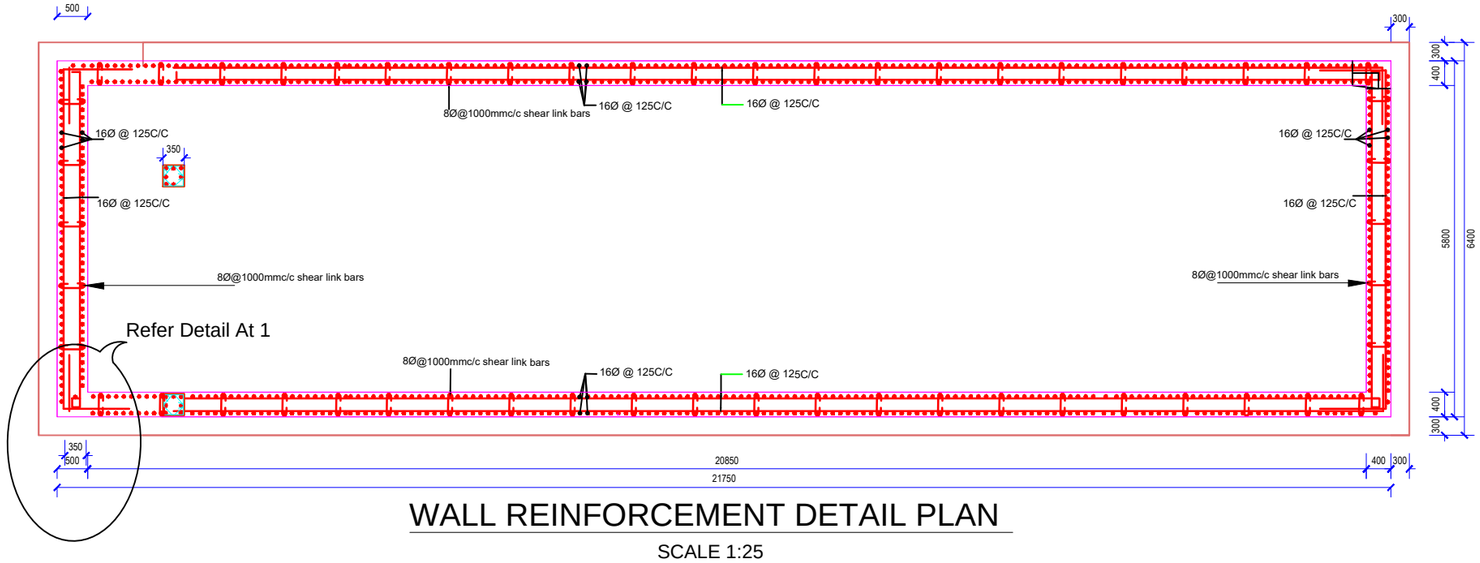
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

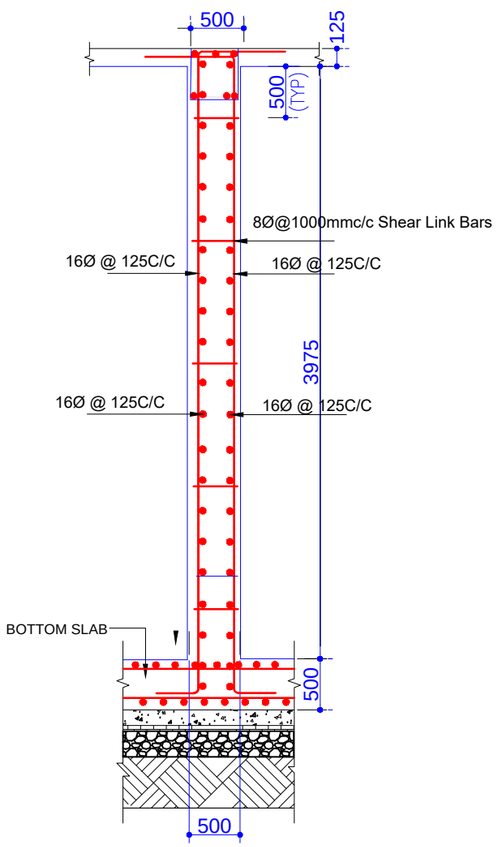
DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
ISOLATED FOUNDATION DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:30	4	
DRAWING No.	PS-C-9	5	



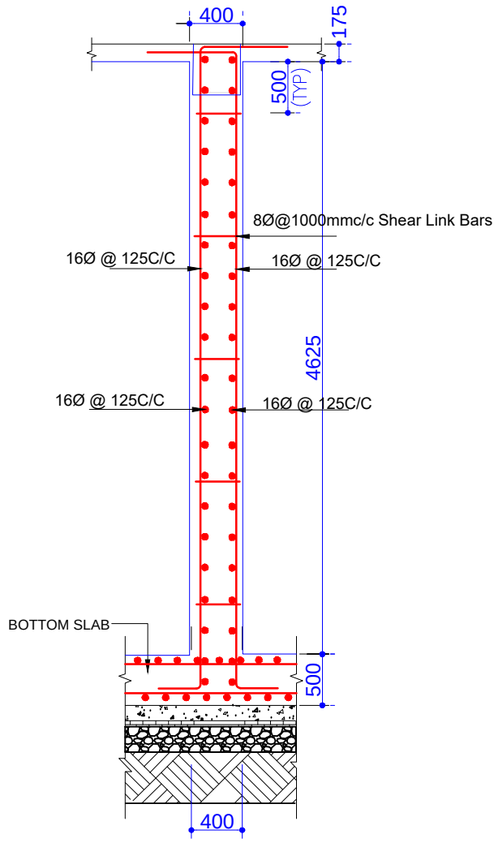
WALL REINFORCEMENT DETAIL PLAN

SCALE 1:25



REINFORCEMENT DETAILS AT 7-7

SCALE 1:50



REINFORCEMENT DETAILS AT 5-5, 6-6

SCALE 1:50

NOTE:

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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
WALL DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-10	5	



BASE SLAB REINFORCEMENT LAYOUT at LEVEL -4.00m

SCALE 1:25

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

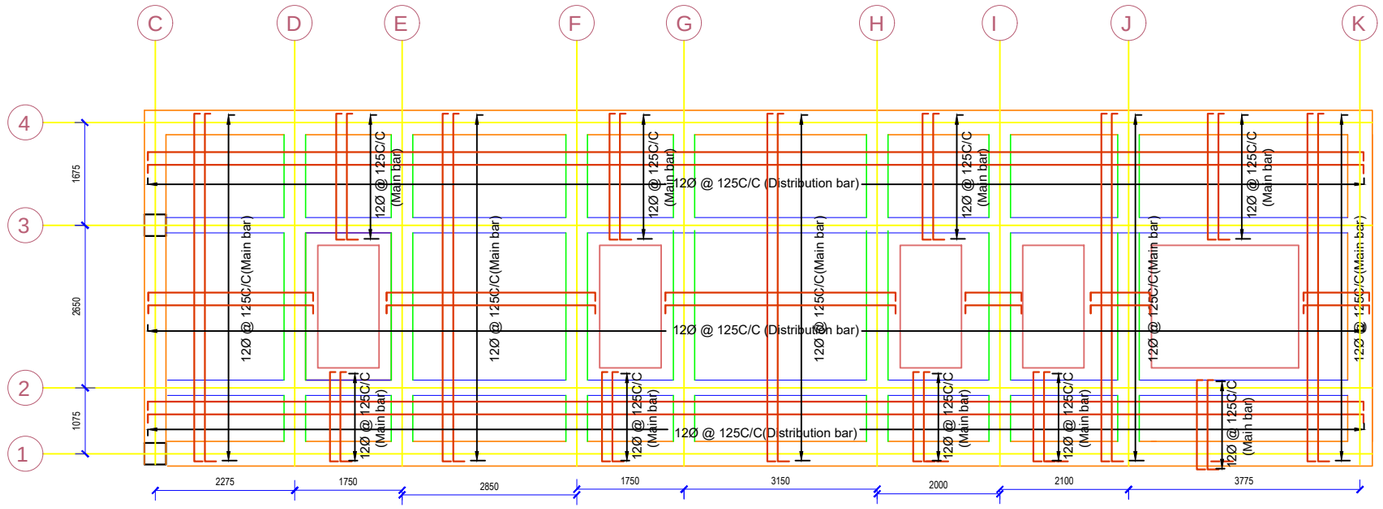
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

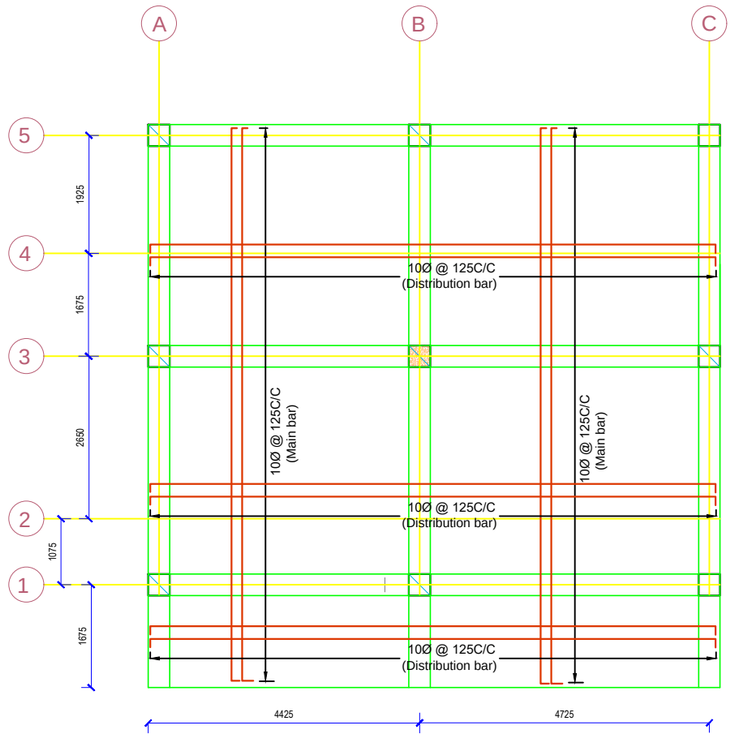
DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
BASE SLAB REINFORCEMENT LAYOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:60	4	
DRAWING No.	PS-C-11	5	



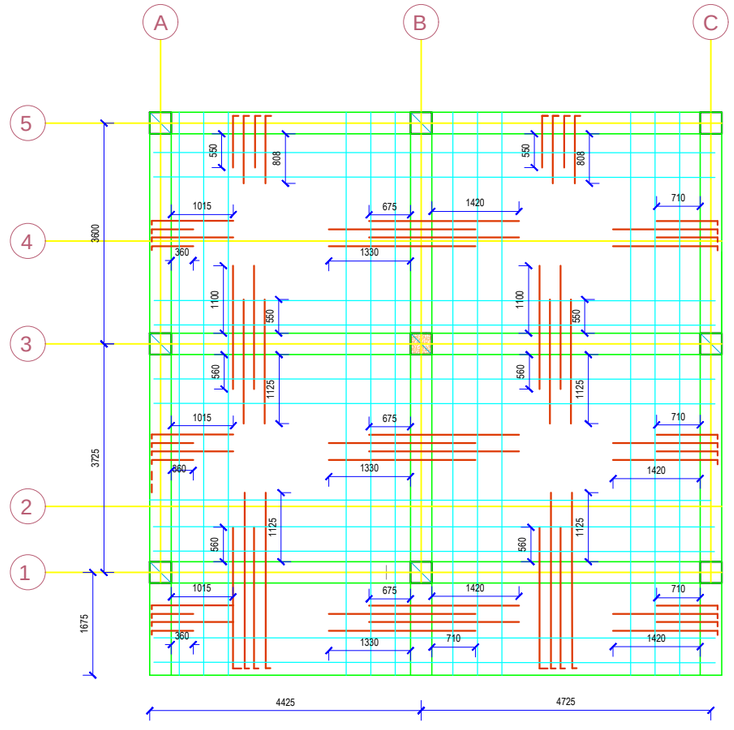
SLAB REINFORCEMENT DETAIL AT MACHINE ROOM FLOOR SLAB OF PUMP HOUSE, THICKNESS =175MM

LVL -4.00m



SLAB BOTTOM REINFORCEMENT DETAIL AT GENERATOR ROOM FLOOR SLAB , THICKNESS =150MM

LVL +4.200m



SLAB TOP REINFORCEMENT DETAIL AT GENERATOR ROOM FLOOR SLAB , THICKNESS =150MM

LVL +4.200m

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

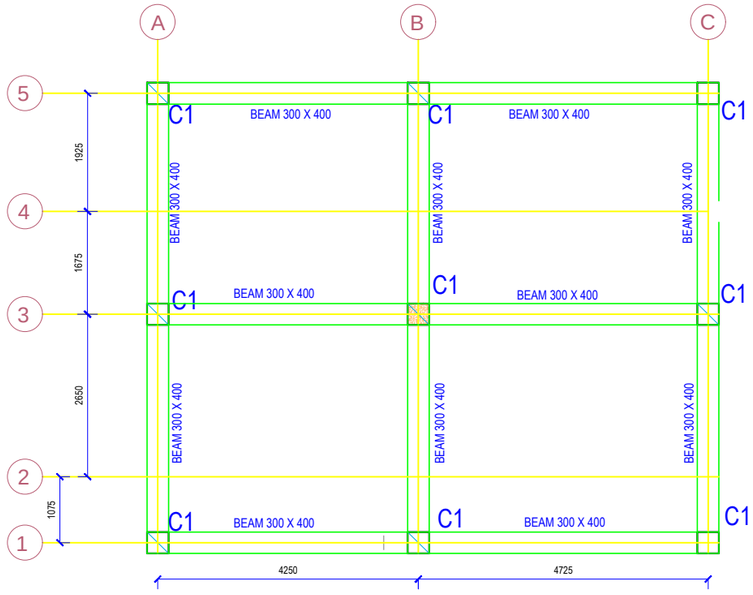
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

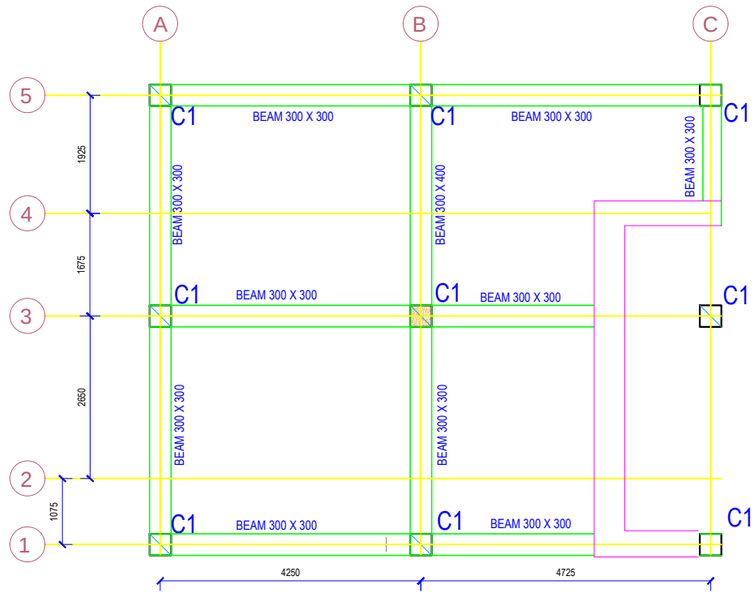
DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
SLAB REINFORCEMENT DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-12	5	



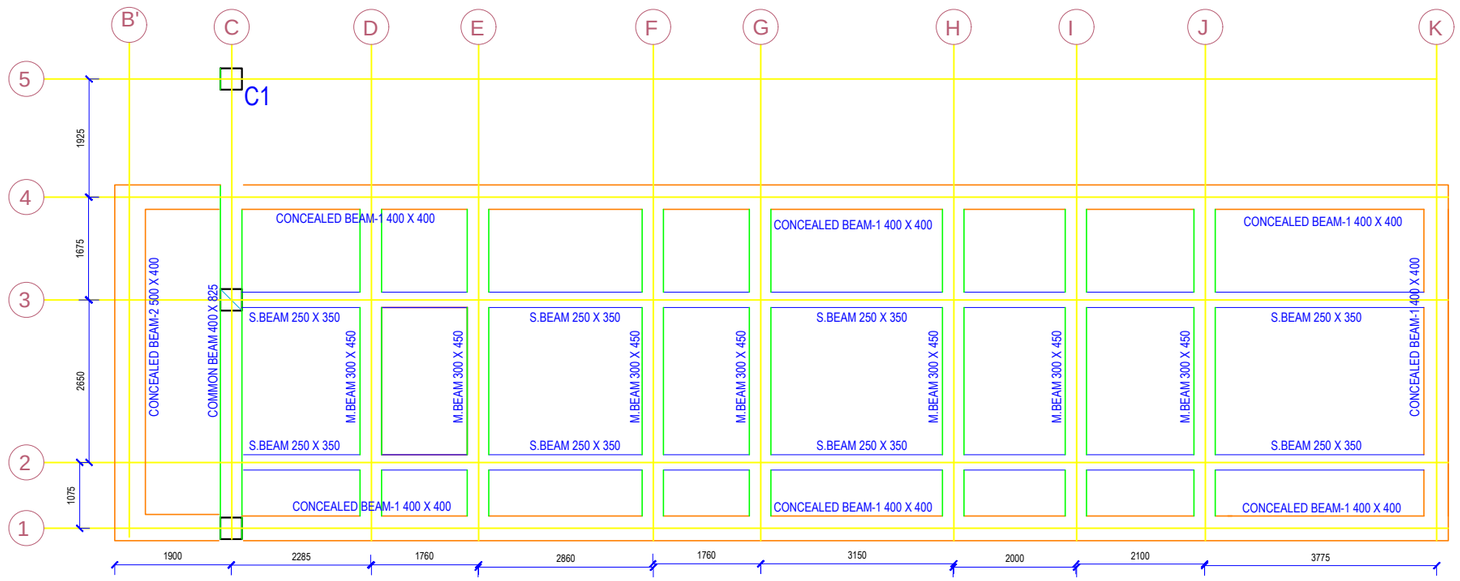
BEAM & COLUMN LAYOUT AT GERNETOR ROOM

LVL +4.350m



UPPER & LOWER TIE BEAM LAYOUT PLAN

LVL +0.600m & -3.500m



BEAM & COLUMN LAYOUT AT MACHINE ROOM

LVL +1.300m

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

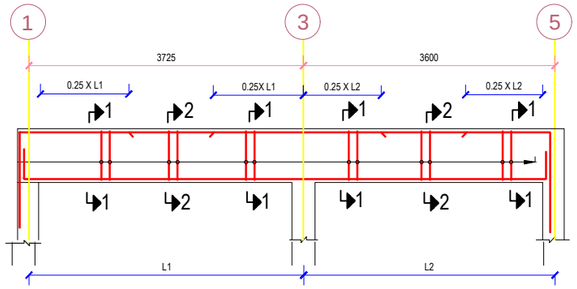
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

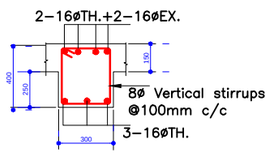
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
BEAM & COLUMN LAYOUT

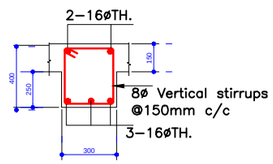
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-13	5	



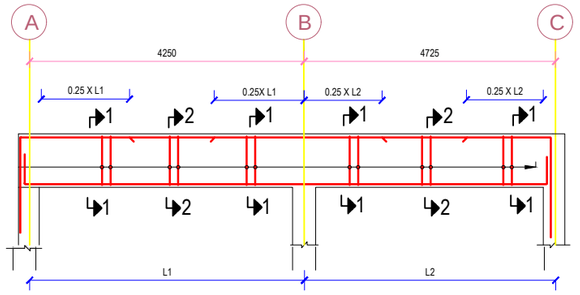
GENERATOR & ELECTRICAL ROOM ROOF BEAM GRID ALONG A-A : B-B & C-C
SCALE 1:75



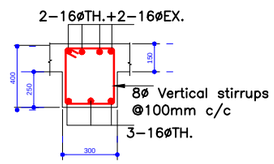
SECTION 1-1
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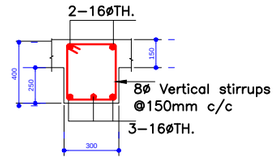
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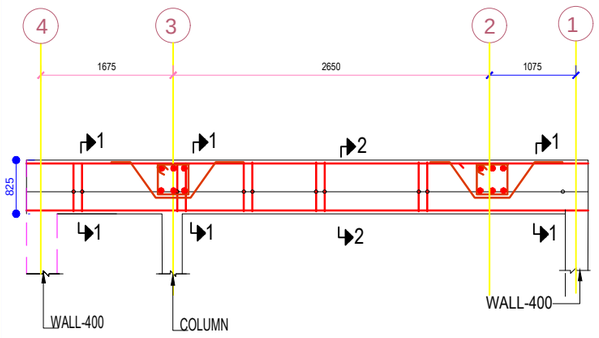
GENERATOR & ELECTRICAL ROOM ROOF BEAM GRID ALONG 1-1; 3-3 & 5-5
SCALE 1:75



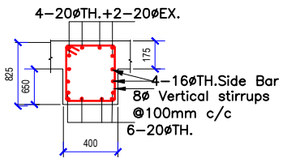
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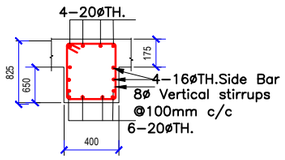
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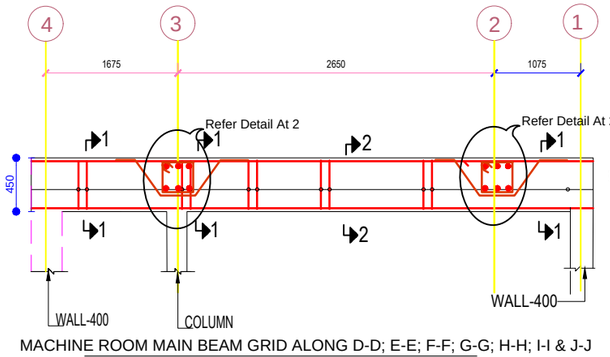
MACHINE ROOM COMMON BEAM GRID ALONG C-C
SCALE 1:75



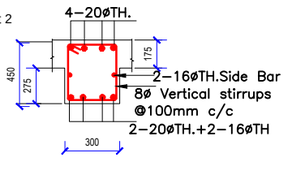
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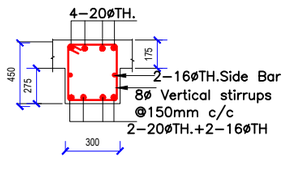
SECTION 2-2
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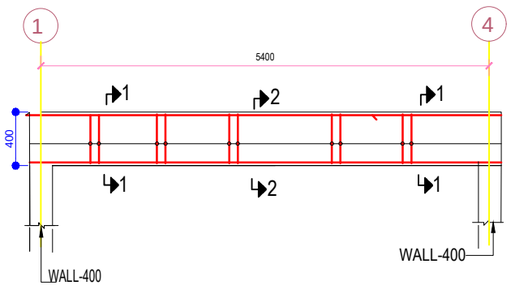
MACHINE ROOM MAIN BEAM GRID ALONG D-D; E-E; F-F; G-G; H-H; I-I & J-J
SCALE 1:75



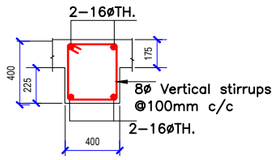
SECTION 1-1
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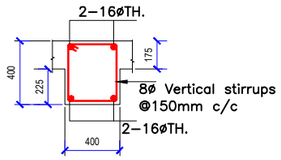
SECTION 2-2
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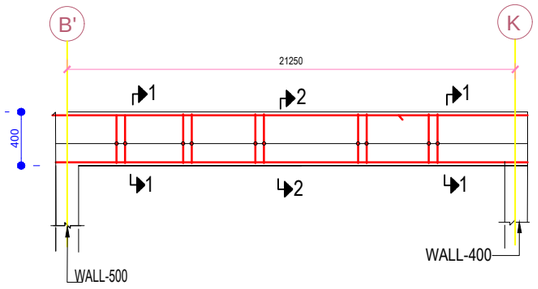
MACHINE ROOM CONCEALED BEAM-1 GRID ALONG K-K
SCALE 1:75



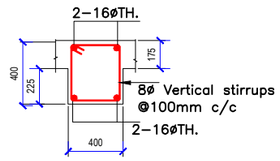
SECTION AT VENTILATION
SCALE 1:50



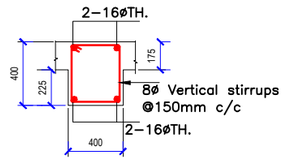
SECTION 1-1 & 2-2
SCALE 1:50



MACHINE ROOM CONCEALED BEAM GRID ALONG 1-1 & 4-4
SCALE 1:75



SECTION AT VENTILATION
SCALE 1:50



SECTION 1-1 & 2-2
SCALE 1:50

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

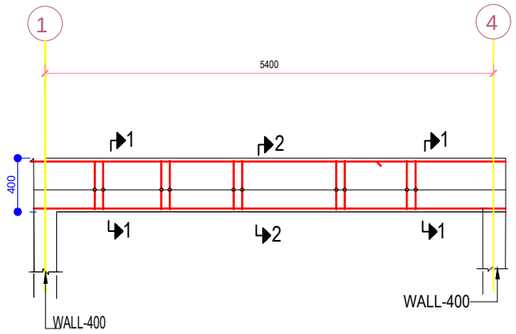
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

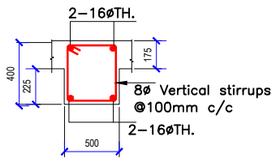
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
BEAM DETAIL

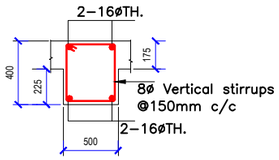
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-14	5	



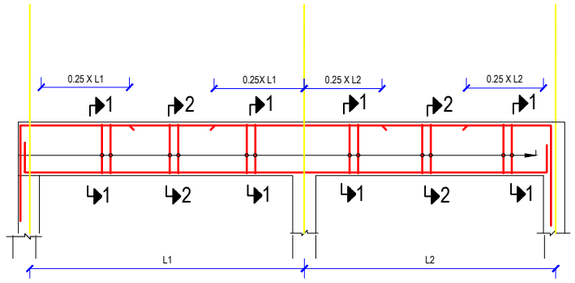
MACHINE ROOM CONCEALED BEAM-2 GRID ALONG B'-B'
SCALE 1:75



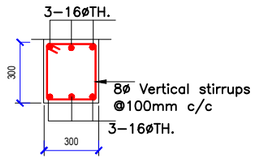
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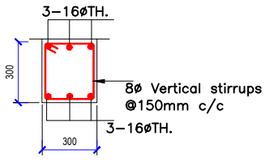
SECTION 1-1 & 2-2
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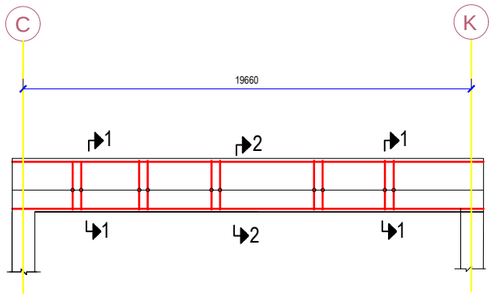
UPPER & LOWER TIE BEAM GRID
SCALE 1:75



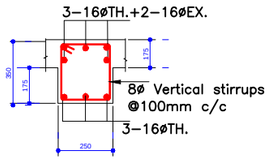
SECTION 1-1
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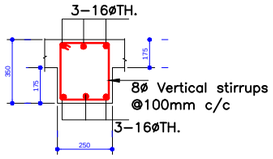
SECTION 2-2
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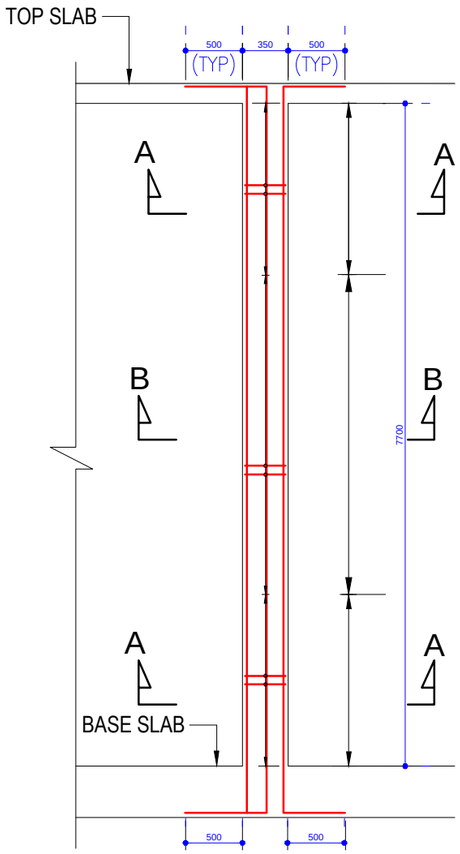
MACHINE ROOM SECONDARY BEAM GRID ALONG 2-2 & 3-3
SCALE 1:75



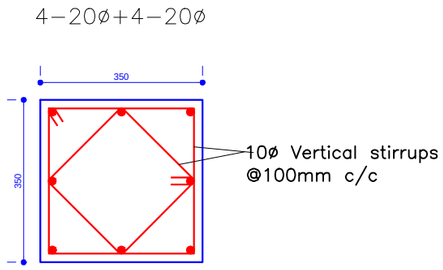
SECTION 1-1
SCALE 1:50



SECTION 2-2
SCALE 1:50



TYPICAL COLUMN SECTION
SCALE 1:50



COLUMN PLAN(A-A & B-B)
SCALE 1:10

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

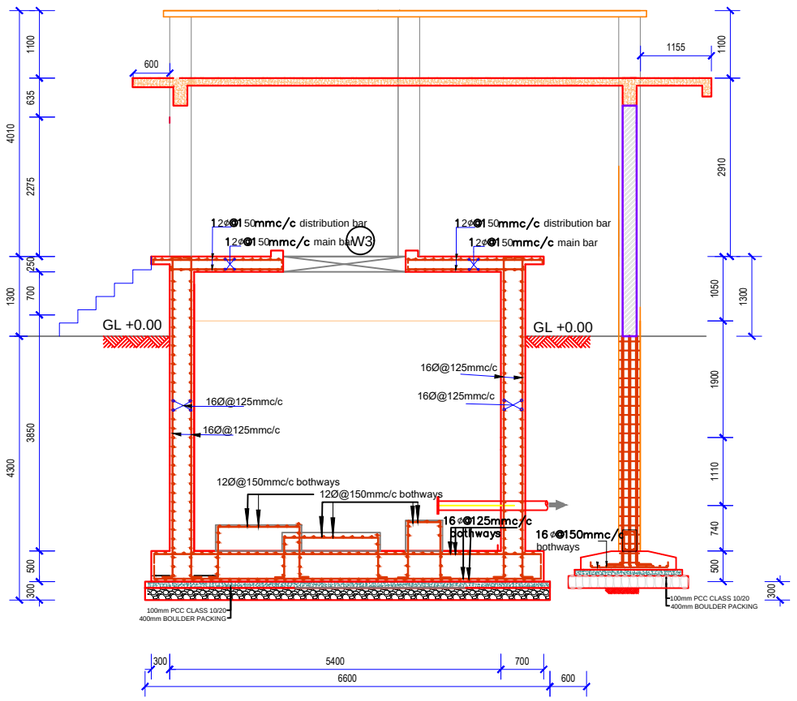
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

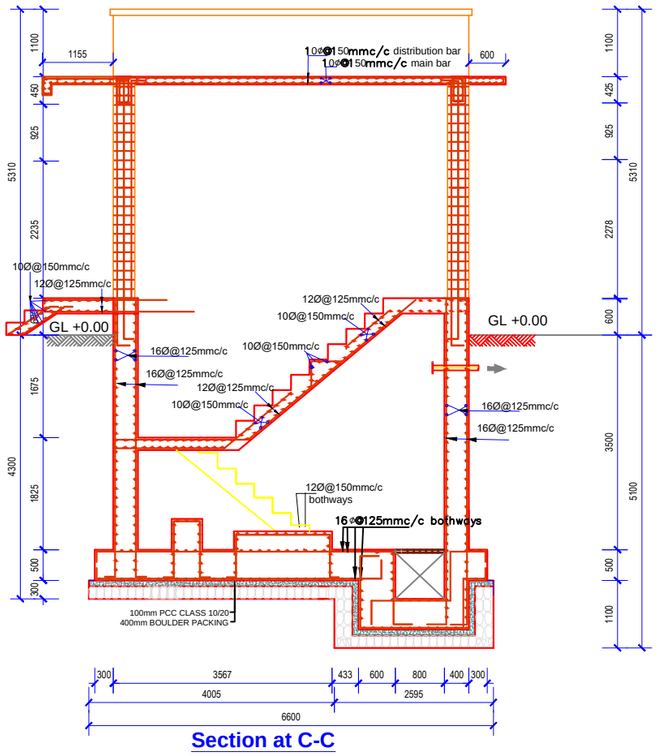
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
BEAM & COLUMN DETAIL

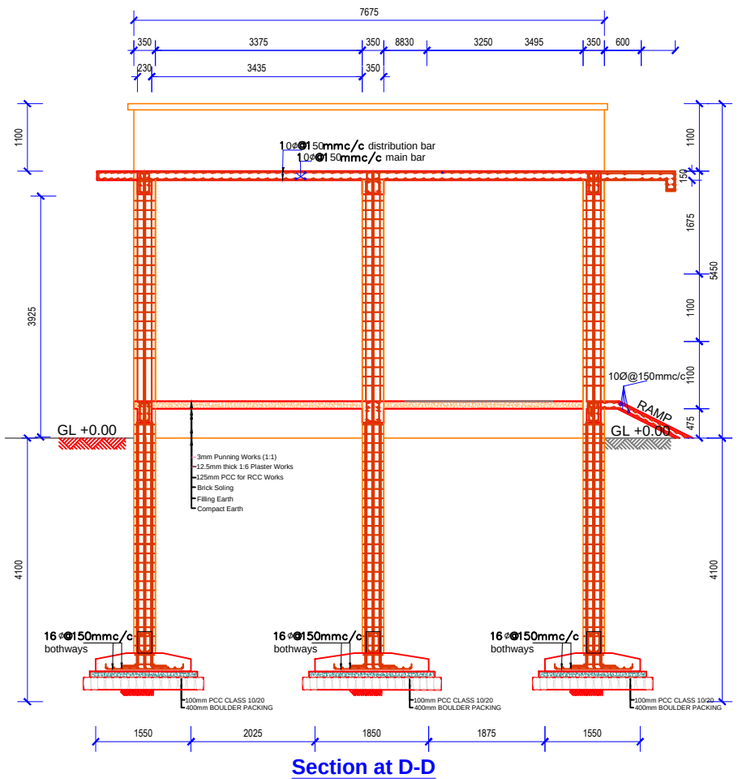
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO-BES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-15	5	



Section at B-B



Section at C-C



Section at D-D

NOTE:
1. DSC-07 COULD NOT REVIEW THIS SECTION OF DSC-05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC-05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC-07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

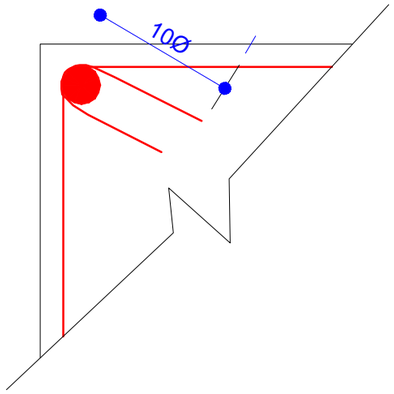
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

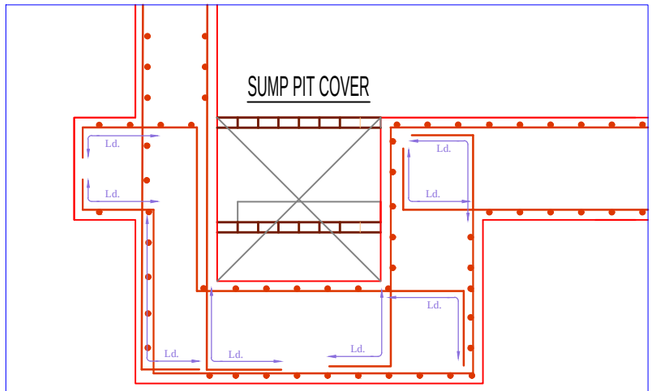
DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
STAIRCASE DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-C-16	5	

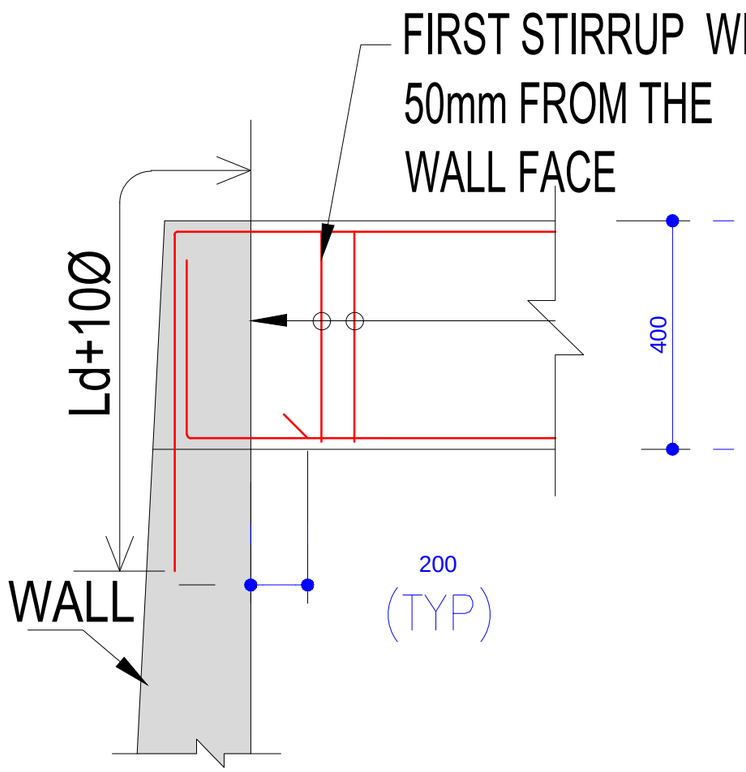


TYP. BEAM STIRRUPS HOOK

SCALE 1:25

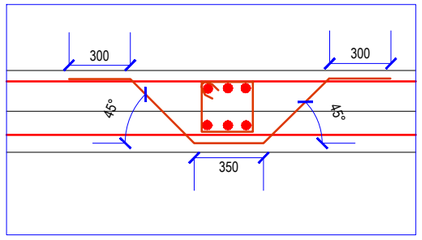


DETAIL 3. CONNECTION DETAIL AT SUMP PIT

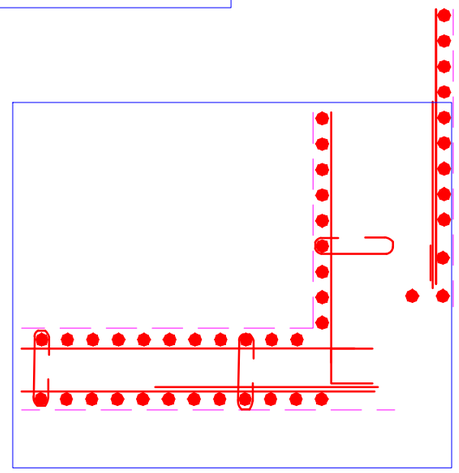


DETAIL -A

SCALE 1:50



DETAIL 2. CONNECTION DETAIL OF SECONDARY BEAM



DETAIL 1. CONNECTION DETAIL OF SHEAR WALL

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

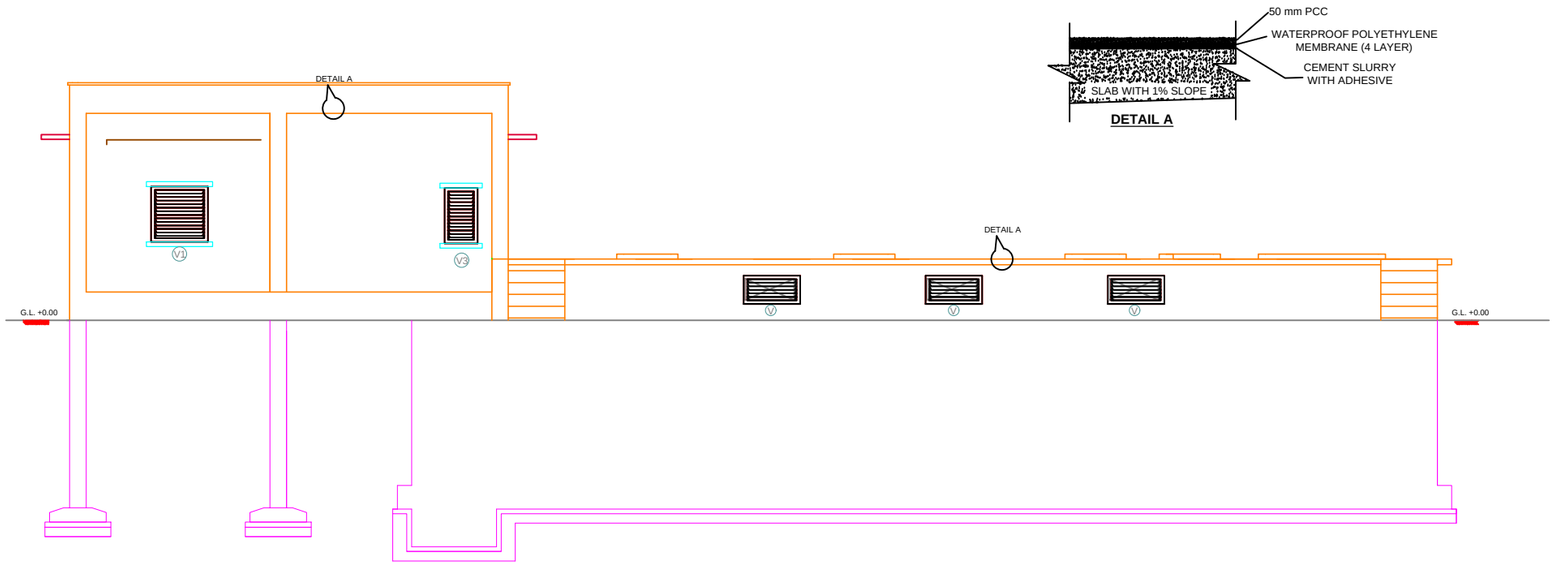
IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

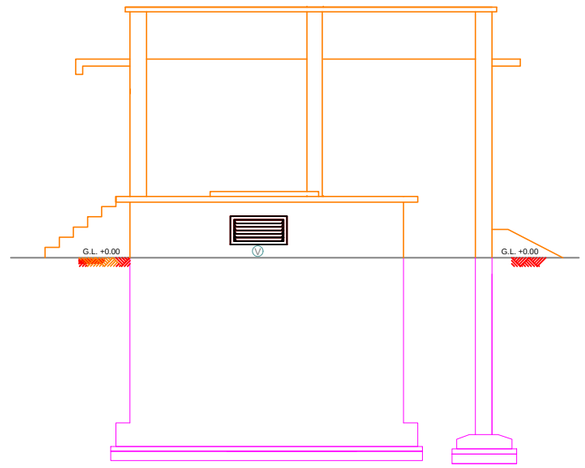
DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
CONNECTION DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:30	4	
DRAWING No.	PS-C-17	5	

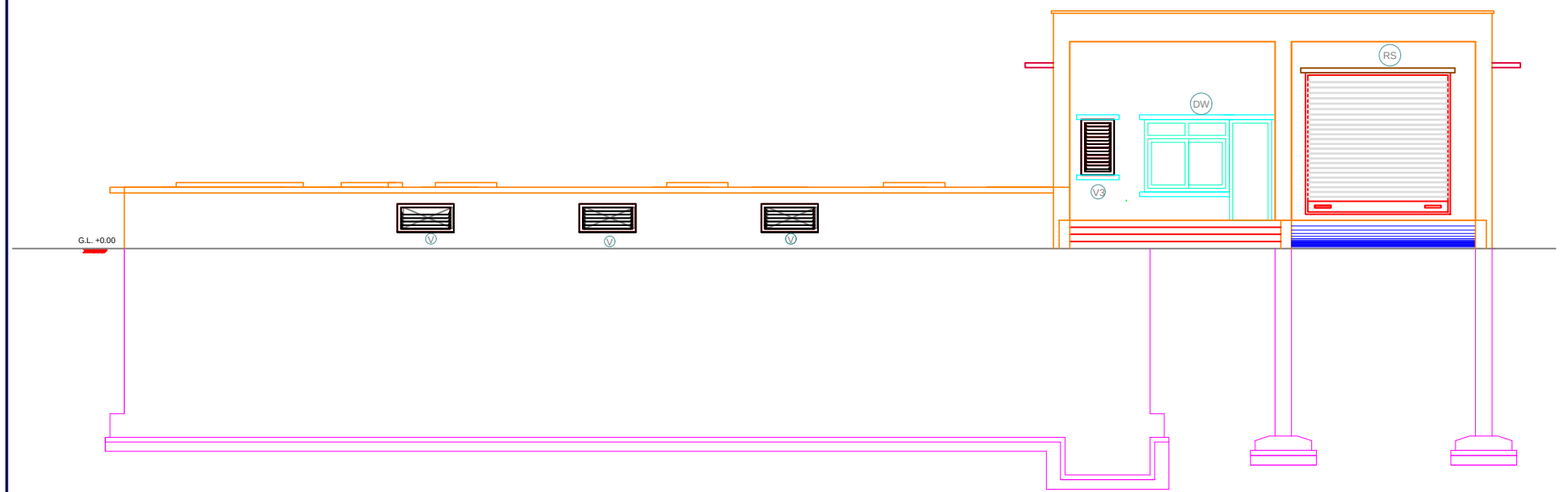


DETAIL A

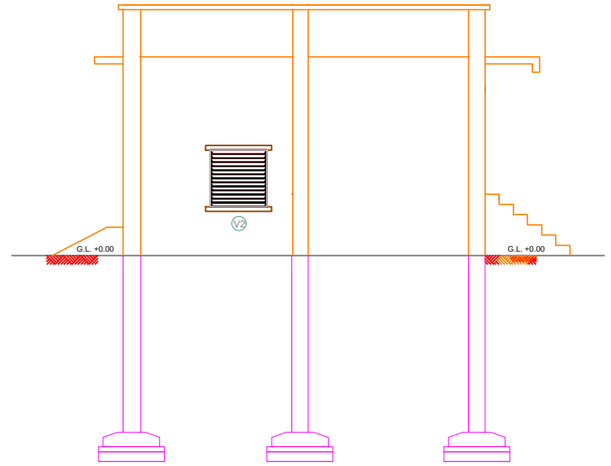
FRONT ELEVATION



RIGHT ELEVATION



BACK ELEVATION



LEFT ELEVATION

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

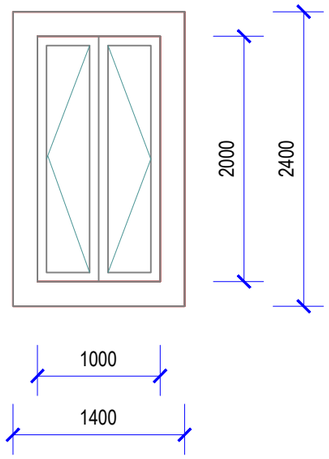
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

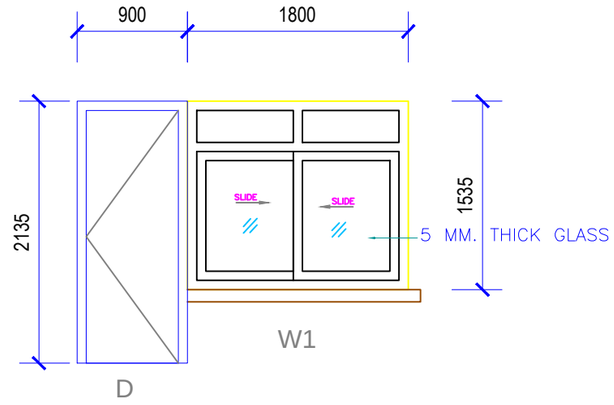
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR PUMP STATION
DOOR, WINDOW & VENTILATION LOCATION

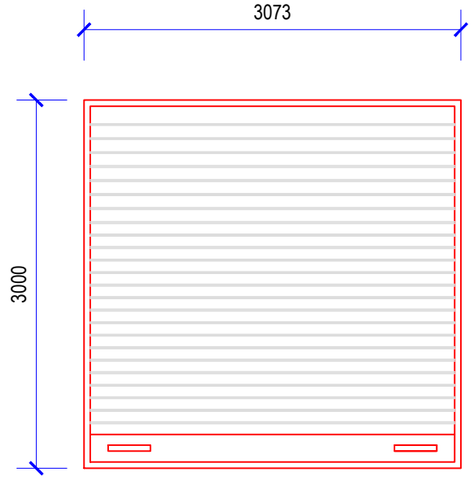
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO-BES	2	
DATE:	Jan-2024	3	
SCALE:	1:130	4	
DRAWING No.	PS-C-18	5	



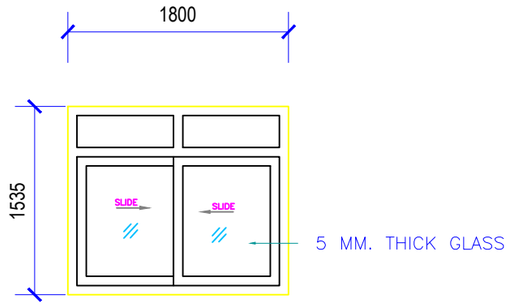
DETAILS OF COVER MANHOLE (CM1)



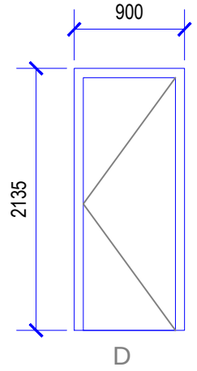
DETAILS OF WINDOW (DW)



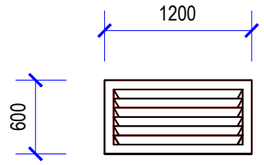
DETAILS OF ROLLING SHUTTER (RS)



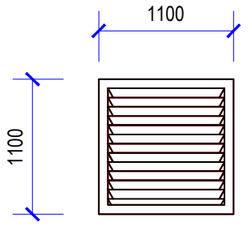
DETAILS OF WINDOW (W1)



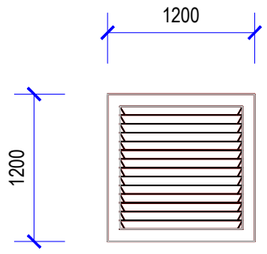
DETAILS OF DOOR (D)



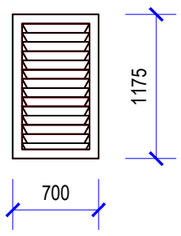
DETAILS OF VENTILATION (V)



DETAILS OF VENTILATION (V1)



DETAILS OF VENTILATION (V2)



DETAILS OF VENTILATION (V3)

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

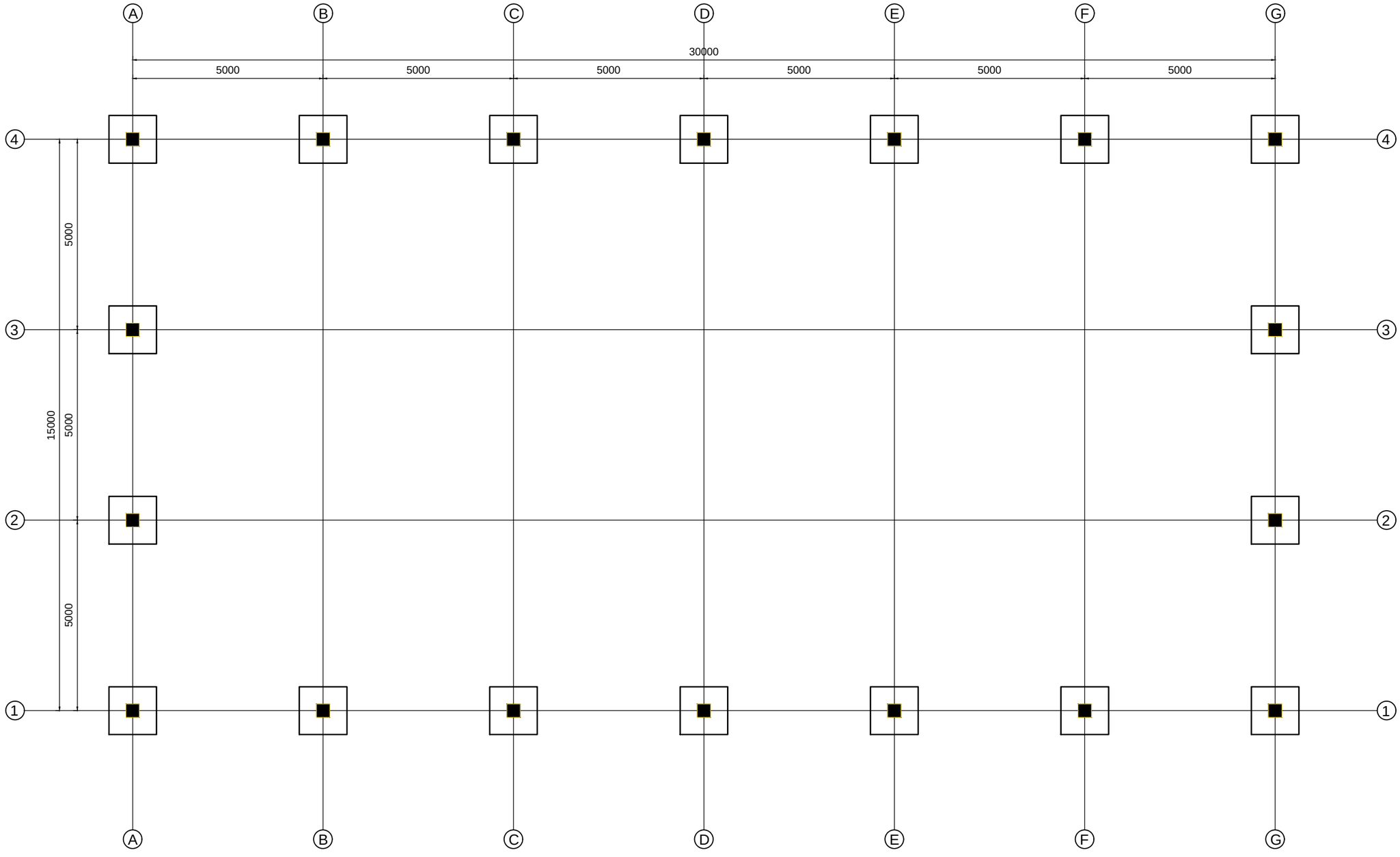
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KRITIPUR PUMP STATION
CIVIL STRUCTURE
DOOR, WINDOW & VENTILATION DETAILS

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	PS-C-19	5	



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

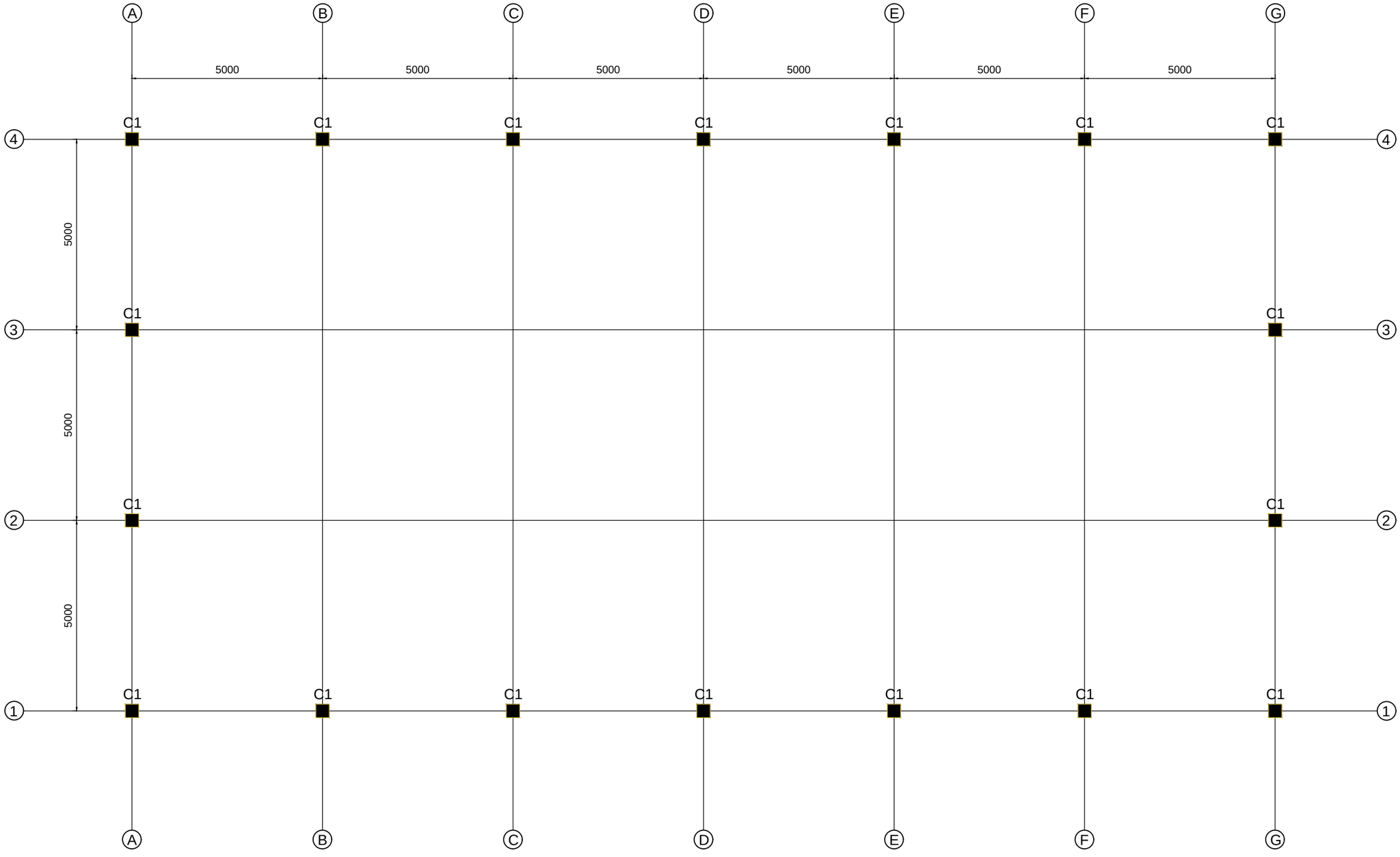
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: TRUSS DESIGN FOOTING LAYOUT PLAN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:110	4	
DRAWING No.	1	5	



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

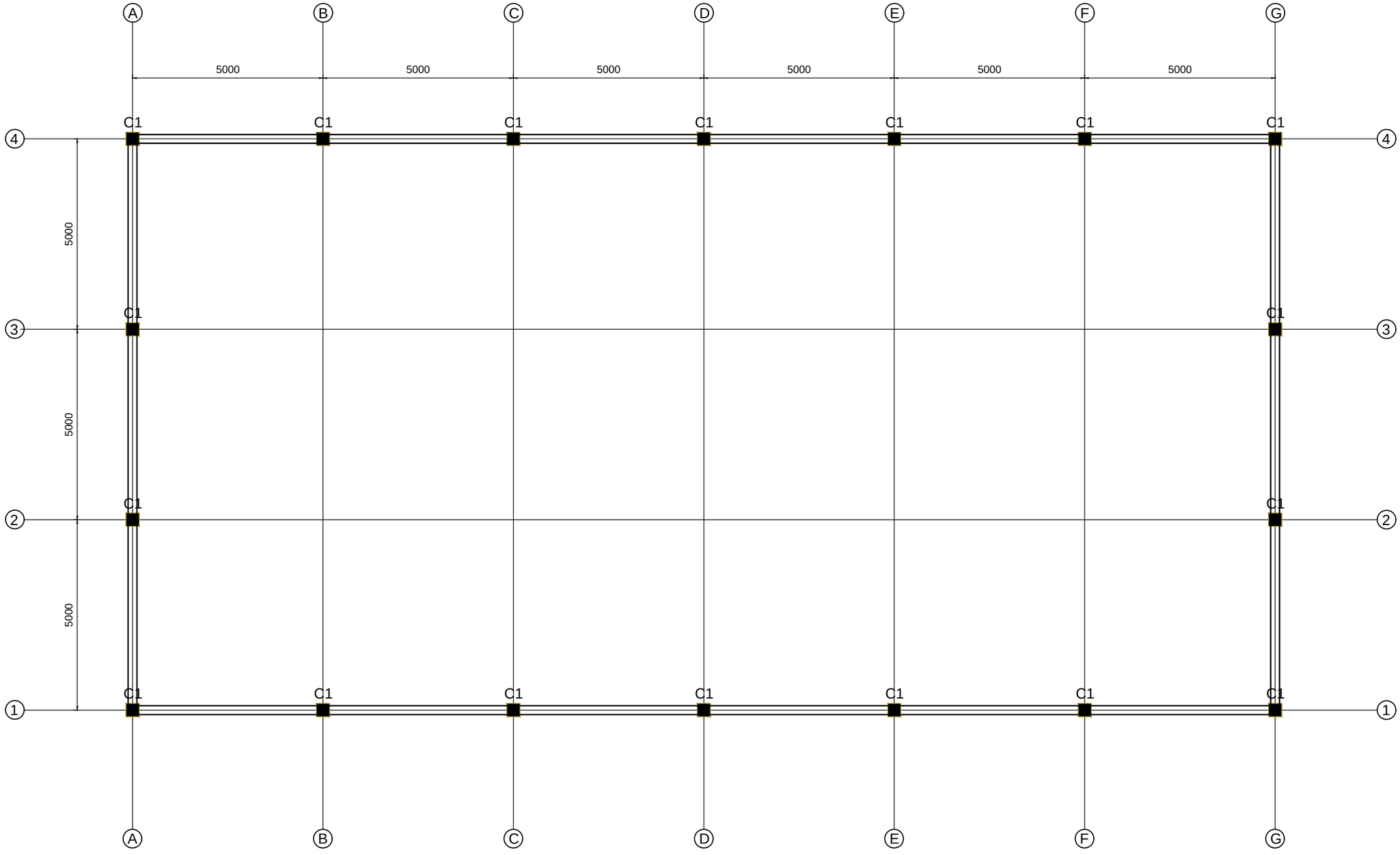
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: TRUSS DESIGN
COLUMN LAYOUT PLAN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:110	4	
DRAWING No.	2	5	



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

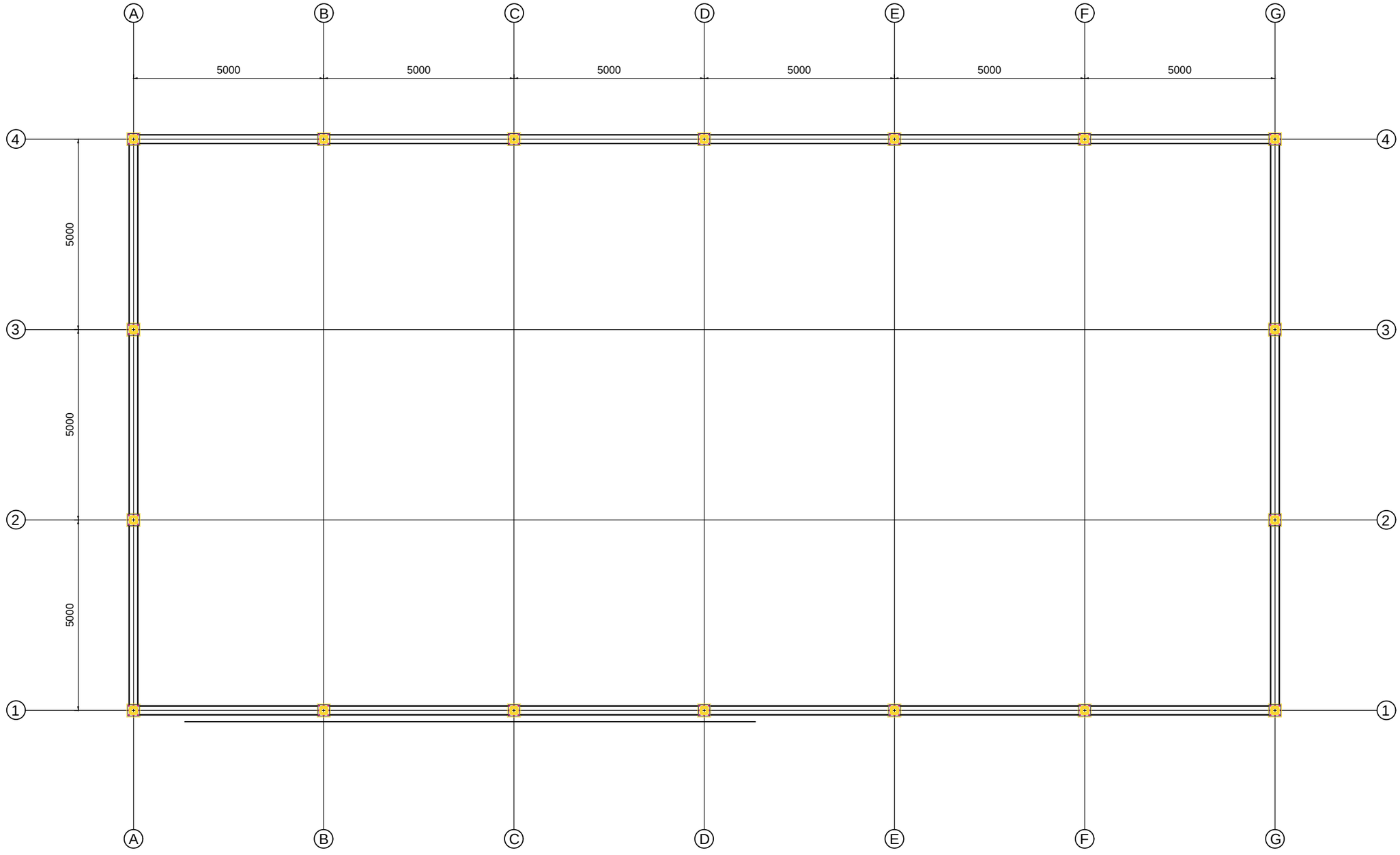
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: TRUSS DESIGN
PLINTH BEAM LAYOUT PLAN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:110	4	
DRAWING No.	3	5	



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

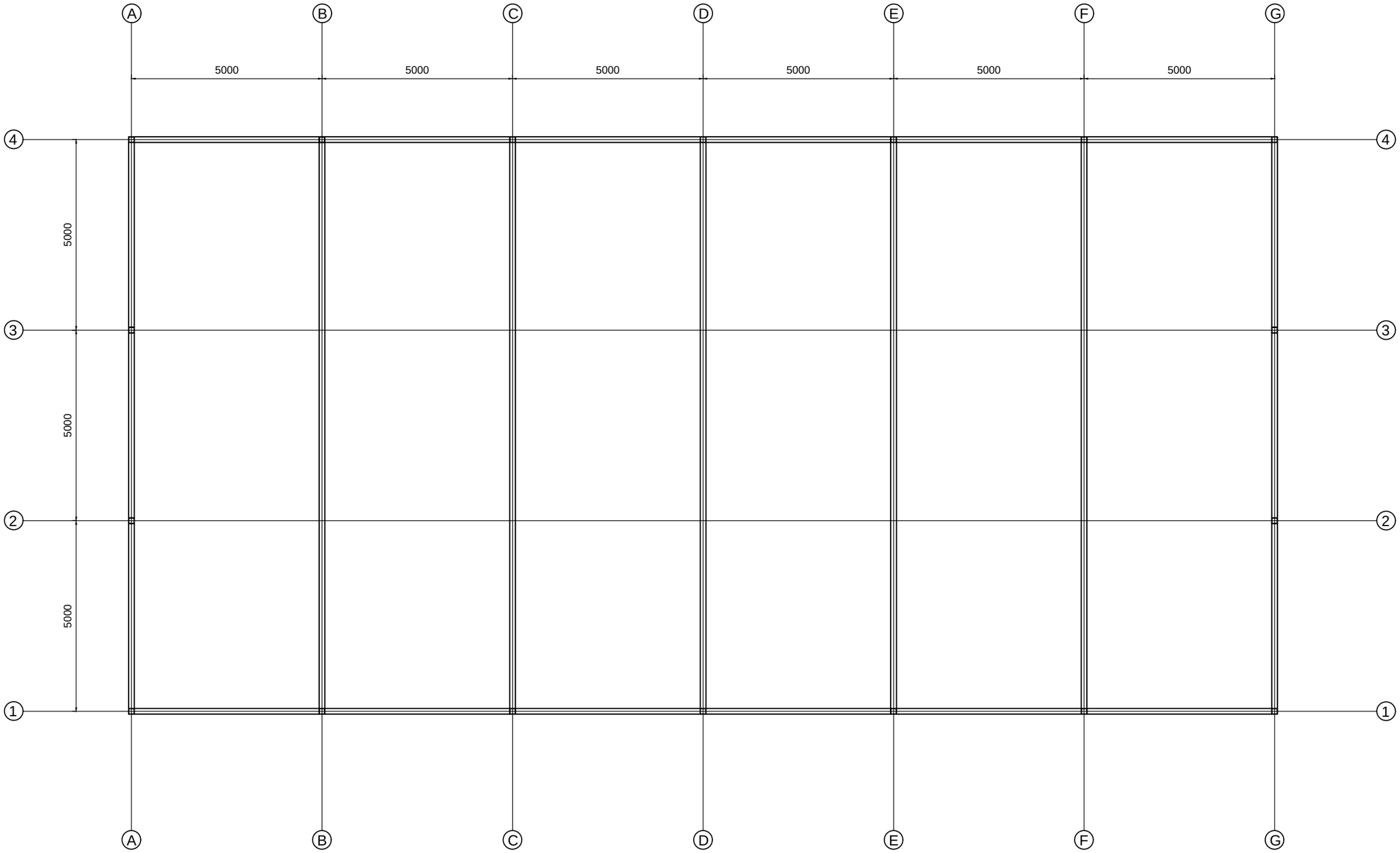
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: TRUSS DESIGN
STEEL COLUMN LAYOUT PLAN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BERMÚDES	2	
DATE:	Jan-2024	3	
SCALE:	1:110	4	
DRAWING No.	4	5	



TUBE (STEEL COLUMN) AND BOTTOM RAFTER PLAN

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

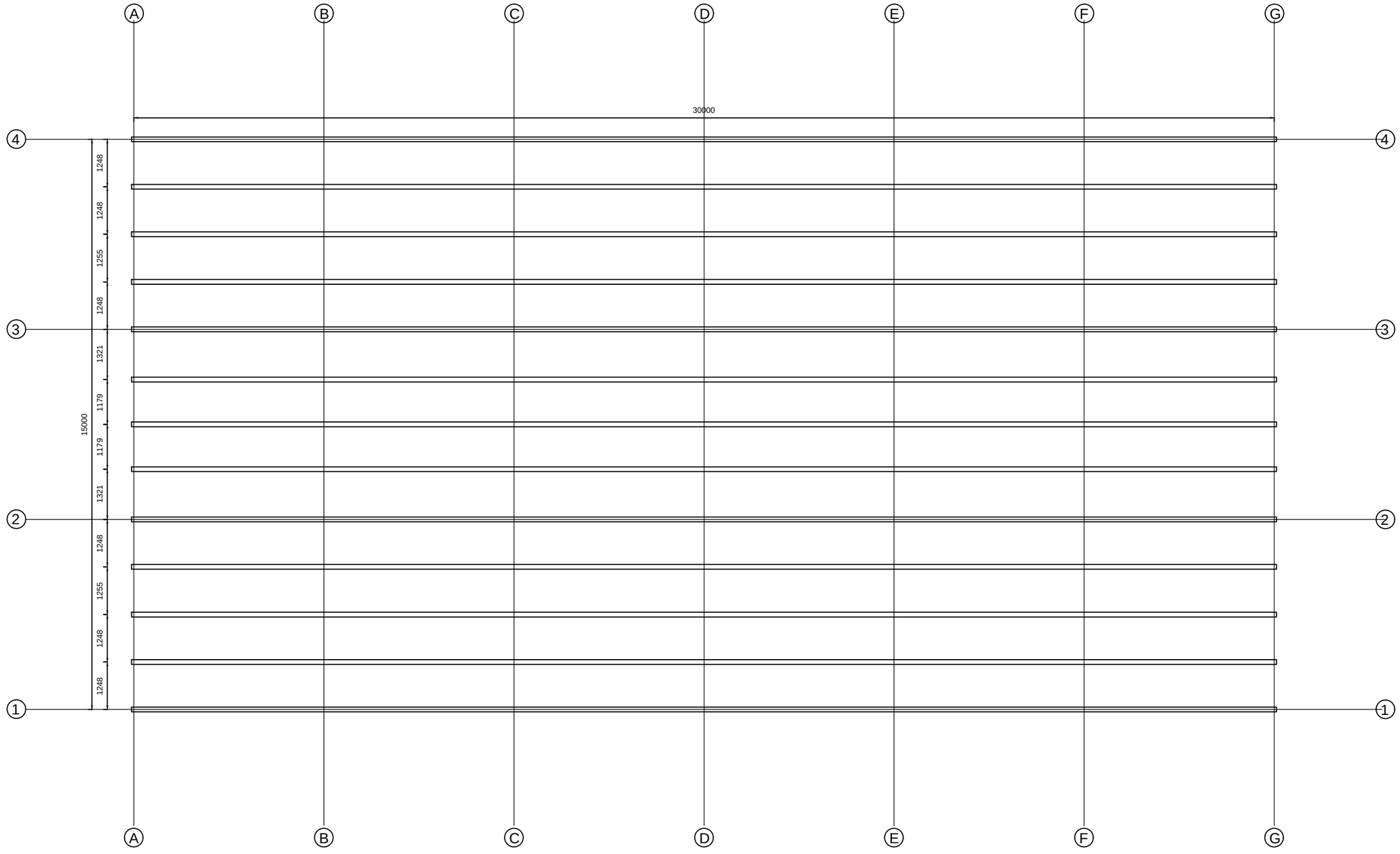
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: TRUSS DESIGN
TOP AND BOTTOM RAFTER PLAN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:110	4	
DRAWING No.	5	5	



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

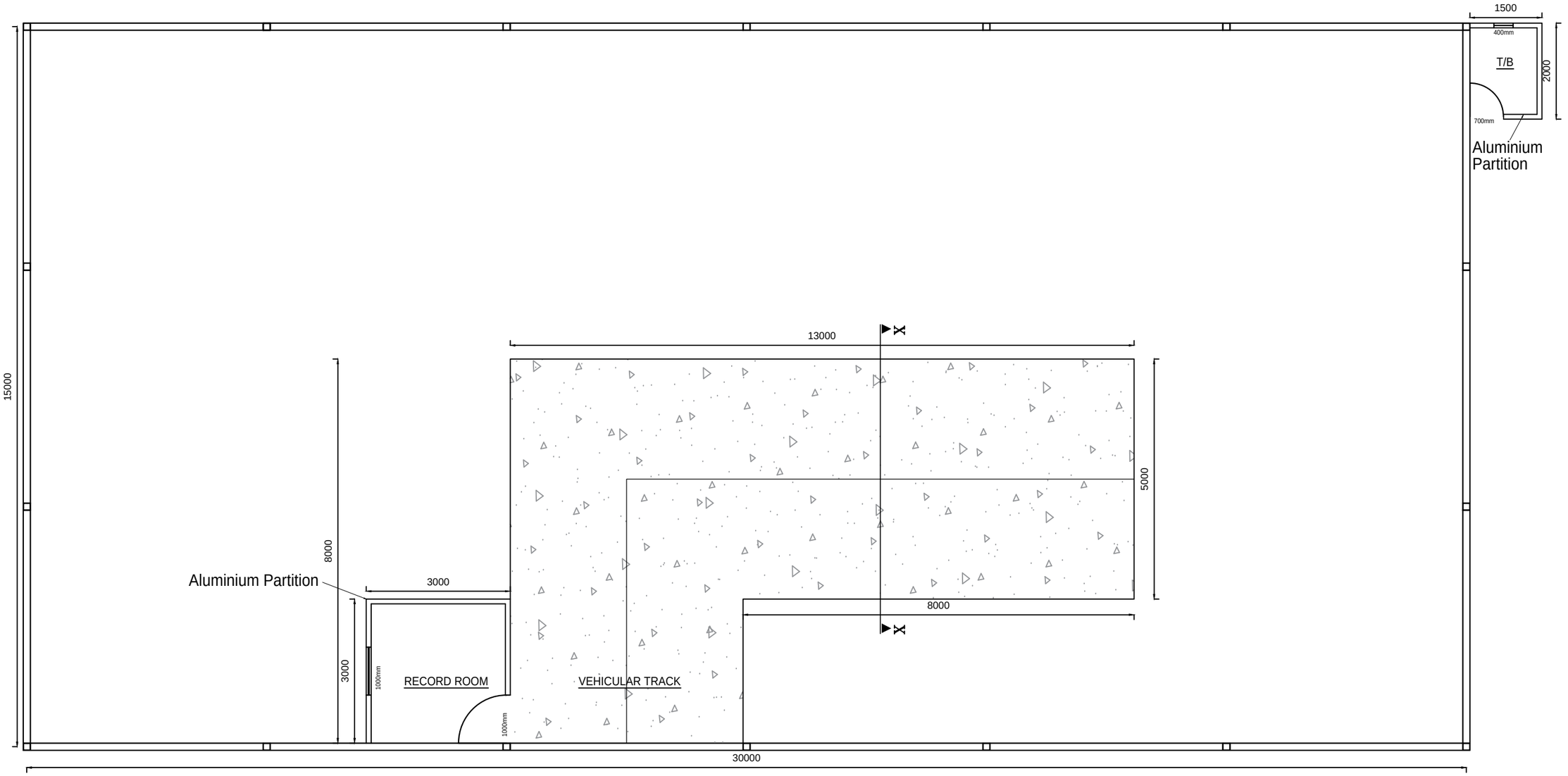
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

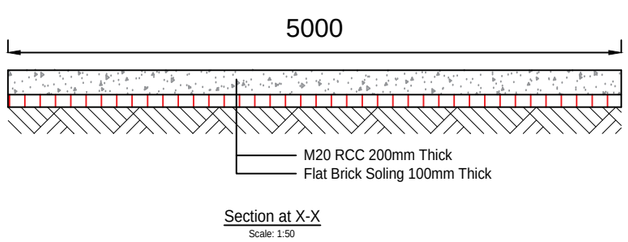
DRAWING TITLE: TRUSS DESIGN
PURLIN LAYOUT PLAN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:110	4	
DRAWING No.	6	5	



TRUSS INTERIOR PLAN

SCALE: 1:90



Section at X-X

Scale: 1:50

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

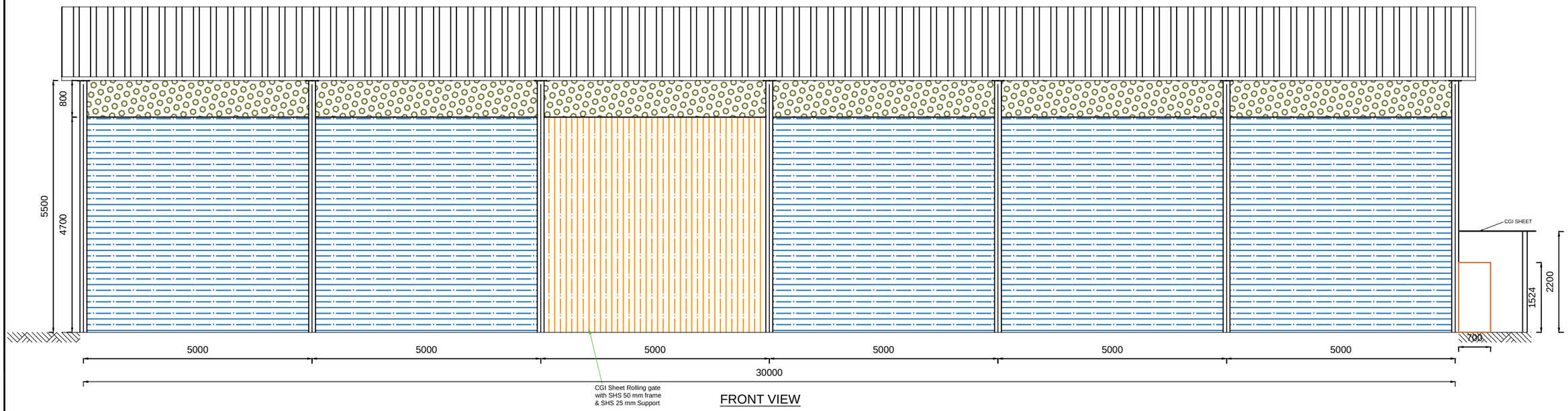
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

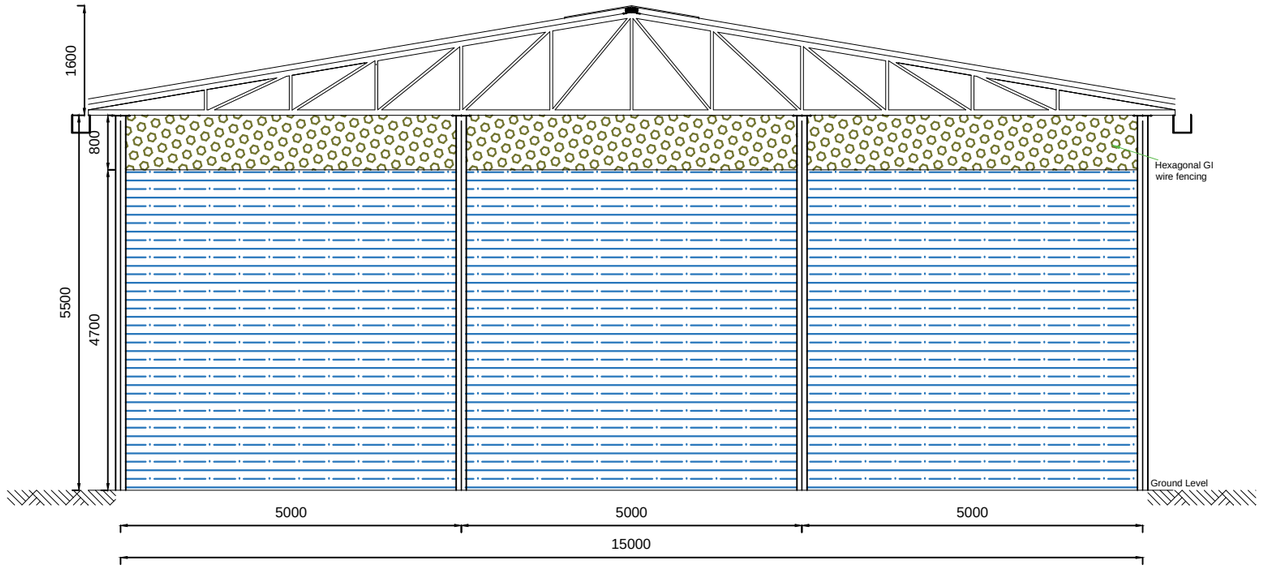
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: TRUSS DESIGN
TRUSS INTERIOR PLAN

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	7	5	



FRONT VIEW



SIDE VIEW

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

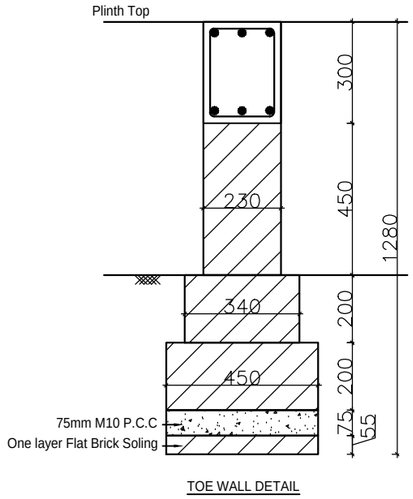
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: TRUSS DESIGN ELEVATION VIEW

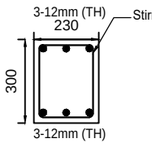
		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:90	4	
DRAWING No.	8	5	



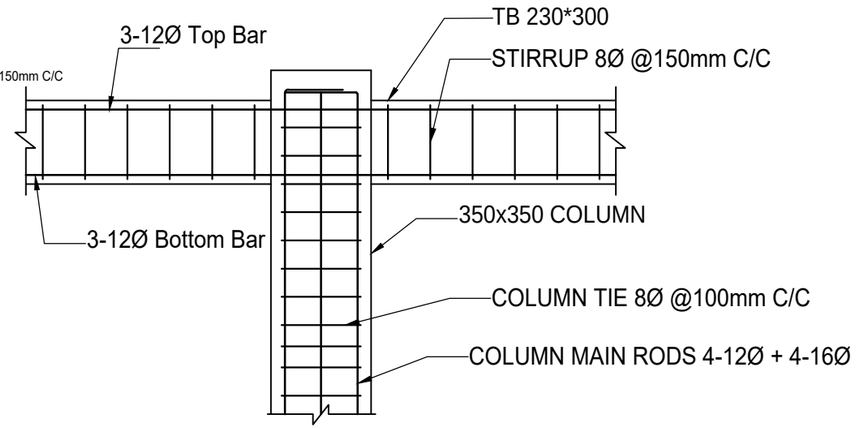
TOE WALL DETAIL

R.C.C COLUMN DETAILS

FLOOR / TYPE	COLUMN C1	Strirrups:
UP TO PLINTH LEVEL	350 / 350 / 4-16Ø+4-12Ø	COLUMN C1 8Ø @100mm C/C

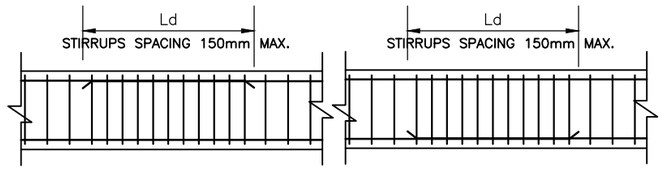


Plinth Beam Details



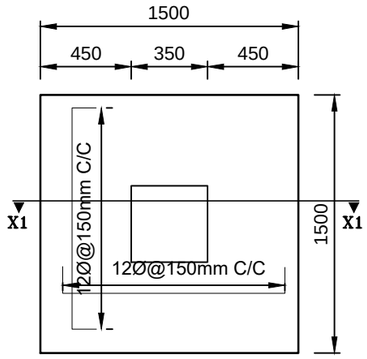
TIE BEAM LONGITUDINAL SECTION

SCALE: 1:22



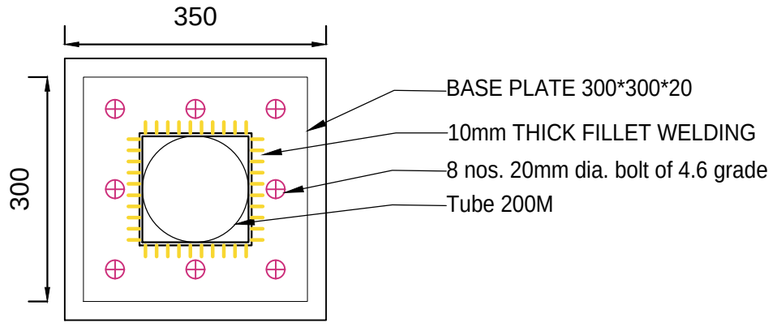
LAPPING NOTES FOR BEAM

LAP LENGTH SHALL NOT BE LESS THAN BAR DEVELOPMENT LENGTH IN TENSION
NOT MORE THAN 50% OF THE BARS SHALL BE SPLICED AT ONE SECTION.
LAP SPLICE SHALL NOT BE PROVIDED:—
1. WITHIN A JOINT
2. WITHIN A DISTANCE OF 2d FROM JOINT FACE
3. WITHIN A QUARTER LINGTH OF THE MEMBER

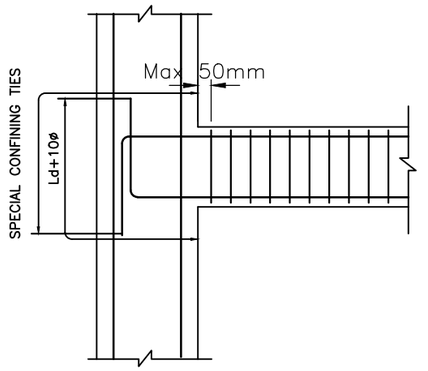


FOOTING F1 PLAN

NOT TO SCALE



COLUMN CONNECTION WITH BASE PLATE

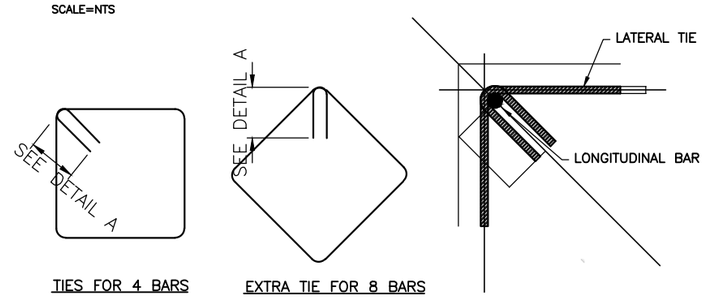


HOOK FOR BEAM BAR

(8Ø Can be deduct from LD+10Ø if 90 bend in provided.)

LAPING FOR BEAM BAR

SCALE=NTS



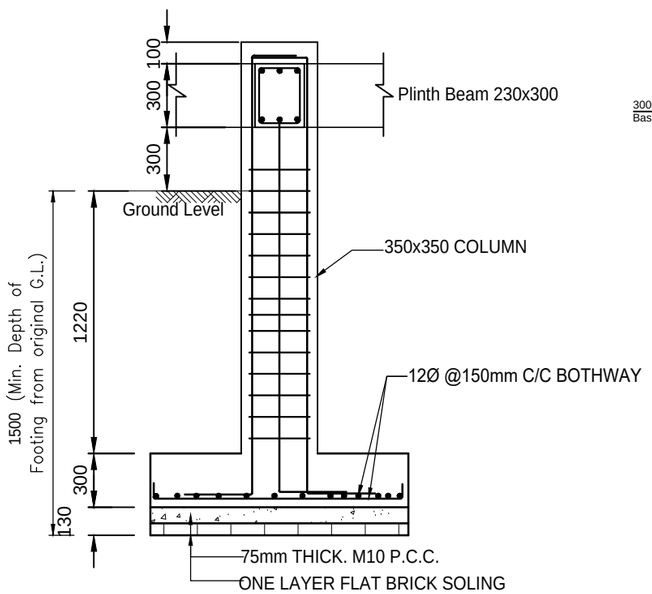
TIES FOR 4 BARS

EXTRA TIE FOR 8 BARS

DETAIL-A

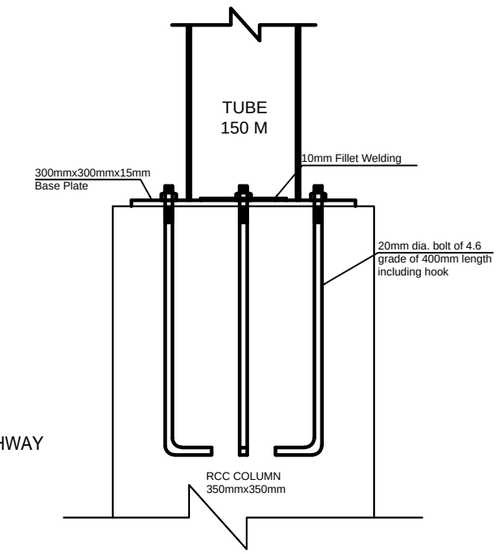
SHAPE OF TIES FOR COLUMN

NOT TO SCALE



FOOTING F1-SECTION AT X1

SCALE: 1:30



Base Plate Details on pedestal
All dimensions are in mm.
Scale: 1:8

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

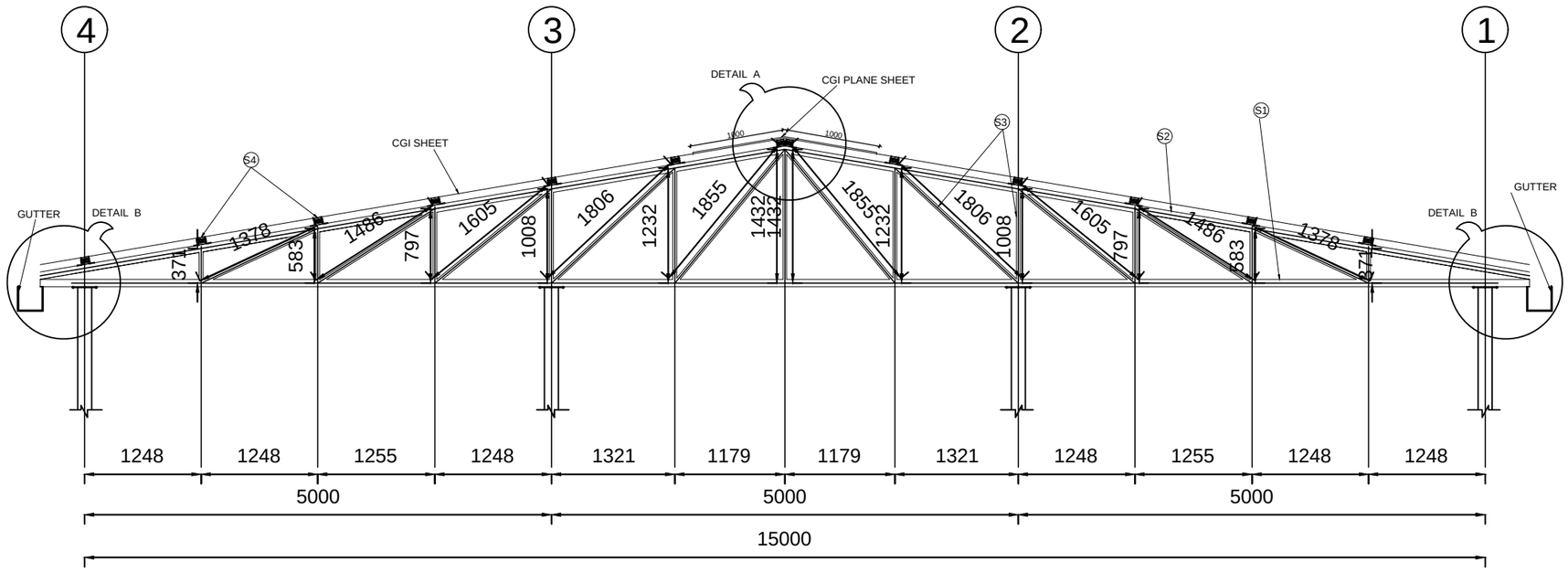
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: TRUSS DESIGN REINFORCEMENT DETAILS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	9	5	

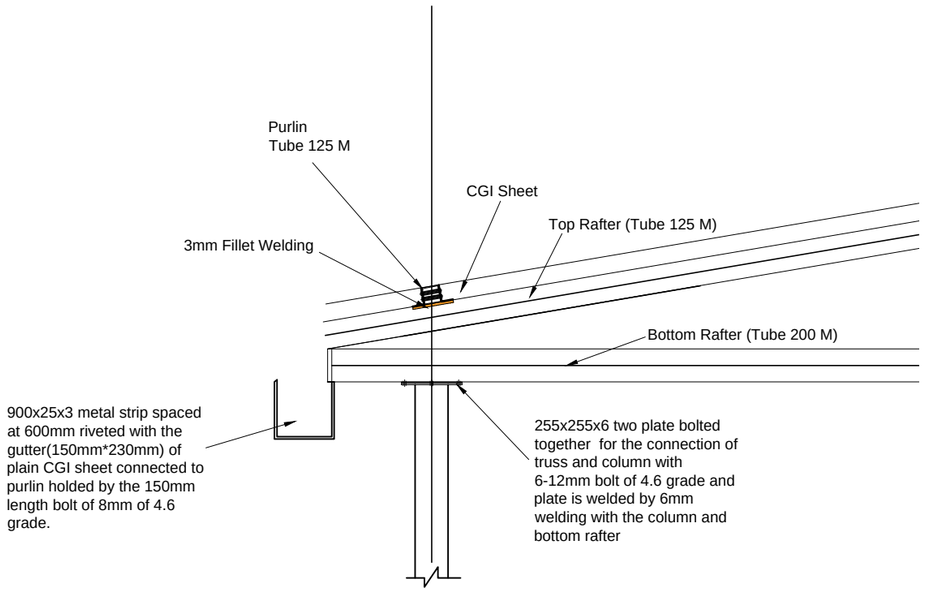


TRUSS(TR1) FOR GRID A & G

SCALE: 1:60

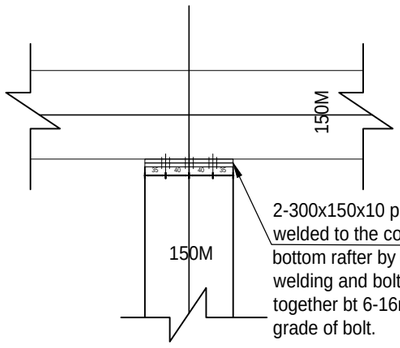
LEGEND

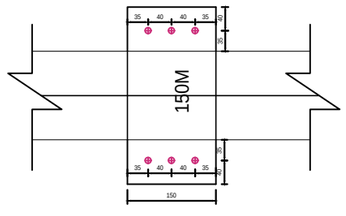
TUBE 150 M (BOTTOM RAFTER)	S1
TUBE 125 M (TOP RAFTER)	S2
TUBE 50 M (VERTICAL & INCLINED MEMBER)	S3
TUBE 125 M (PURLIN)	S4



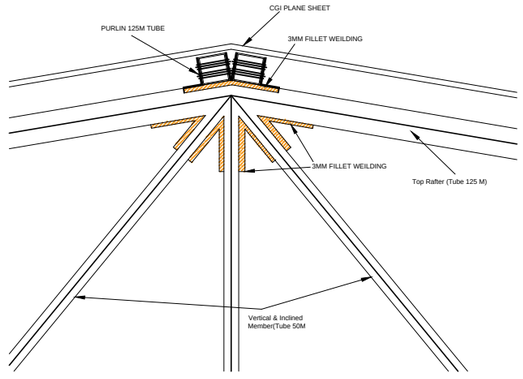
DETAIL OF B

NOT TO SCALE

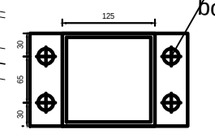




Column and Bottom Rafter Connection



DETAIL OF A



4 nos. 12mm dia. bolt of 4.6 grade

6mm plate attached with both purlin for joint connection (6mm Cleat attached to purlins for connection with top rafter)

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: TRUSS DESIGN TRUSS DETAILS

		Rev.	DATE
DRAWN:	SAJ		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	10	5	

DISTRIBUTION NETWORK IMPROVEMENT WORKS IN KIRTIPUR

CONTRACT No.: PID/SKV/DNI2-KIRTIPUR

MECANICAL WORKS



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR SRT & PS & NETWORK
CK CONNECTIONS
SITE LAYOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:700	4	
DRAWING No.	CK-1	5	

OMU-2 (DMA 3 & 4)
FLOWMETER
CHAMBER

OMU-2 (DMA 3&4) DI 400 mm

BUTTERFLY
VALVE
CHAMBER 2

LYAKU TANK (OLD)

KWACHO OHT (NEW)

200mm-CW-DI

200mm-CW-DI

KWACHO OHT &
LYAKU TANK
FLOWMETER
CHAMBER

OHT OUTLET
FLOWMETER
CHAMBER

OMU1 (DMA 2&DMA 1)
350mm-DI

350mm-CW-DI

300mm-CW-DI

4194

PUMPING STATION

PV0400023
BY PASS CHAMBER

PV0400024

PV0400025

EMFM CHAMBER

DFTP 900
BV 900
DJ 900

PV0400016

OUTLET

OUT LET
PV0400017

BUTTERFLY
VALVE
CHAMBER 1

OVERFLOW

WASH OUT
PV0400021

PV0400022

DI 700Ø OUTLET PIPE

PV0400020
WASH OUT

OVERFLOW

OUT LET
PV0400015

OUT LET
PV0400014

OUT LET

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT
(PHASE 2)

IN ASSOCIATION WITH:

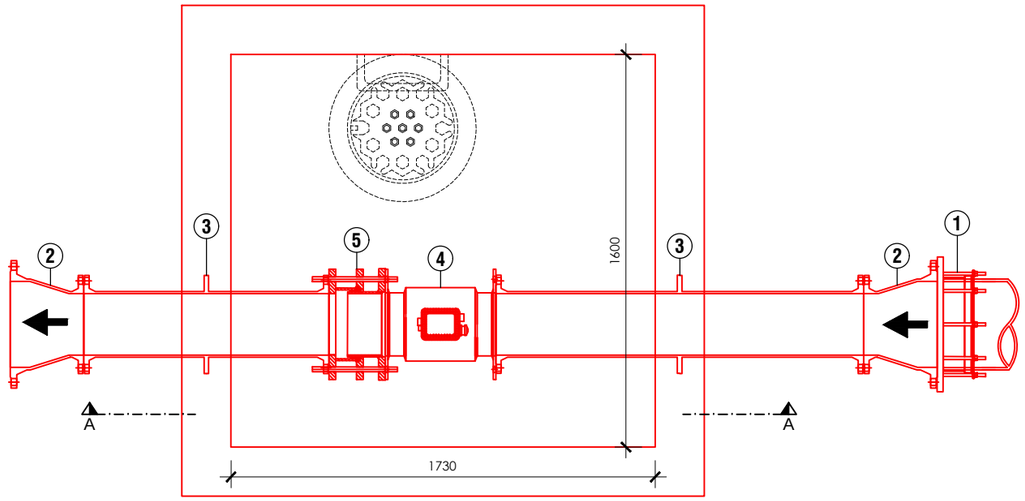
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

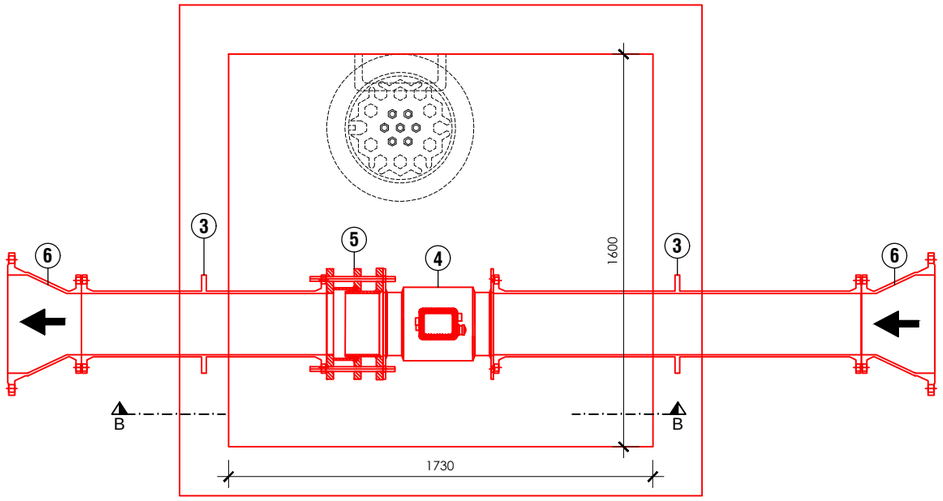
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PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE:
KRITIPUR SRT & PS & NETWORK
CK CONNECTIONS
SITE LAYOUT

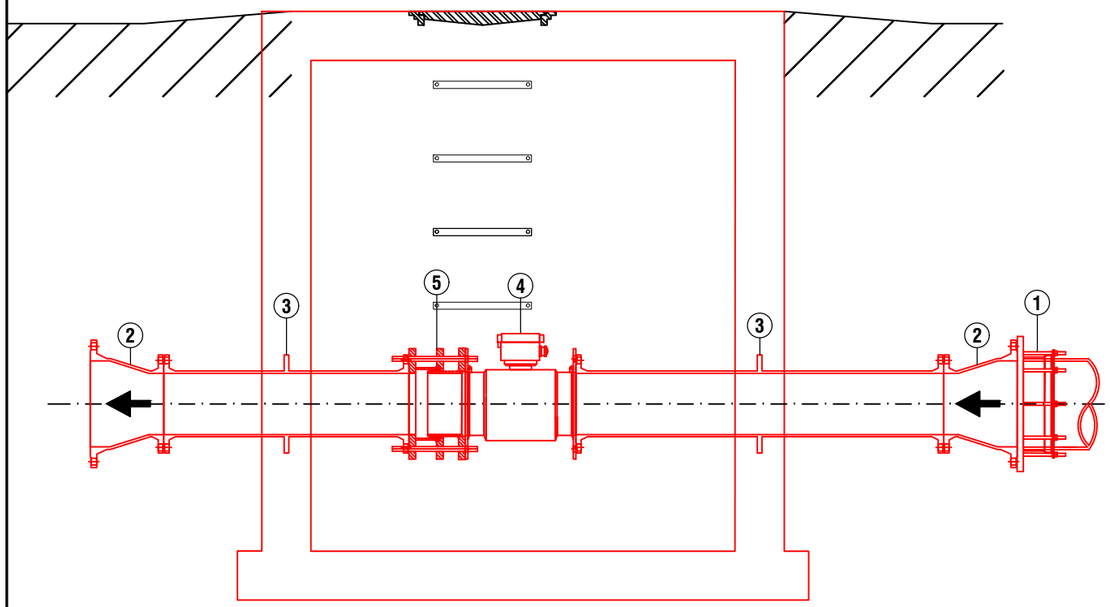
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:200	4	
DRAWING No.	CK-2	5	



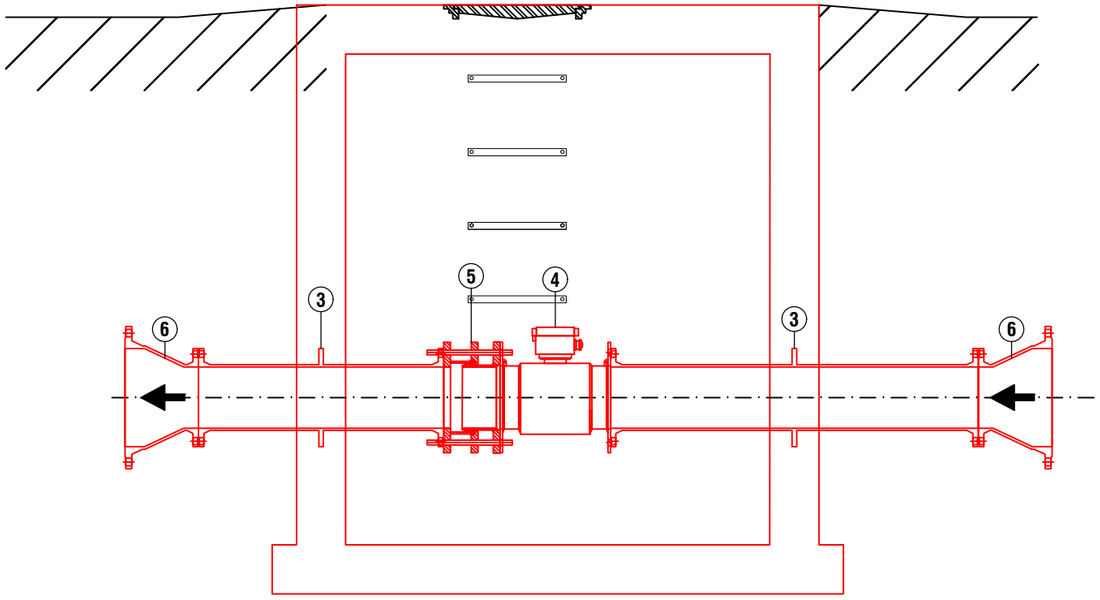
DRISTRIUTION OMU-1 (DMA-1 & 2) FLOWMETER CHAMBER



DRISTRIBUTION OMU-2 (DMA 3 & 4) FLOWMETER CHAMBER



SECTION A-A VIEW



SECTION B-B VIEW

ITEM	DESIGNATION	PN	DN	QTY
1	FLANGED ADAPTER	15	350	1
2	FLANGED REDUCER	16	300/250	2
3	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	250	4
4	ELECTRO-MAGNETIC FLOWMETER	16	250	2
5	SELF RESTRAINING DISMANTLING JOINT -DI	16	250	2
6	FLANGED REDUCER	16	400/250	2

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

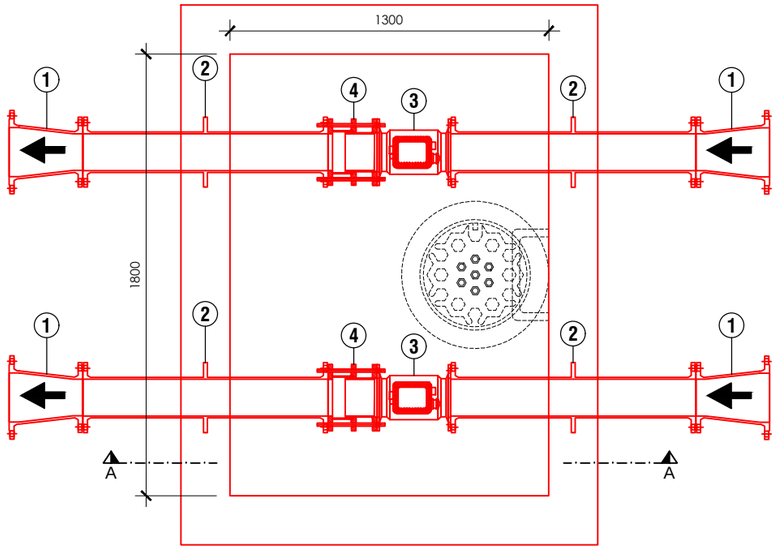
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

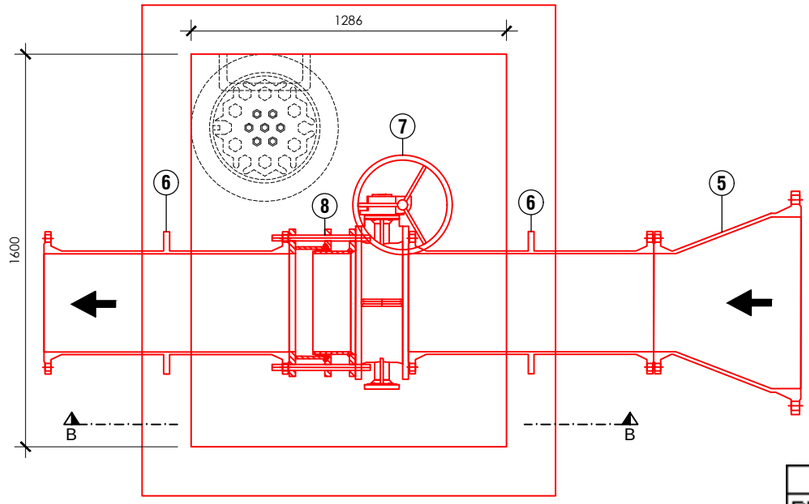
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR SRT & PS & NETWORK CK CONNECTIONS CHAMBERS DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:25	4	
DRAWING No.	CK-3	5	

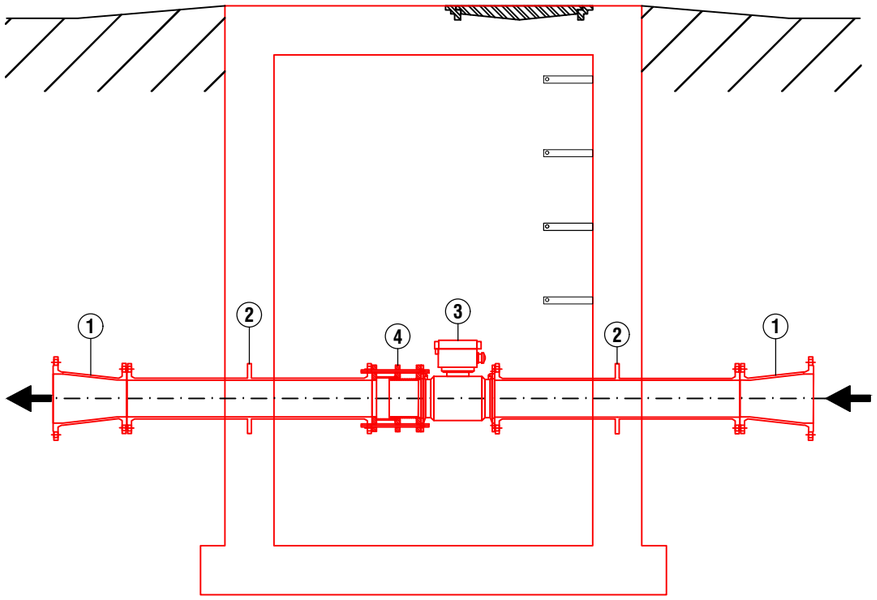


KWACHO RVT & LYAKU RVT FLOWMETER CHAMBER

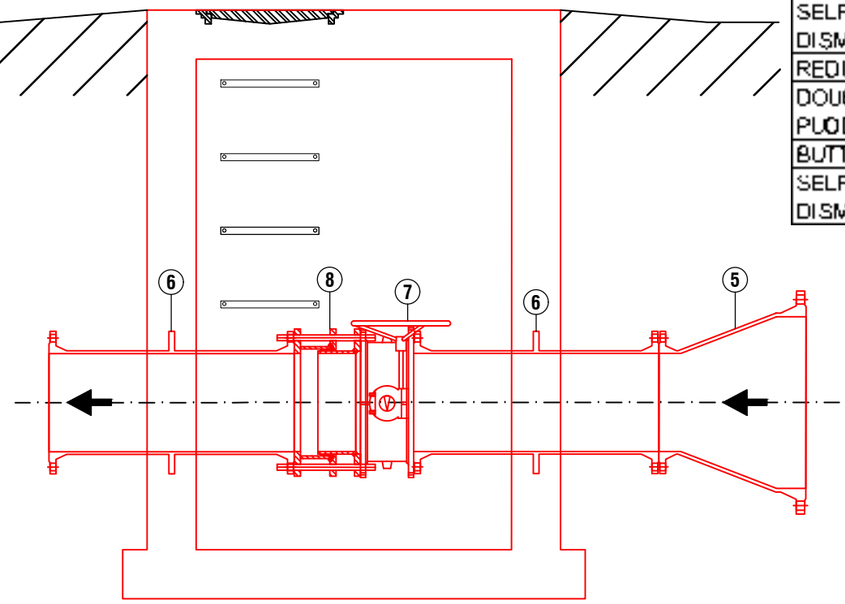


BUTTERFLY VALVE CHAMBER - 2

DESIGNATION	PN	DN	QTY
REDUCER	16	200/150	4
DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	150	4
ELECTRO-MAGNETIC FLOWMETER	16	150	2
SELF RESTRAINING DISMANTLING JOINT-DI	16	150	2
REDUCER	16	700/400	1
DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	400	2
BUTTERFLY VALVE	16	400	1
SELF RESTRAINING DISMANTLING JOINT-DI	16	400	1



SECTION A-A VIEW



SECTION B-B VIEW

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

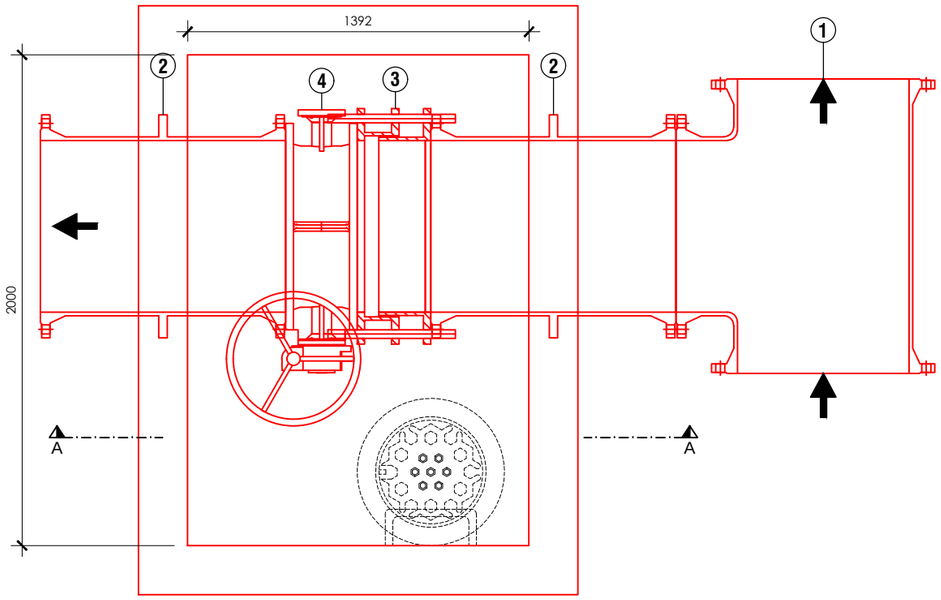
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

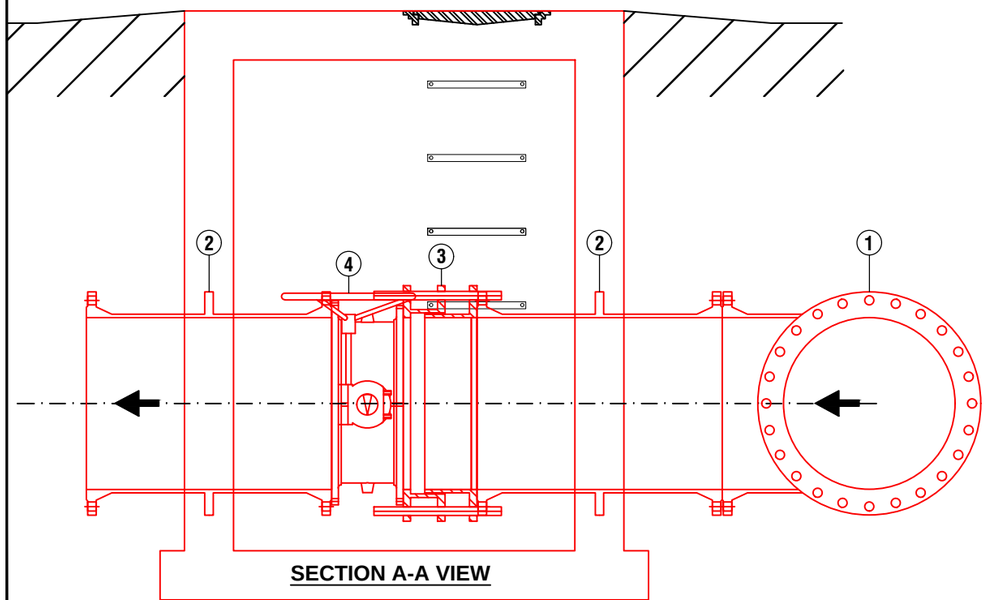
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR SRT & PS & NETWORK CK CONNECTIONS CHAMBERS DETAIL

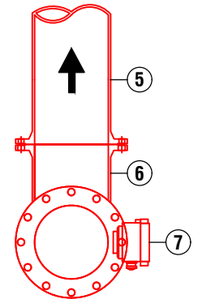
		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:25	4	
DRAWING No.	CK-4	5	



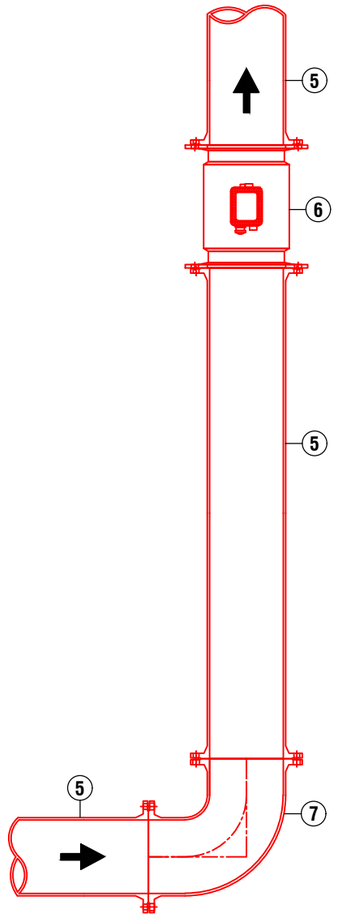
BUTTERFLY CHAMBER - 1



SECTION A-A VIEW



KRITIPUR OHT INLET FLOWMETER CHAMBER°



SECTION VIEW

ITEM	DESIGNATION	PN	DN	QTY
1	FLANGED EQUAL TEE	16	700	1
2	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	700	2
3	SELF RESTRAINING DISMANTLING JOINT -DI	16	700	1
4	BUTTERFLY VALVE	16	700	1
5	DOUBLE FLANGED PIPE	16	300	

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

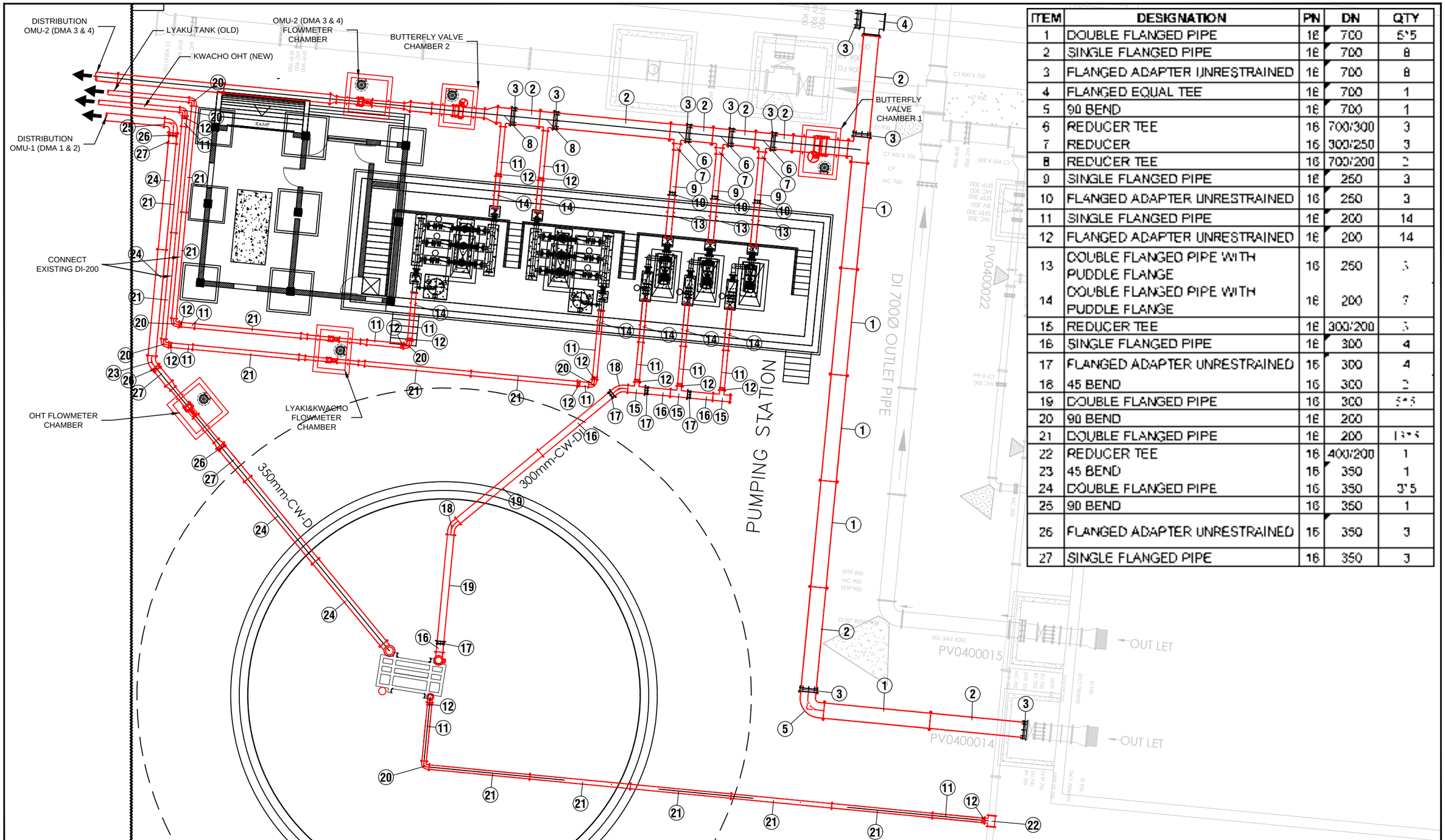
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR SRT & PS & NETWORK
CK CONNECTIONS
INLET FLOWMETER & CHAMBERS DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:25	4	
DRAWING No.	CK-5	5	



ITEM	DESIGNATION	PN	DN	QTY
1	DOUBLE FLANGED PIPE	16	700	5.5
2	SINGLE FLANGED PIPE	16	700	8
3	FLANGED ADAPTER UNRESTRAINED	16	700	8
4	FLANGED EQUAL TEE	16	700	1
5	90 BEND	16	700	1
6	REDUCER TEE	16	700/300	3
7	REDUCER	16	300/250	3
8	REDUCER TEE	16	700/200	2
9	SINGLE FLANGED PIPE	16	250	3
10	FLANGED ADAPTER UNRESTRAINED	16	250	3
11	SINGLE FLANGED PIPE	16	200	14
12	FLANGED ADAPTER UNRESTRAINED	16	200	14
13	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	250	3
14	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	200	7
15	REDUCER TEE	16	300/200	3
16	SINGLE FLANGED PIPE	16	300	4
17	FLANGED ADAPTER UNRESTRAINED	16	300	4
18	45 BEND	16	300	2
19	DOUBLE FLANGED PIPE	16	300	5.5
20	90 BEND	16	200	
21	DOUBLE FLANGED PIPE	16	200	13.5
22	REDUCER TEE	16	400/200	1
23	45 BEND	16	350	1
24	DOUBLE FLANGED PIPE	16	350	3.5
25	90 BEND	16	350	1
26	FLANGED ADAPTER UNRESTRAINED	16	350	3
27	SINGLE FLANGED PIPE	16	350	3

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

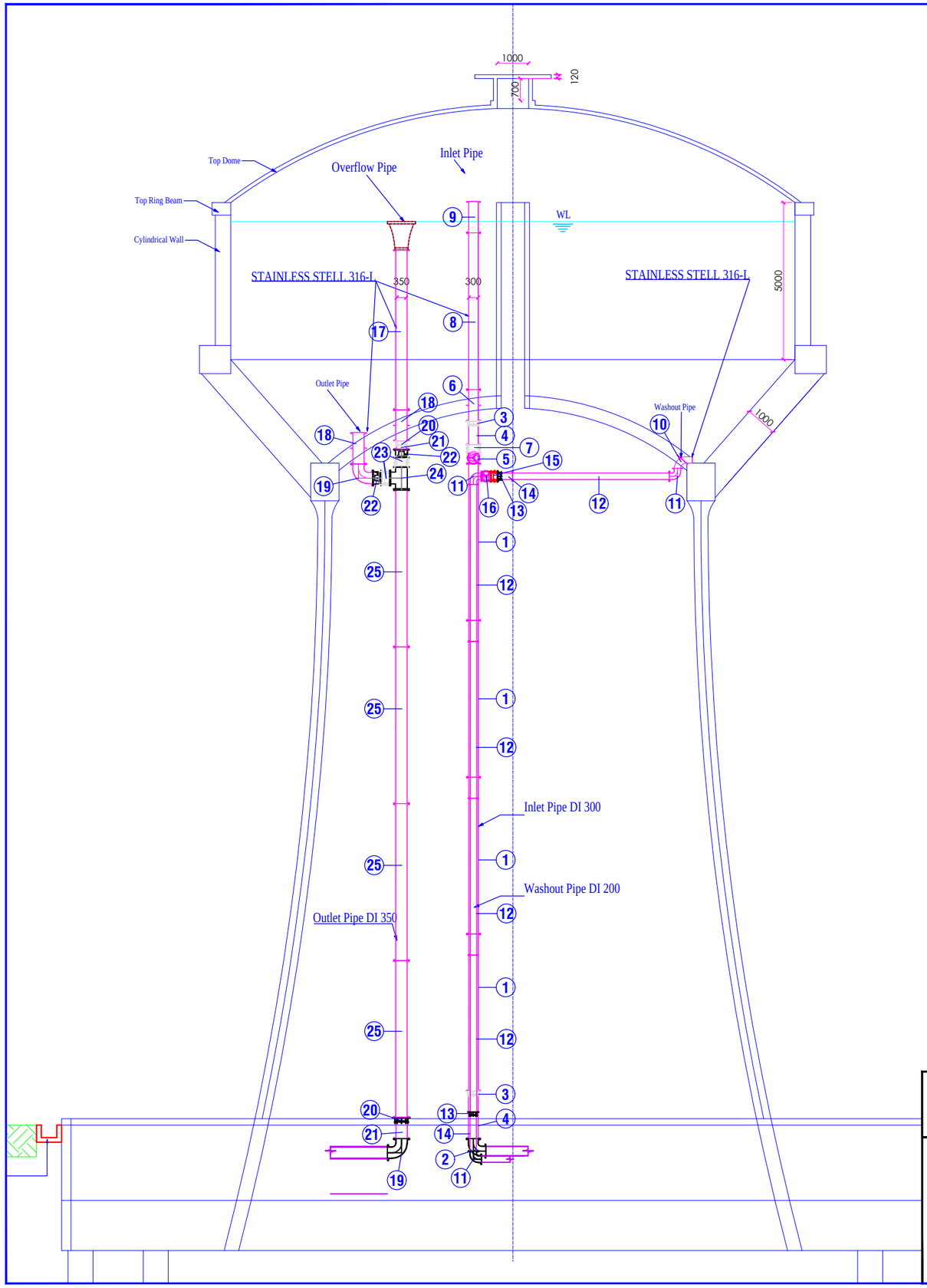
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE:
KRITIPUR SRT & PS & NETWORK
CK CONNECTIONS
CONNECTION DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:175	4	
DRAWING No.	CK-6	5	



ITEM	DESIGNATION	PN	DN	QTY	MATERIAL
1	DOUBLE FLANGED PIPE	16	300	4*5	DI
2	90 BEND	16	300	1	DI
3	FLANGE ADAPTER	16	300	2	DI
4	SINGLE FLANGE PIPE	16	300	2	DI
5	GATE VALVE	16	300	1	
6	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	300	1	SS 316-L
7	SELF RESTRAINING DISMANTLING JOINT -DI	16	300	1	DI
8	DOUBLE FLANGED PIPE	16	300	1*5	SS 316-L
9	DOUBLE FLANGED PIPE	16	300	1*1	SS 316-L
10	PUDDLE FLANGE 90 BEND	16	200	1	SS 316-L
11	90 BEND	16	300	3	DI
12	DOUBLE FLANGED PIPE	16	200	5*5	DI
13	FLANGE ADAPTER	16	200	2	DI
14	SINGLE FLANGE PIPE	16	200	2	DI
15	SELF RESTRAINING DISMANTLING JOINT -DI	16	200	1	DI
16	GATE VALVE	16	200	1	
17	DOUBLE FLANGED PIPE	16	350	1*5	SS 316-L
18	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	350	2	SS 316-L
19	90 BEND	16	350	2	DI
20	FLANGE ADAPTER	16	350	2	DI
21	SINGLE FLANGE PIPE	16	350	2	DI
22	BUTTERFLY VALVE	16	350	2	
23	SELF RESTRAINING DISMANTLING JOINT -DI	16	350	2	DI
24	EQUAL TEE	16	350	1	DI
25	DOUBLE FLANGED PIPE	16	350	4*5	DI

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KRITIPUR SRT & PS & NETWORK
CK CONNECTIONS
CONNECTION DETAIL OHT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES -	2	
DATE:	Jan-2024	3	
SCALE:	1:150	4	
DRAWING No.	CK-7	5	



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

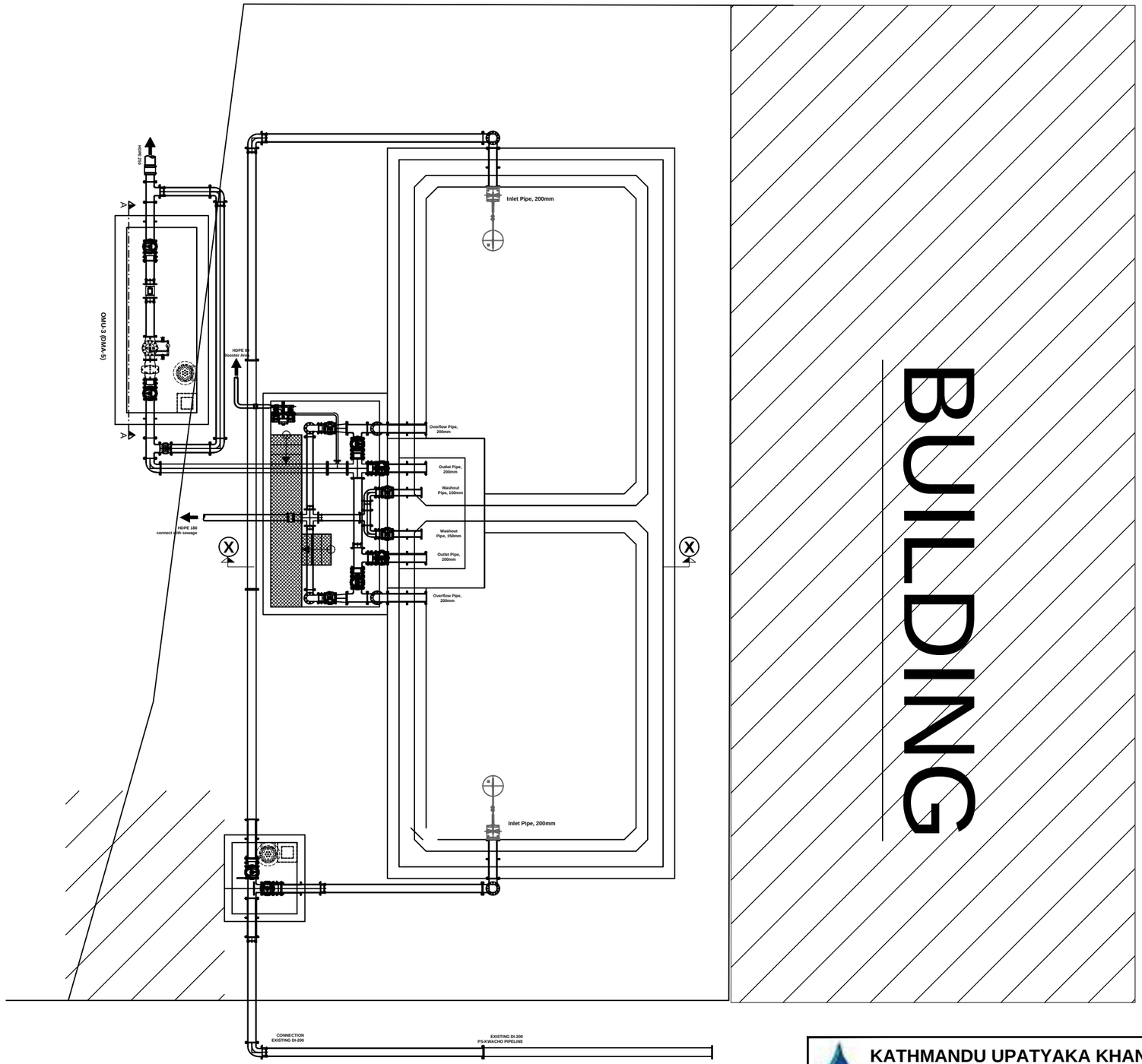
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE:
KWACHO RVT
MECHANICAL WORKS
LAYOUT PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:250	4	
DRAWING No.	RVTK-1	5	



BUILDING

TEMPLE

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

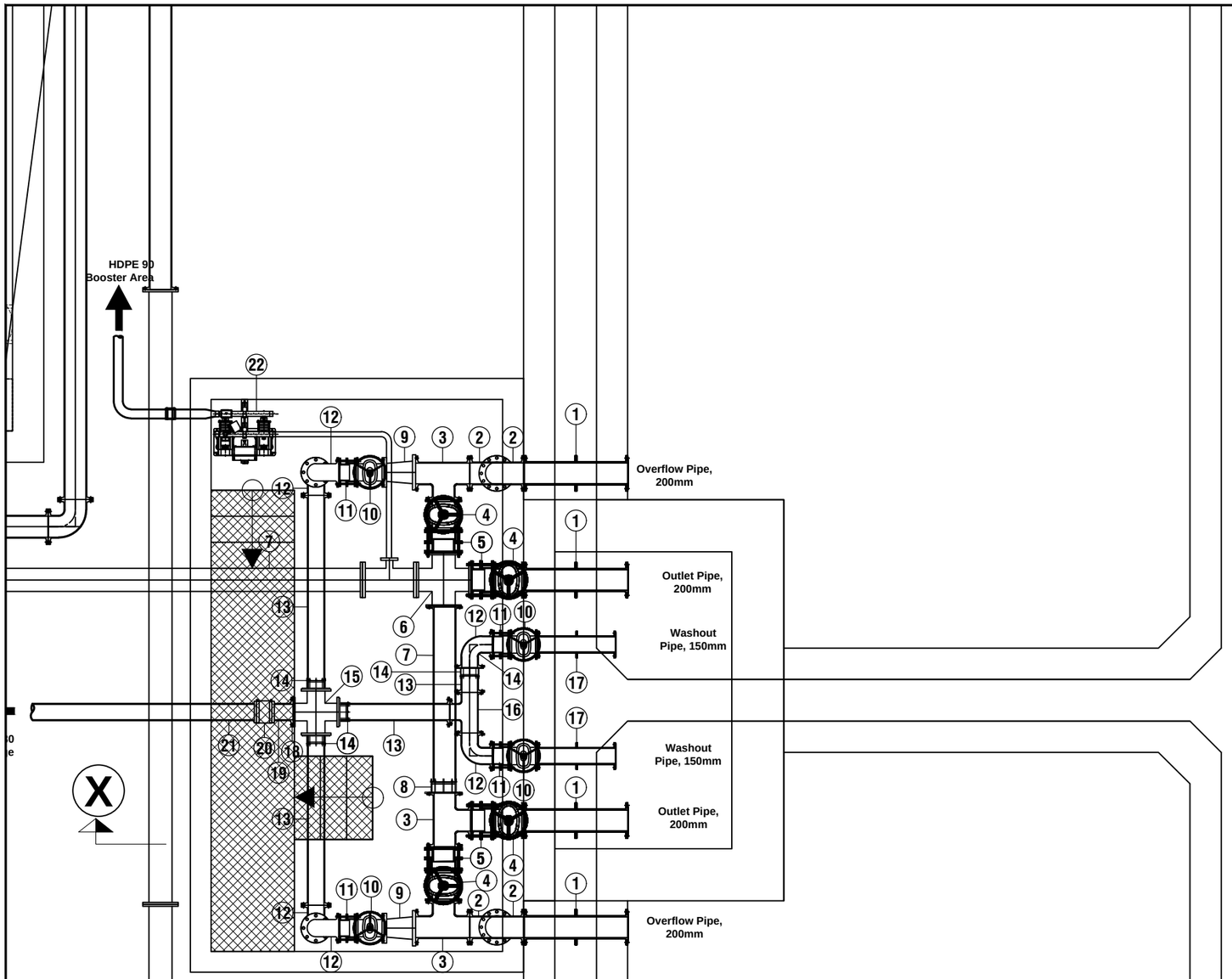
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KWACHO RVT MECHANICAL WORKS LAYOUT PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:120	4	
DRAWING No.	RVTK-2	5	



ITEM	DESIGNATION	PN	DN	QTY
1	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	200	4
2	FLANGE 90º BEND DI	16	200	6
3	FLANGE EQUAL TEE-DI	16	200	1
4	GATE VALVE DI	16	200	2
5	SELF RESTRAINING DISMANTLING JOINT DI	16	200	2
6	FLANGED ADPATER UNRESTRAINED	16	200	6
7	SINGLE FLANGED PIPE DI	16	200	6
8	DOUBLE FLANGED PIPE DI	16	200	2
9	FLOATING VALVE	16	200	2

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

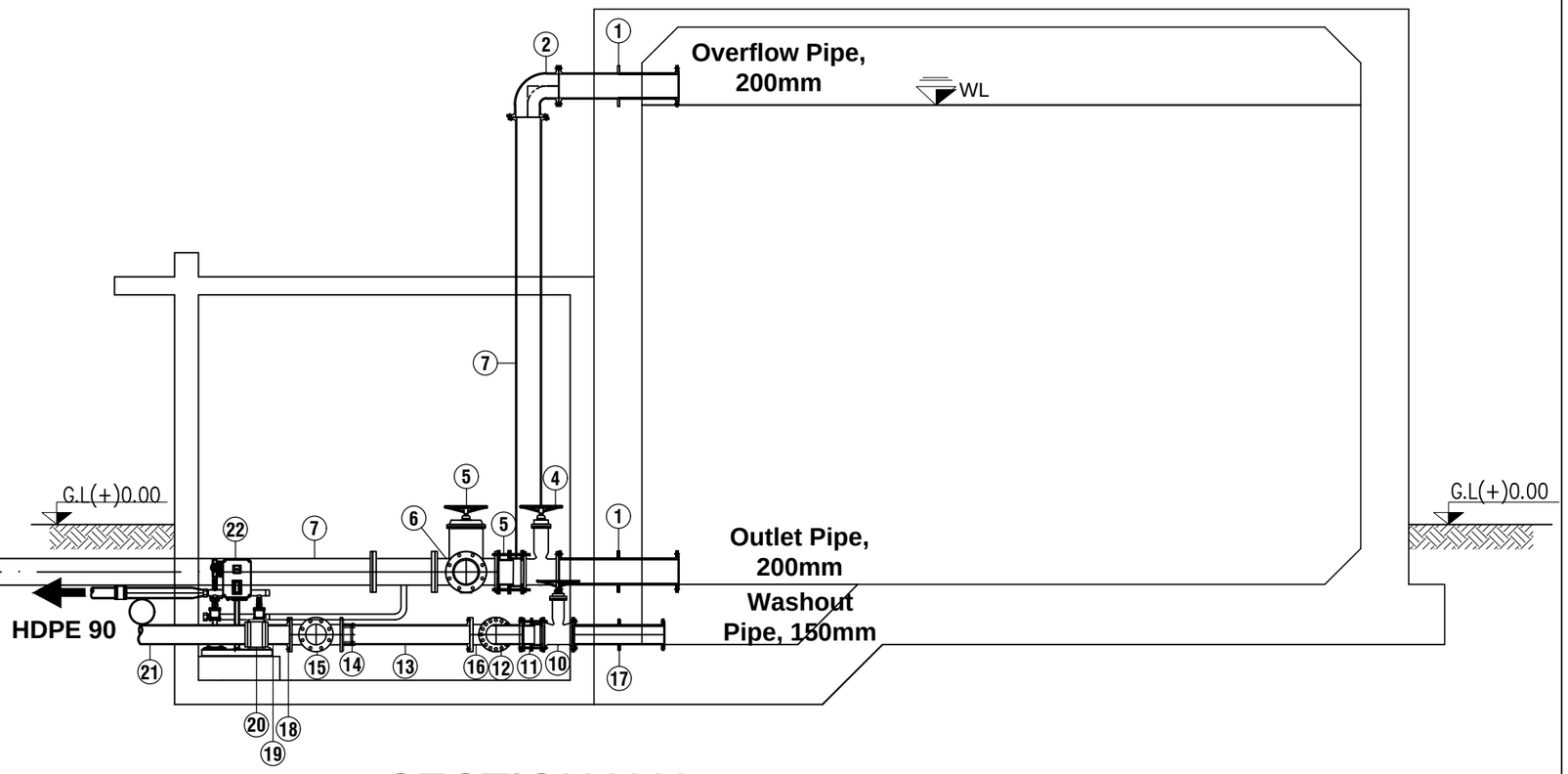
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KWACHO RVT
PLAN VIEW
MECHANICAL WORKS OUTLET&OUTFLOW&WASHOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	RVTK-3	5	



SECTION X-X

ITEM	DESIGNATION	PN	DN	QTY
1	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	200	4
2	FLANGE 90º BEND-DI	16	200	4
3	FLANGE EQUAL TEE-DI	16	200	3
4	GATE VALVE-DI	16	200	4
5	SELF RESTRAINING DISMANTLING JOINT DI	16	200	4
6	FLANGED EQUAL CROSS TEE DI	16	200	1
7	SINGLE FLANGED PIPE DI	16	200	3
8	FLANGED ADPATER UNRESTRAINED	16	200	1
9	FLANGE REDUCER	16	200/150	2
10	GATE VALVE-DI	16	150	4
11	SELF RESTRAINING DISMANTLING JOINT DI	16	150	4
12	FLANGE 90º BEND-DI	16	150	4
13	SINGLED FLANGED PIPE DI	16	150	3
14	FLANGLD ADPATLR UNRESTRAINED	16	150	3
15	FLANGED EQUAL CROSS TEE DI	16	150	1
16	FLANGED EQUAL TEE DI	16	150	1
17	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	150	1
18	DUCTILE IRON BACKING RING	16	150	1
19	HDPE STUB END	16	150	1
20	ELECTROFUSION COUPLING	10	90	1
21	HDPE PIPE	10	90	
22	Hydro Multi booster set Q 7.33 m3/h, H-33 m	16	200	2

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

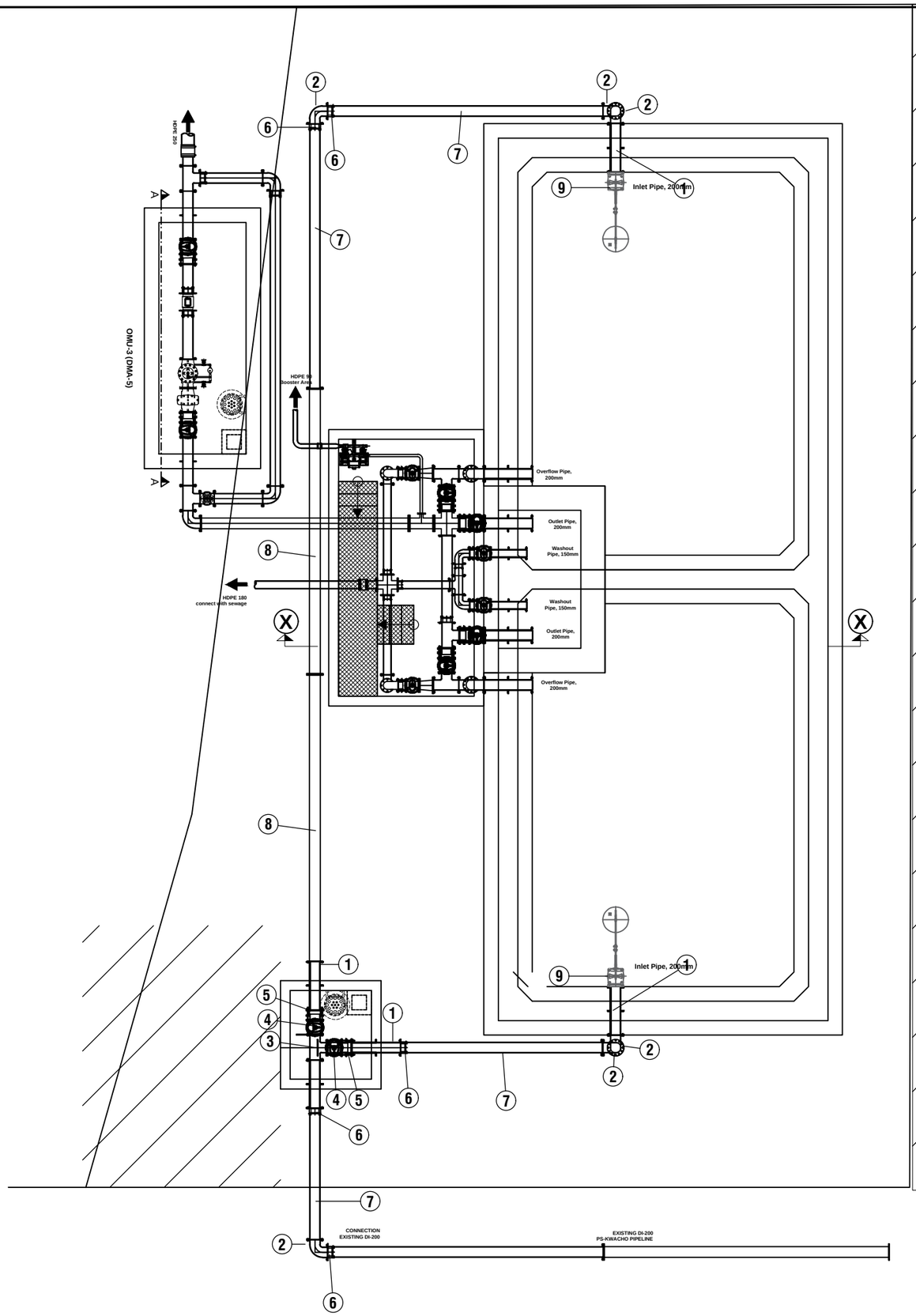
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE:
DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE:
PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE:
KWACHO RVT
SECTION VIEW
MECHANICAL WORKS OUTLET&OUTFLOW&WASHOUT

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:50	4	
DRAWING No.	RVTK-4	5	



ITEM	DESIGNATION	PN	DN	QTY
1	DOUBLE FLANGED PIPE WITH PUDDLE FLANGE	16	200	4
2	FLANGE 90º BEND-DI	16	200	6
3	FLANGE EQUAL TEE-DI	16	200	1
4	GATE VALVE-DI	16	200	2
5	SELF RESTRAINING DISMANTLING JOINT DI	16	200	2
6	FLANGED ADPATER UNRESTRAINED	16	200	6
7	SINGLE FLANGED PIPE DI	16	200	6
8	DOUBLE FLANGED PIPE DI	16	200	2
9	FLOATING VALVE	16	200	2

BUILDING

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KWACHO RVT SECTION VIEW MECHANICAL WORKS INLET

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:120	4	
DRAWING No.	RVTK-5	5	

Drawing & Equipment List & Legend

S = NONE

Equipment List

Equip No.	Equip Name	Capacity	Expected Power (kW/ea)	Q y (Standby)	Remark
1.Kirtipur Pumping Station (Lyaku Tank Old)					
MK-101	Clear Water Pump	Vertical Multi-Stage Pump Cap. : 0.86 ㎥/min x 74mH	15	3(1)	LOP
MK-102	Check Valve	Non-slam, Dashpot with Counter weight loaded type (flange end) Size :Φ125mm x10 kg/㎠	-	2	
MK-103	Discharge Valve	Motorized Butterfly Valve (Wafer type) Size :Φ125mm x 10 kg/㎠	0.4	2	MOP Interlock of Pump
MK-104	Water Hammer Control System	Bladder Tanks, Cap. : 0.5㎥ Connection Pipe Diameter: Φ80mm	230V	1set	MOP
2.Kirtipur Pumping Station (Kwacho Tank New)					
MK-201	Clear Water Pump	Vertical Multi-Stage Pump Cap. : 1.12㎥/min x 84mH	22	2(1)	LOP
MK-202	Check Valve	Non-slam, Dashpot with Counter weight loaded type (flange end) Size :Φ150 mm x 20 kg/㎠	-	1	
MK-203	Discharge Valve	Motorized Butterfly Valve (Wafer type) Size :Φ150mm x 20 kg/㎠	0.4	1	MOP Interlock of Pump
MK-204	Water Hammer Control System	Bladder Tanks, Cap. : 0.5㎥ Connection Pipe Diameter: Φ80mm	230V	1	MOP
3.Kirtipur Pumping Station (Kirtipur OHT New)					
MK-301	Clear Water Pump	End Suction Single-stage Volute Pump Cap. : 2.12 ㎥/min x 30mH	15	2(1)	LOP
MK-302	Check Valve	Non-slam, Dashpot with Counter weight loaded type (flange end) Size :Φ200mm x10 kg/㎠	-	2	
MK-303	Discharge Valve	Motorized Butterfly Valve (flange end) Size :Φ200mmx 10 kg/㎠	0.4	2	MOP Interlock of Pump
MK-304	Sump Pump	Submersible Motor Pump Cap. : 0.1㎥/min x 10mH	0.75	2(1)	LOP
MK-305	Maintenance Hoist	Manual Movable Crane Hoist Cap. : 1.0 ton, Lift x Length : H8.0m x L3.0m	-	1set	

Line Service

ABBR	FLUID TYPE
CW	CLEAR WATER
DW	DRAIN WATER

Pipe Material

ABBR	MATERIAL	USED
SS	STAINLESS STEEL	CLEAR WATER, DRAIN WATER
DI	DUCTILE IRON	CLEAR WATER, DRAIN WATER

Equipment Identification

M K - 1 0 1 A

- A — EQUIPMENT DETAIL CLASSIFICATION
- 101 — EQUIPMENT NUMBER
- K — PLACE NAME (KIRTIPUR)
- M — MECHANICAL PART

Line Identification

100mm - CW - SS

- SS — PIPE MATERIAL
- CW — FLUID TYPE
- 100mm — PIPE DIAMETER

NOTE:

1. DSC-07 COULD NOT REVIEW THIS SECTION OF DSC-05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC-05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC-07.
2. ALL THE CHANGES DONE BY DSC-07 ARE INDICATED BY CLOUD IN THE DRAWING.

Drawing List

NO.	DRAWING NAME	SCALE	REMARK
DPR/DNI-8/KIRTI/MECH-01	Drawing & Equipment List & Legend	NONE	
DPR/DNI-8/KIRTI/MECH-02	Pumping Station Process Flow Diagram	NONE	
DPR/DNI-8/KIRTI/MECH-03	Layout Plan of Kirtipur Pumping Station	1 : 100	
DPR/DNI-8/KIRTI/MECH-04	Plan of Kirtipur Pumping Station	1 : 80	
DPR/DNI-8/KIRTI/MECH-05	Section of Kirtipur Pumping Station	1 : 80	
DPR/DNI-8/KIRTI/MECH-06	Fittings Schedule of Pumping Station (1/3)	NONE	
DPR/DNI-8/KIRTI/MECH-07	Fittings Schedule of Pumping Station (2/3)	NONE	
DPR/DNI-8/KIRTI/MECH-08	Fittings Schedule of Pumping Station (3/3)	NONE	

Equipment Legend

	TURBINE TYPE MULTI-STAGE & END SUCTION SINGLE -STAGE VOLUTE PUMP		MANUAL MOVABLE CRANE HOIST
	VERTICAL MULTI-STAGE PUMP		MANUAL TROLLY CHAIN HOIST
	SUBMERSIBLE PUMP		BLADDER TANKS
	MOTORIZED BUTTERFLY VALVE		

Pipe Legend

	GATE VALVE		FLEXIBLE JOINT,BELLOWS TYPE
	CHECK VALVE		FLANGE
	BUTTERFLY VALVE		REDUCER
	BALL VALVE		

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION MECHANICAL WORKS INDEX OF DRAWINGS

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-M-1	5	

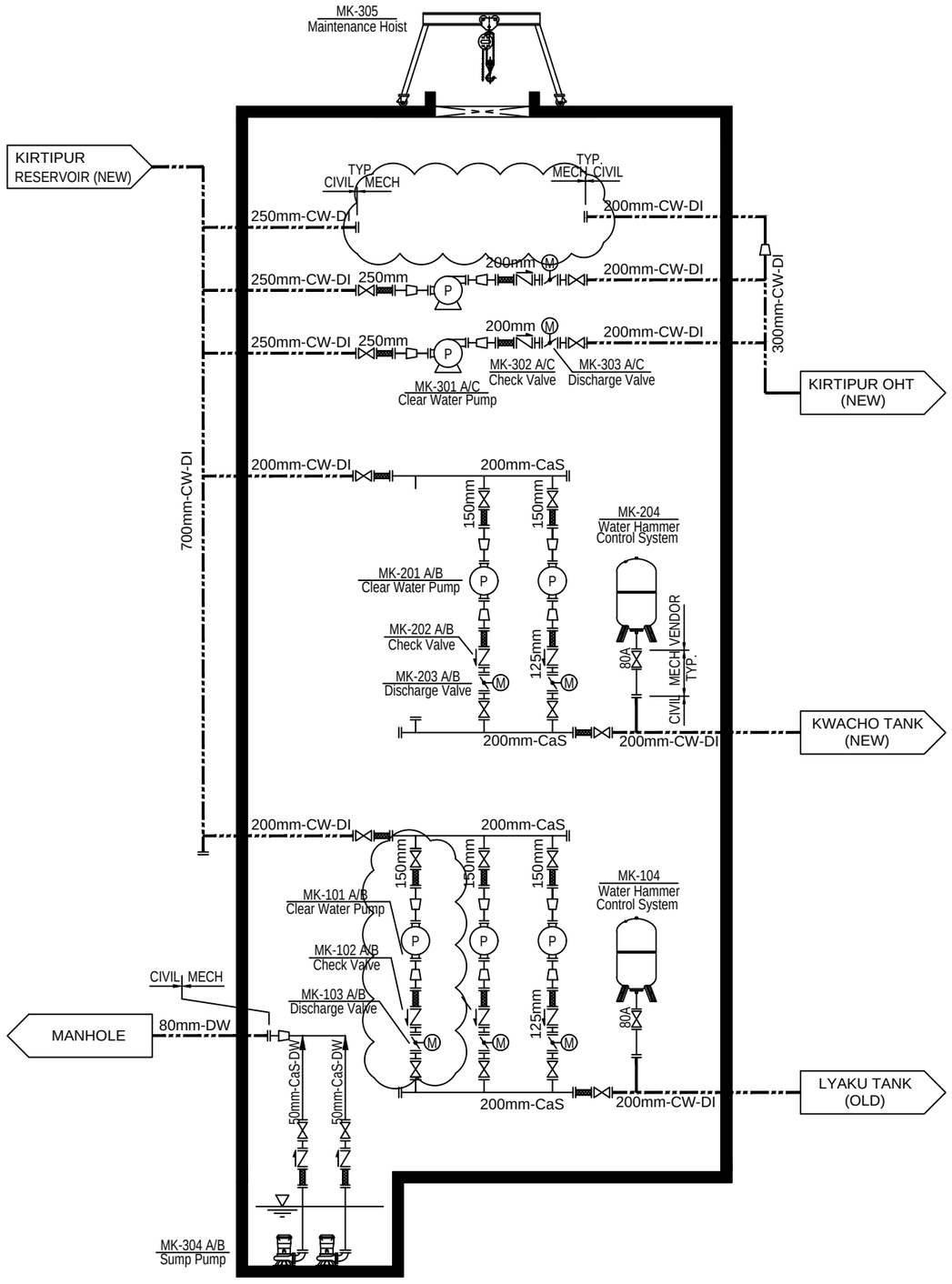
Pumping Station Process Flow Diagram

S = NONE

LEGEND

Mech. Pipe

Civil Pipe



Pumping Station Process Flow Diagram

NOTE:

1. DSC-07 COULD NOT REVIEW THIS SECTION OF DSC-05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC-05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC-07.
2. ALL THE CHANGES DONE BY DSC-07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

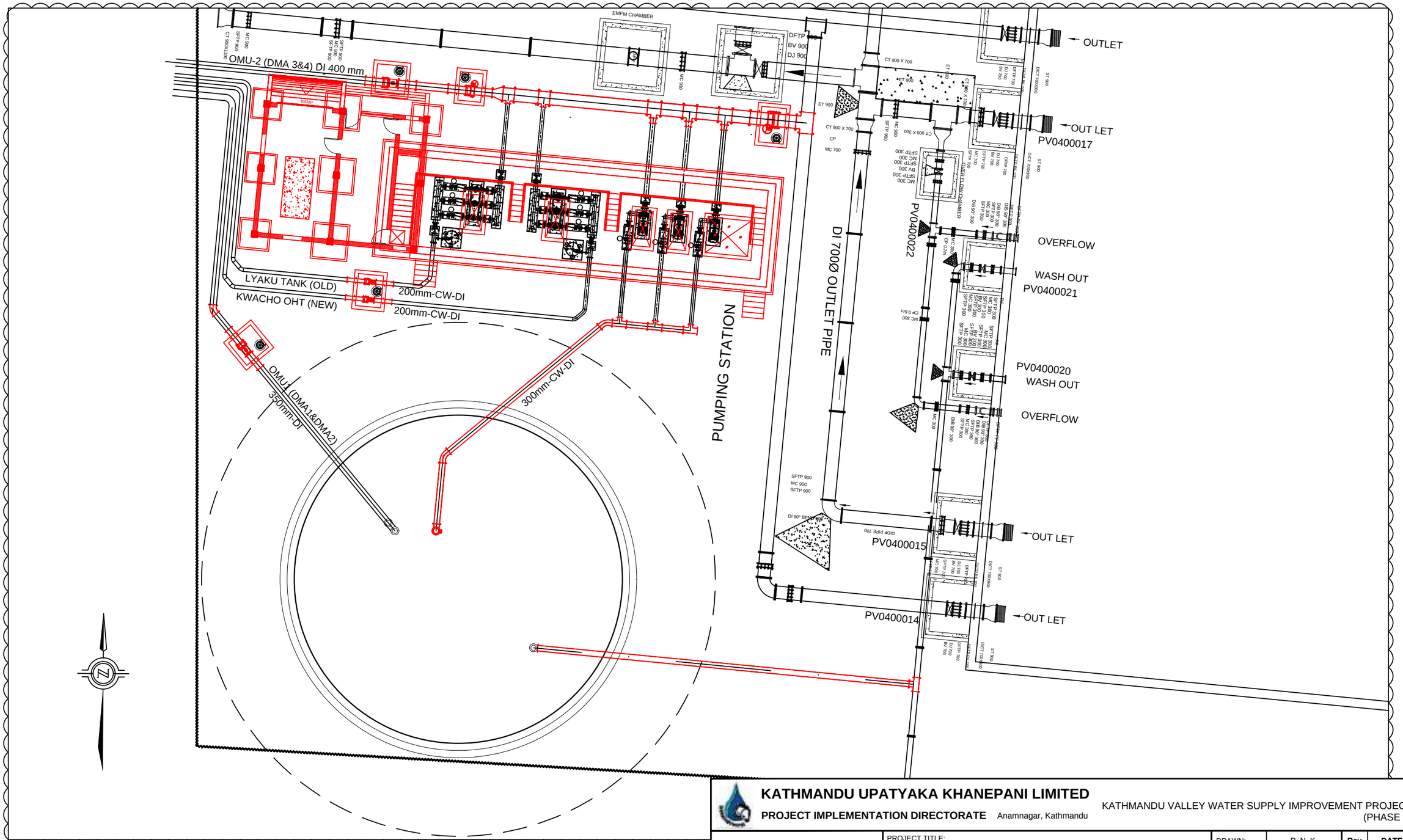
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION MECHANICAL WORKS PROCESS FLOW DIAGRAM

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-M-2	5	

Layout Plan of Kirtipur Pumping Station

S = 1 : 100



NOTE:

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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

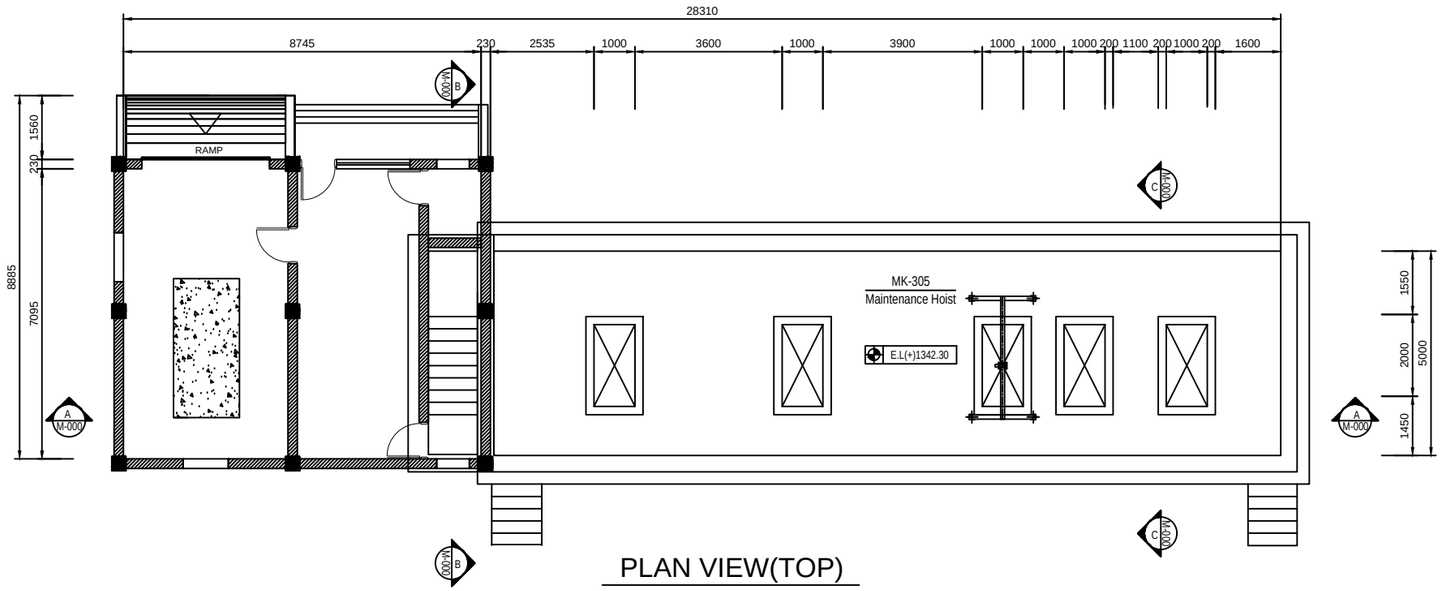
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

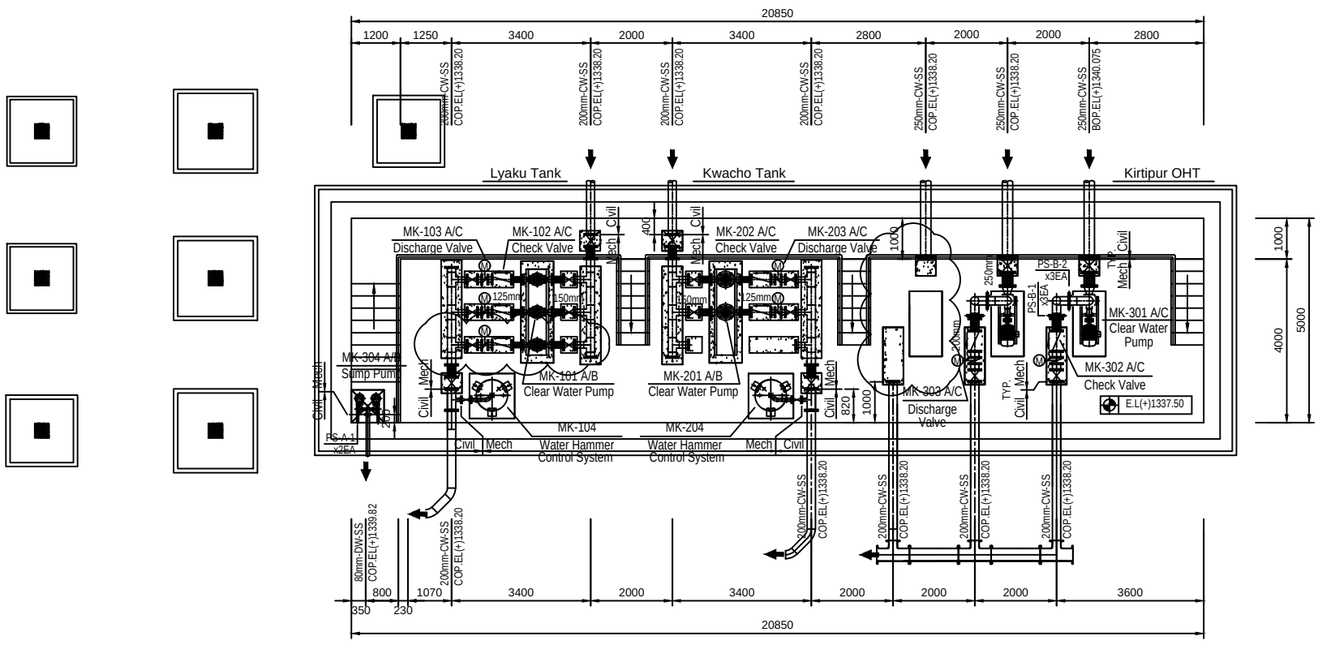
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION MECHANICAL WORKS LAYOUT PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-M-3	5	



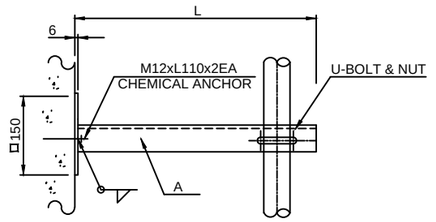
PLAN VIEW(TOP)



PLAN VIEW(BOTTOM)

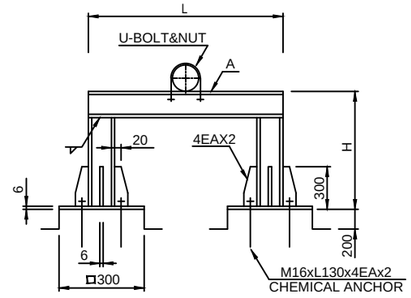
NOTE

1. The construction company shall discuss with the civil and architecture supervisors prior to the construction phase in order to prevent any possible issues in equipment and pipeline works.
2. Flange dimensions for mechanical equipment and pipeline might vary with the manufacturers. Therefore, the construction company must consult mechanical supervisor about flange specifications before ordering the relevant items.
3. The specification and type of equipment applied to the drawings can be changed, since they vary with the manufacturers.
4. All equipment related to the automatic operation of the pumping station is supplied by the SCADA SYSTEM except level control of SRT Kwacho, SRT Lyaky, OHT and existing Kirtipur SRT



UNIT : mm

NO \ MARK	A	L	U-BOLT	EA
PS-A-1	L-50x50x6t	500	50	2



UNIT : mm

NO \ MARK	A	L	H	U-BOLT	EA
PS-B-1	C-150x75x9t	400	500	200	3
PS-B-2	C-150x75x9t	400	1600	200	3

PIPE SUPPORT

S = NONE

NOTE:

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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

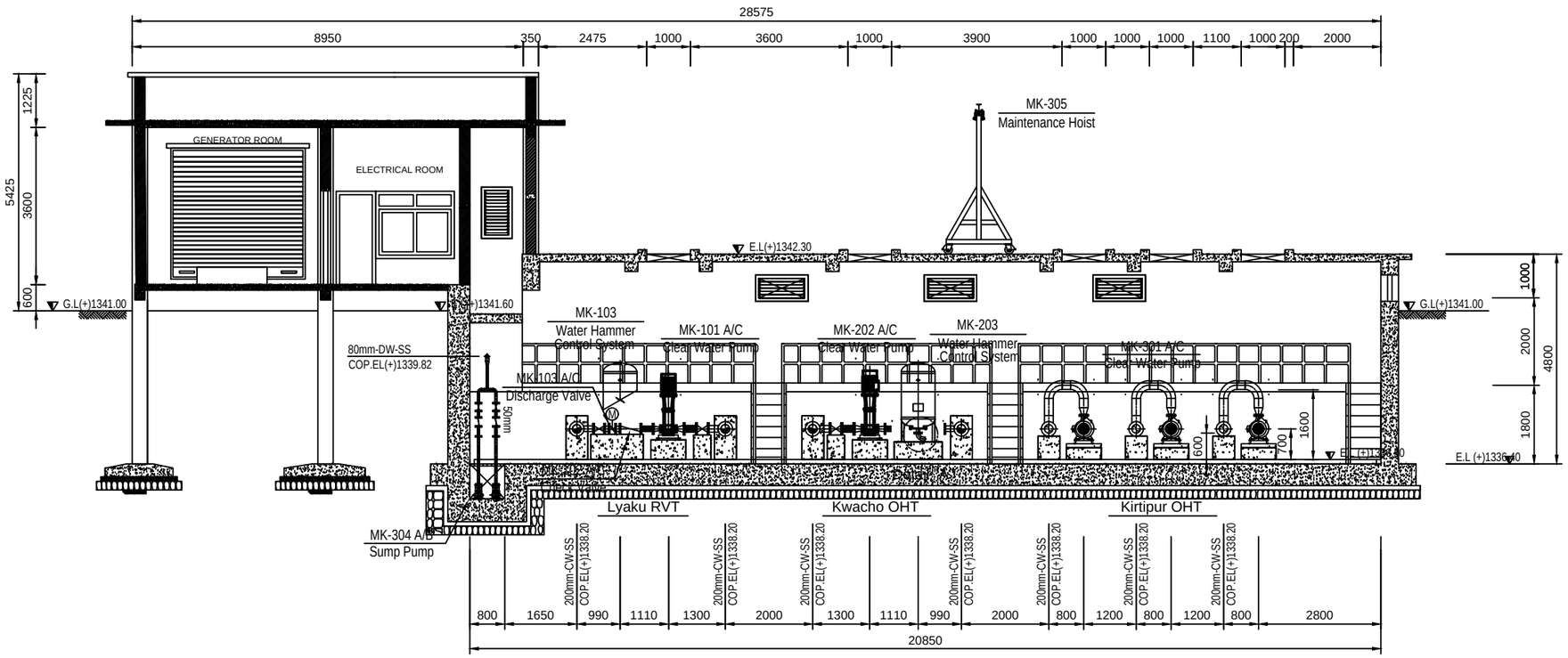
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

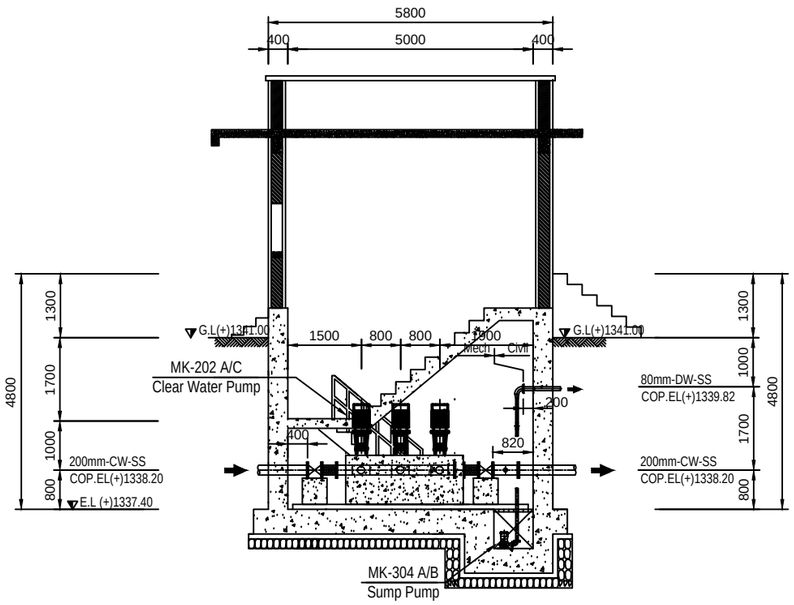
DRAWING TITLE: KIRTIPUR PUMP STATION MECHANICAL WORKS PLAN DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-M-4	5	

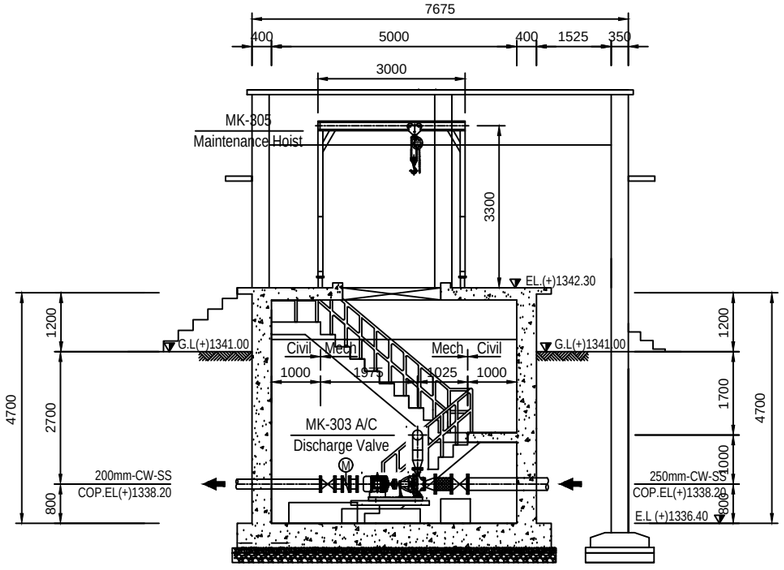


NOTE

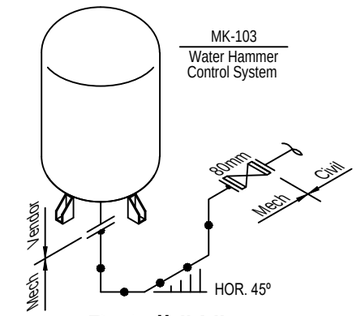
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SECTION B-B



SECTION C-C



Detail "A"

NOTE:

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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

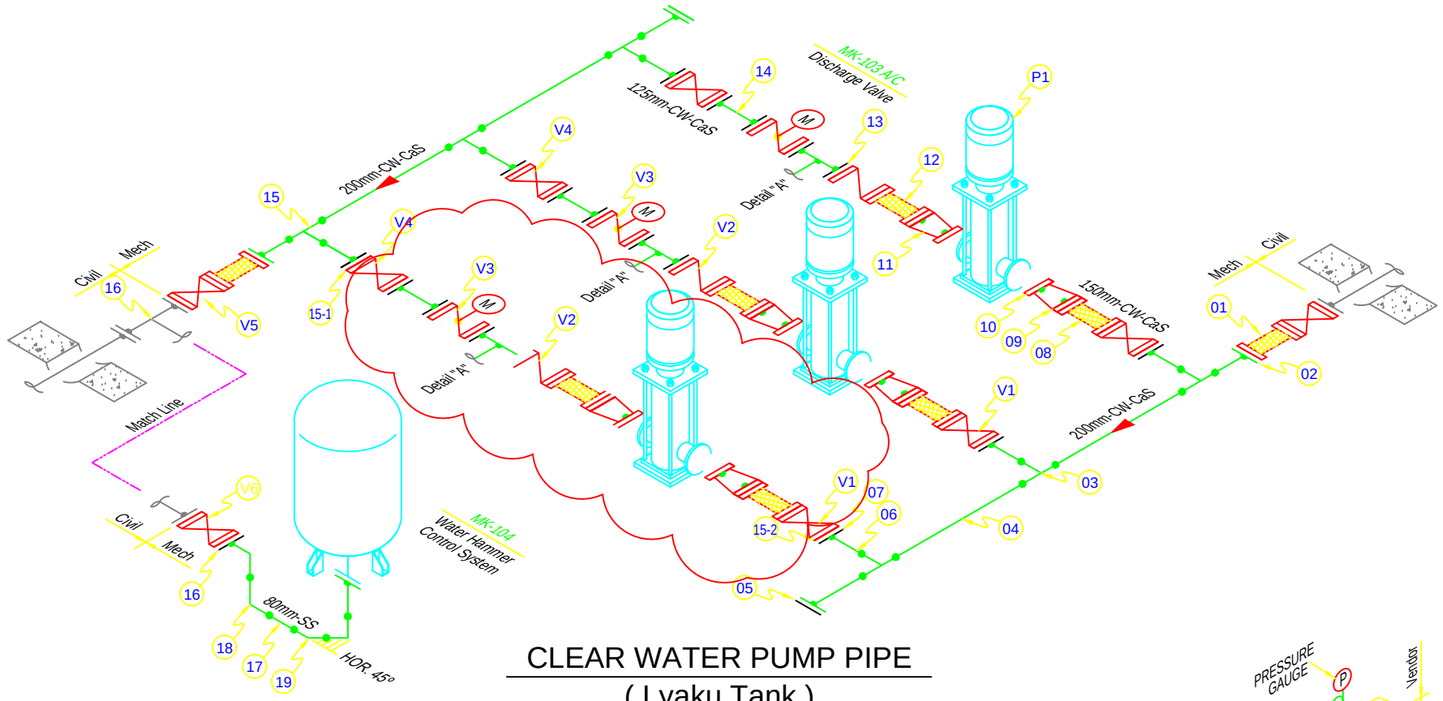
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION MECHANICAL WORKS SECTION DETAIL

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-M-5	5	

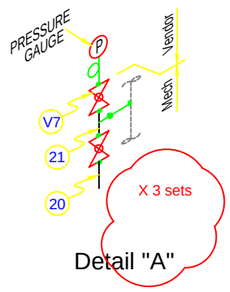
Fittings Schedule of Pumping Station (1/3)

S = NONE



CLEAR WATER PUMP PIPE

(Lyaku Tank)



Detail "A"

FITTINGS SCHEDULE						
Item No.	Dia(mm)	Mat	Description	Q'TY	Thickness(mm) Pressure	Remarks
01	200	CaS	Flexible Joint	2 ea	PN16	
02	200	CaS	Flange	4 ea	PN16	
03	200x150	CaS	Tee	3 ea	4,5mm/4mm	
04	200	CaS	Pipe	3.0 m	4,5 mm	
05	200	CaS	Blind Flange	0 ea	PN16	
06	150	CaS	Pipe	1.2 m	4 mm	
07	150	CaS	Flange	7 ea	PN16	
08	150	CaS	Flexible Joint	3 ea	PN16	
09	150x80	CaS	Reducer	3 ea	4mm/2.9mm	
10	80	CaS	Flange	5 ea	PN16	
11	125x80	CaS	Reducer	3 ea	3,6mm/2,9mm	
12	125	CaS	Flexible joint	3 ea	PN16	
13	125	CaS	Flange	17 ea	PN16	
14	125	CaS	Pipe	1.5 m	3,6 mm	
15	200x125	CaS	Tee	3 ea	4,5mm/3,6mm	
15-1	125	CaS	Blind Flange	0 ea	PN16	
15-2	150	CaS	Blind Flange	0 ea	PN16	
16	200	CaS	Tee	1 ea	4,5mm/2,9mm	
Surge tank pipe fittings						
16	80	CaS	Flange	2 ea	PN16	
17	80	CaS	Pipe	0.4 m	2,9 mm	
18	80	CaS	Elbow (90°)	3 ea	2,9 mm	
19	80	CaS	Elbow (45°)	1 ea	2,9 mm	
Pressure Gauge pipe fittings						
20	15	CaS	Pipe	2.4 m	Sch 20S	
21	15x15	CaS	Tee	3 ea	Sch 20S	
Valves						
V1	150	CI	Gate Valve	3 ea	PN16	
V2	125	CS	Check Valve	3 ea	PN16	MK-102(Check Valve)
V3	125	CI	Butterfly Valve	3 ea	PN16	MK-103(Discharge Valve)
V4	125	CI	Gate Valve	3 ea	PN16	
V5	200	CI	Gate Valve	2 ea	PN16	
V6	80	CI	Gate Valve	1 ea	PN16	
V7	15	CI	Ball Valve	6 ea	PN16	
Pumps						
P1	-	-	Vertical Multi-Stage Pump	3		MK-101(Clear water pump)

CaS : Carbon Steel
CI : Cast Iron
DI : Ductile Iron
CS : Cast Steel

NOTE:

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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

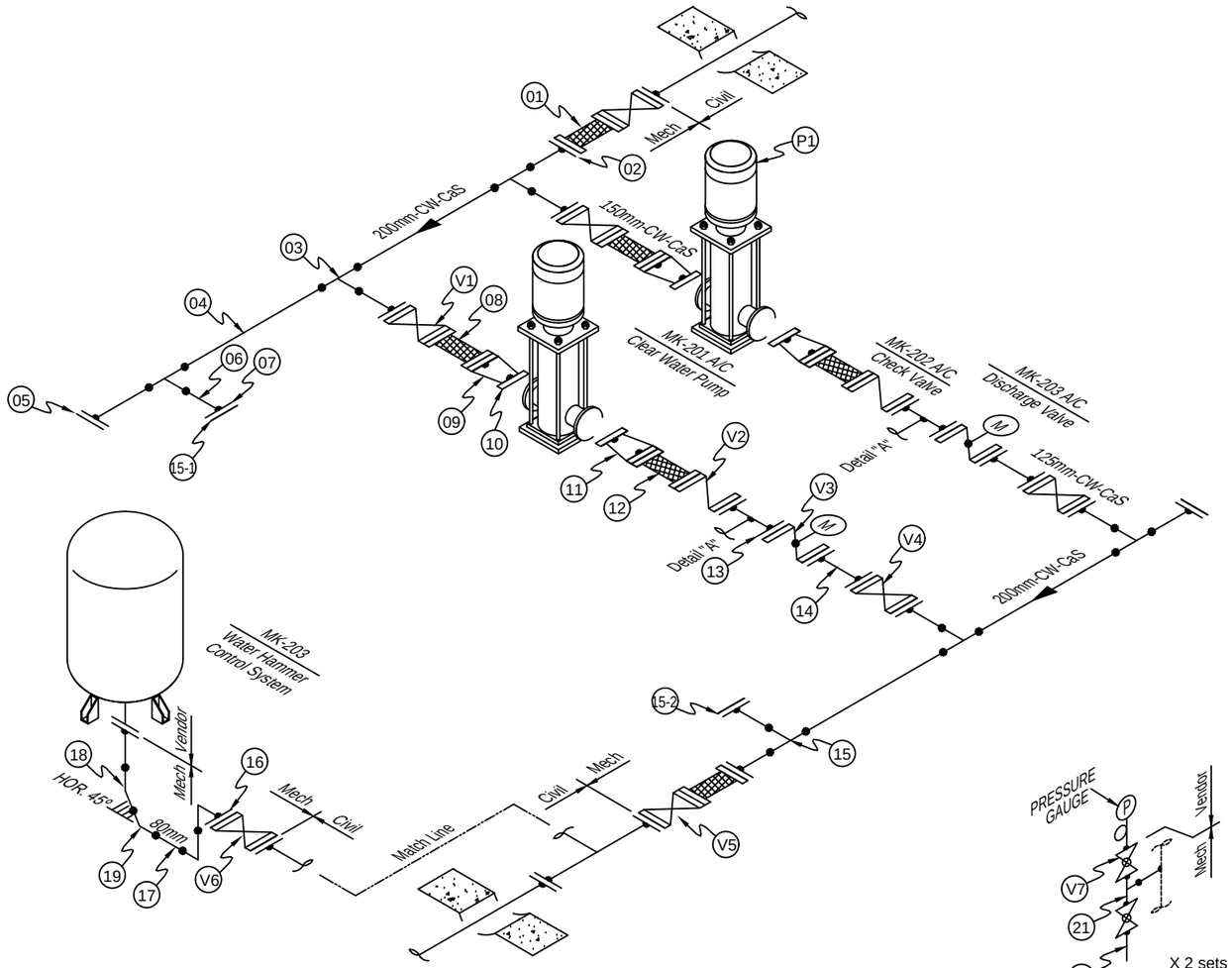
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION MECHANICAL WORKS FITTINGS SCHEDULE

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-M-6	5	

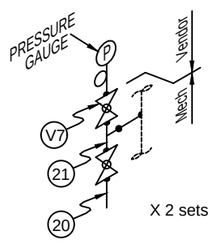
Fittings Schedule of Pumping Station (2/3)

S = NONE



CLEAR WATER PUMP PIPE

(Kwacho Tank)



X 2 sets

Detail "A"

FITTINGS SCHEDULE						
Item No.	Dia(mm)	Mat	Description	Q'TY	Thickness(mm) Pressure	Remarks
01	200	CaS	Flexible Joint	2 ea	PN16	
02	200	CaS	Flange	4 ea	PN16	
03	200x150	CaS	Tee	3 ea	4,5mm/4mm	
04	200	CaS	Pipe	3.0 m	4,5 mm	
05	200	CaS	Blind Flange	2 ea	PN16	
06	150	CaS	Pipe	1.2 m	4 mm	
07	150	CaS	Flange	5 ea	PN16	
08	150	CaS	Flexible Joint with Flange	2 ea	PN16	
09	150x100	CaS	Reducer	2 ea	4 mm/3,2mm	
10	100	CaS	Flange	4 ea	PN16	
11	125x100	CaS	Reducer	2 ea	3.6 mm/3,2mm	
12	125	CaS	Flexible joint with Flange	2 ea	PN16	
13	125	CaS	Flange	12 ea	PN16	
14	125	CaS	Pipe	1.0 m	3,6 mm	
15	200x125	CaS	Tee	3 ea	4,5 mm/3,6mm	
15-1	150	CaS	Blind Flange	1 ea	PN16	
15-2	125	CaS	Blind Flange	1 ea	PN16	
Surge Tank Pipe Fittings						
16	80	CaS	Flange	2 ea	PN16	
17	80	CaS	Pipe	0.4 m	2,9 mm	
18	80	CaS	Elbow (90°)	3 ea	2,9 mm	
19	80	CaS	Elbow (45°)	1 ea	2,9 mm	
Pressure Gauge Pipe Fittings						
20	15	CaS	Pipe	1.6 m	Sch 20S	
21	15x15	CaS	Tee	2 ea	Sch 20S	
Valves						
V1	150	CI	Gate Valve	2 ea	PN16	
V2	125	CS	Check Valve	2 ea	PN16	MK-202(Check Valve)
V3	125	CI	Butterfly Valve	2 ea	PN16	MK-203(Discharge Valve)
V4	125	CI	Gate Valve	2 ea	PN16	
V5	200	CI	Gate Valve	2 ea	PN16	
V6	80	CI	Gate Valve	1 ea	PN16	
V7	15	CI	Ball Valve	4 ea	PN16	
Pumps						
P1	-	-	Vertical Multi-Stage Pump	2		MK-201(Clear water pump)

CaS : Carbon Steel
CI : Cast Iron
CS : Cast Steel
DI : Ductile Iron

NOTE:

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2. ALL THE CHANGES DONE BY DSC-07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

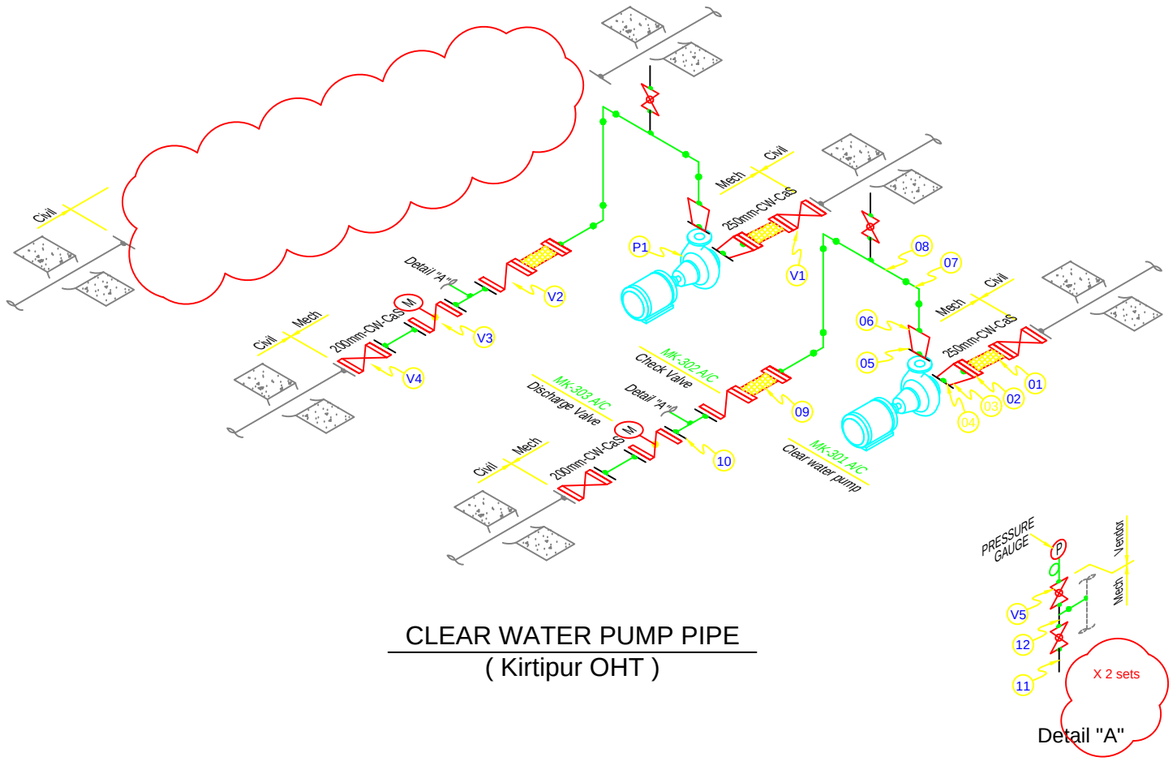
PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION MECHANICAL WORKS FITTINGS SCHEDULE

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-M-7	5	

Fittings Schedule of Pumping Station (3/3)

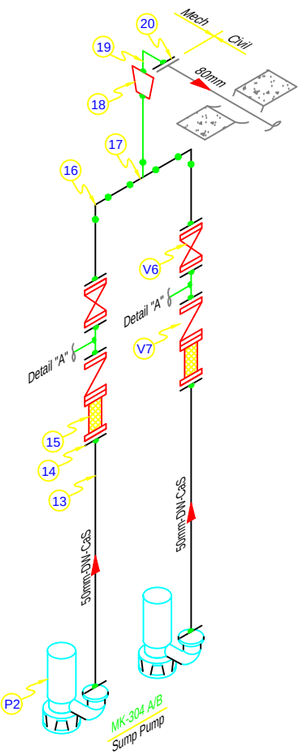
S = NONE



CLEAR WATER PUMP PIPE

(Kirtipur OHT)

Detail "A"



SUMP PUMP PIPE

FITTINGS SCHEDULE

Item No.	Dia(mm)	Mat	Description	Q'TY	Thickness(mm) Pressure	Remarks
01	250	CaS	Flexible Joint with Flange	2 ea	PN10	
02	250	CaS	Flange	2 ea	PN10	
03	250x125	CaS	Reducer	2 ea	5mm/3,6mm	
04	125	CaS	Flange	2 ea	PN10	
05	100	CaS	Flange	2 ea	PN10	
06	200x100	CaS	Reducer	2 ea	4,5mm/3,2mm	
07	200	CaS	Elbow (90°)	6 ea	4,5 mm	
08	200	CaS	Pipe	3.0 m	4,5 mm	
09	200	CaS	Flexible Joint with Flange	2 ea	PN10	
10	200	CaS	Flange	14 ea	PN10	
Pressure Gauge & Air Vent Pipe Fittings						
11	15	CaS	Pipe	2.8 m	Sch 20S	
12	15x15	CaS	Tee	4 ea	Sch 20S	
Drainage pipe fittings						
13	50	CaS	Pipe	4.6 m	2,3 mm	
14	50	CaS	Flange	10 ea	PN10	
15	50	CaS	Flexible Joint with Flange	2 ea	PN10	
16	50	CaS	Elbow (90°)	2 ea	2,3 mm	
17	50	CaS	Tee	1 ea	2,3 mm	
18	80x50	CaS	Reducer	1 ea	2,9 mm/2,3 mm	
19	80	CaS	Elbow (90°)	1 ea	2,9 mm	
20	80	CaS	Flange	1 ea	PN10	
Valves						
V1	250	CI	Gate Valve	2 ea	PN10	
V2	200	CS	Check Valve	2 ea	PN10	MK-302(Check Valve)
V3	200	CI	Butterfly Valve	2 ea	PN10	MK-303(Discharge Valve)
V4	200	CI	Gate Valve	2 ea	PN10	
V5	15	CI	Ball Valve	13 ea	PN10	
V6	50	CS	Check Valve	2 ea	PN10	
V7	50	CI	Gate Valve	2 ea	PN10	
Pumps						
P1	-	-	End Suction Single Stage pump	2		MK-301(Clear water pump)
P2	-	-	Submersible Motor pump	2		MK-304(Sump pump)

CaS : Carbon Steel
CI : Cast Iron
CS : Cast Steel
DI : Ductile Iron

NOTE:

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2. ALL THE CHANGES DONE BY DSC-07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION
MECHANICAL WORKS
FITTINGS SCHEDULE

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES.	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-M-8	5	

DISTRIBUTION NETWORK IMPROVEMENT WORKS IN KIRTIPUR

CONTRACT No.: PID/SKV/DNI2-KIRTIPUR

ELECTRICAL WORKS

INDEX OF DRAWINGS

NO.	DRAWING TITLE	REMARKS
ELECTRIC POWER SYSTEM		
ELEC-00	INDEX OF DRAWINGS	
ELEC-01	SYMBOL & LEGEND	
ELEC-02	11KV SINGLE LINE DIAGRAM	
ELEC-03	MCC DETAIL DIAGRAM	
ELEC-04	SITE LAYOUT OF KIRTIPUR	
ELEC-05	CABLE SCHEDULE	
ELEC-06	PLAN LAYOUT, POWER DISTRIBUTION (1/2)	
ELEC-07	PLAN LAYOUT, POWER DISTRIBUTION (2/2)	
ELEC-08	PLAN LAYOUT, GROUNDING & LIGHTNING PROTECTION SYSTEM	
ELEC-09	PLAN LIGHTING AND SOCKETS SYATEM (1/2)	
ELEC-10	PLAN LIGHTING AND SOCKETS SYATEM (2/2)	

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PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION ELECTRICAL WORK INDEX OF DRAWINGS

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-E-1	5	

SYMBOL & LEGEND

ABBREVIATION	DESCRIPTION	SYMBOL	ABBREVIATION	DESCRIPTION
DoF	DROP OUT FUSE		CH	CABLE HEAD
VCB	VACUUM CIRCUIT BREAKER		M.H	MANHOLE(1000x1000x1000)
MCCB	MOLDED CASE CIRCUIT BREAKER		LOP	LOCAL OPERATION PANEL
MC	MAGNETIC CONTACT		LP	LIGHTING PANEL
ACB	AIR CIRCUIT BREAKER		ETB	EARTH TERMINAL BOX
LA	LIGHTNING ARRESTER	V		AC-VOLTMETER
SA	SURGE ABSORBER	A		AC-AMMETER
PT	POTENTIAL TRANSFORMER			CHANGE-OVER SWITCH FOR VOLTMETER
CT	CURRENT TRANSFORMER			CHANGE-OVER SWITCH FOR AMMETER
ZCT	ZERO PHASE CURRENT TRANSFORMER		E	EARTH
PTT	POTENTIAL TEST TERMINAL	27		UNDER VOLTAGE RELAY
CTT	CURRENT TEST TERMINAL	50		INSTANTANEOUS OVER CURRENT RELAY
TR	TRANSFORMER	51		OVER CURRENT RELAY
S.R	SERIES REACTOR	51G		OVER CURRENT GROUND RELAY
ATS	AUTO TRANSFER SWITCH	————		CABLE EMBEDDED IN WALL, CEILING
S.C	STATIC CONDENSER	— — — —		EXPOSED CABLE
	DIESEL GENERATOR	—— - —— - ——		UNDER GROUND CABLE
	EARTH LEAKAGE DETECTER	—— —— ——		CABLE EMBEDDED IN FLOOR
		————		CABLE IN TRAY

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PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

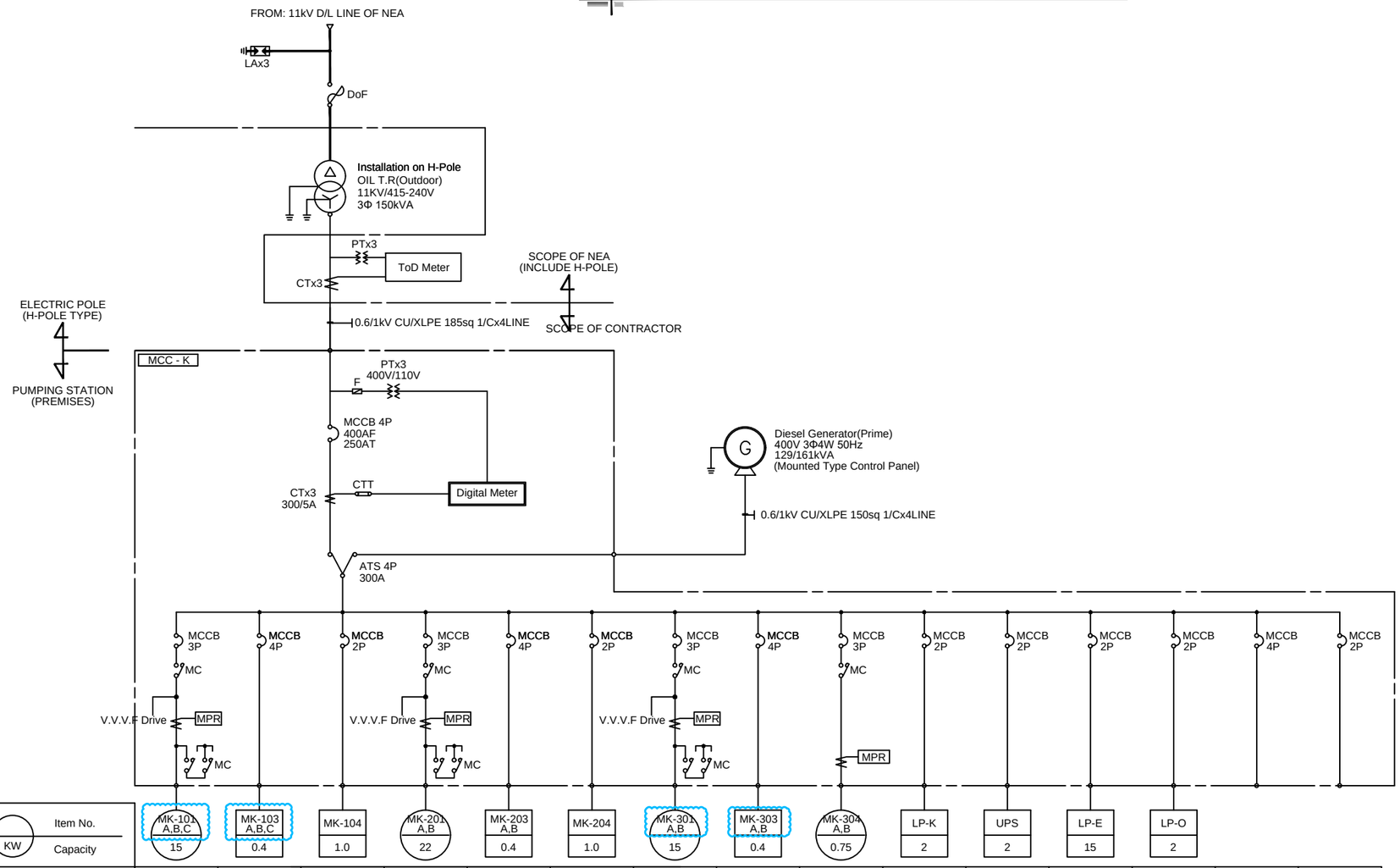
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION ELECTRICAL WORK SYMBOL & LEGEND

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-E-2	5	

11KV SINGLE LINE DIAGRAM



Item		Clear Water Pump	Discharge valve	Water Hammer Control System	Clear Water Pump	Discharge valve	Water Hammer Control System	Clear Water Pump	Discharge valve	Sump pump	Lighting Panel	Ups Panel	Lighting Panel (Existing)	Lighting Panel (Operating House)	Spare	Spare
Quantity	Duty	2	3	1	1	2	1	1	2	1	1	1	1	1	2	2
	Stand-By	1	0	-	1	0	-	1	0	1	-	-	-	-	-	-
	Total	3	3	1	2	2	1	2	2	2	1	1	1	1	2	2
MCCB (AF/AT)		100AF/100AT	50AF/15AT	50AF/15AT	225AF/125AT	50AF/15AT	50AF/15AT	225AF/125AT	50AF/15AT	50AF/15AT	50AF/15AT	50AF/15AT	100AF/75AT	50AF/15AT	50AF/50AT	50AF/50AT
Current Transformer		100/5	-	-	100/5	-	-	100/5	-	10/5	-	-	-	-	-	-
Static Condenser (uF)		100	-	-	200	-	-	250	-	-	-	-	-	-	-	-
Remark										Automatic Operation by Electrode Type Level Switch		SCADA STYSTEM SCOPE				

PANEL NAME

NO.	DESCRIPTION	REMARK
MCC-K	400V MOTOR CONTROL CENTER PANEL	

NOTE

- Digital Meter (Metering: V,A,kW,kWH,Var,PF,F) (Digital integrated Metering device)
- MPR : Motor Protection Relay
  Protection features of Digital Motor Protection Relay(MPR)
  : Over current, undercurrent, locked rotor at start, open-phase, unbalanced phase, ground fault, leakage current
- ToD METER shall be provided by Electric Power Company.
- Power Factor Correction should be above 95%.
- The capacity of the condenser can be changed according to the power factor and efficiency of the motor
- For manual operation, the sequence must be configured so that the pump and the valve can be interlocked.
- All equipments related to Automatic Operation are supplied by SCADA SYSTEM except the automatic system to control tank Level that is in the scope of this design

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KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

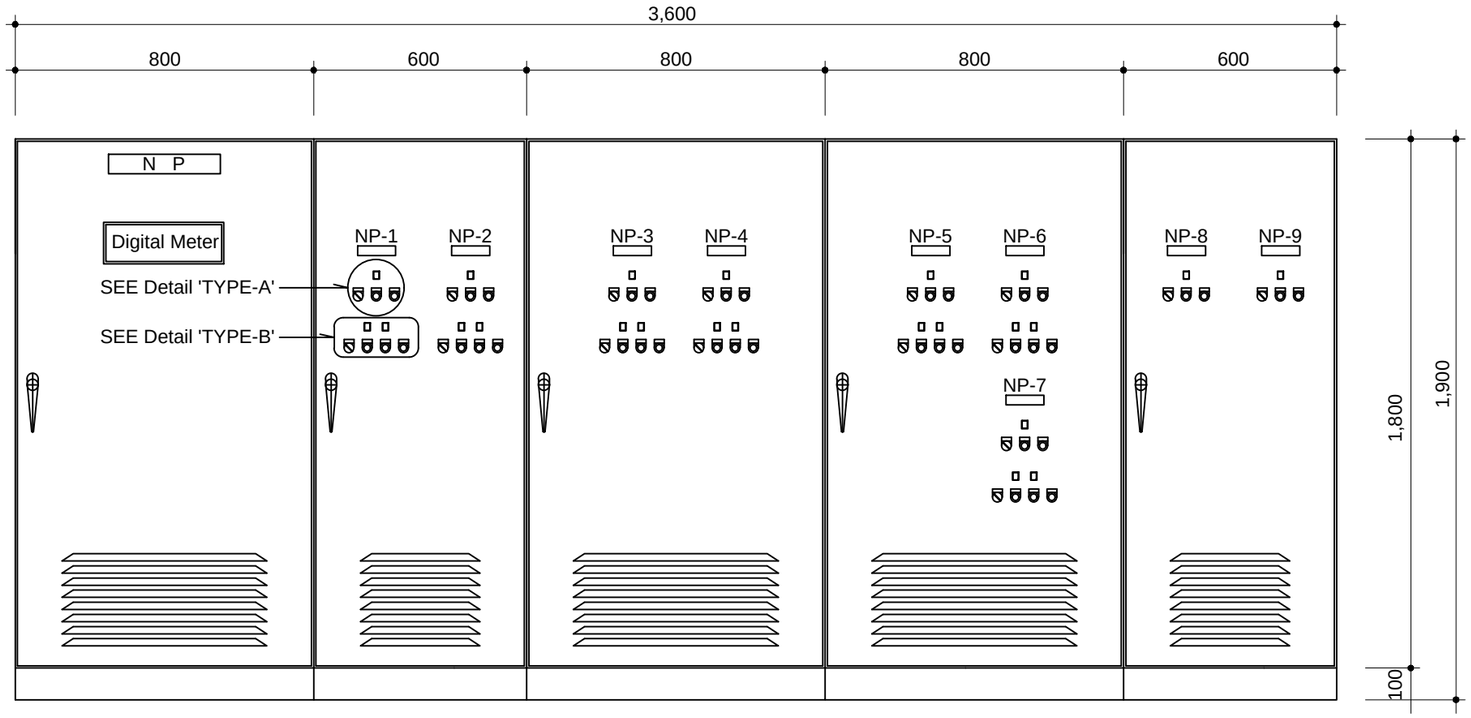
KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

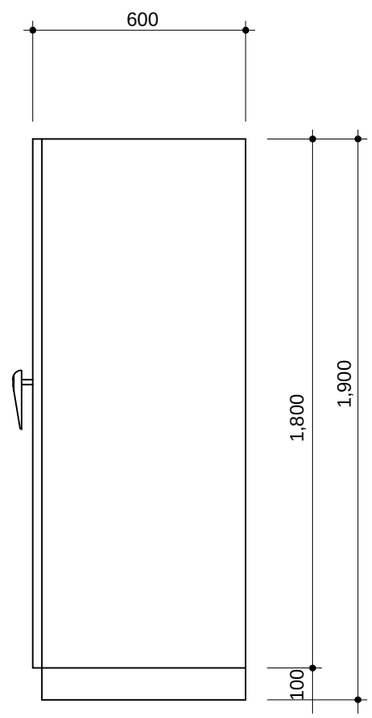
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: KIRTIPUR PUMP STATION ELECTRICAL WORK 11KV SINGLE LINE DIAGRAM

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-E-3	5	

MCC DETAIL DIAGRAM



FRONT VIEW



SIDE VIEW

PANEL NAME

NO.	DESCRIPTION	REMARK
NP-1, 2	Clear Water Pump (M-101 A,B,C)	V.V.V.F Drive
NP-3, 4	Clear Water Pump (M-201 A,B)	V.V.V.F Drive
NP-5~7	Clear Water Pump (M-301 A,B)	V.V.V.F Drive
NP-8, 9	Sump Pump (M-304 A,B)	Direct on Line

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NOTE

- TYPE "A"
  - S/S SWITCH
  - LAMP (FAULT)
  - P.B W/LAMP (RUN,STOP)
- TYPE "B"
  - S/S SWITCH
  - LAMP (FAULT, FULL OPEN)
  - P.B W/LAMP (OPEN,CLOSE,STOP)

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

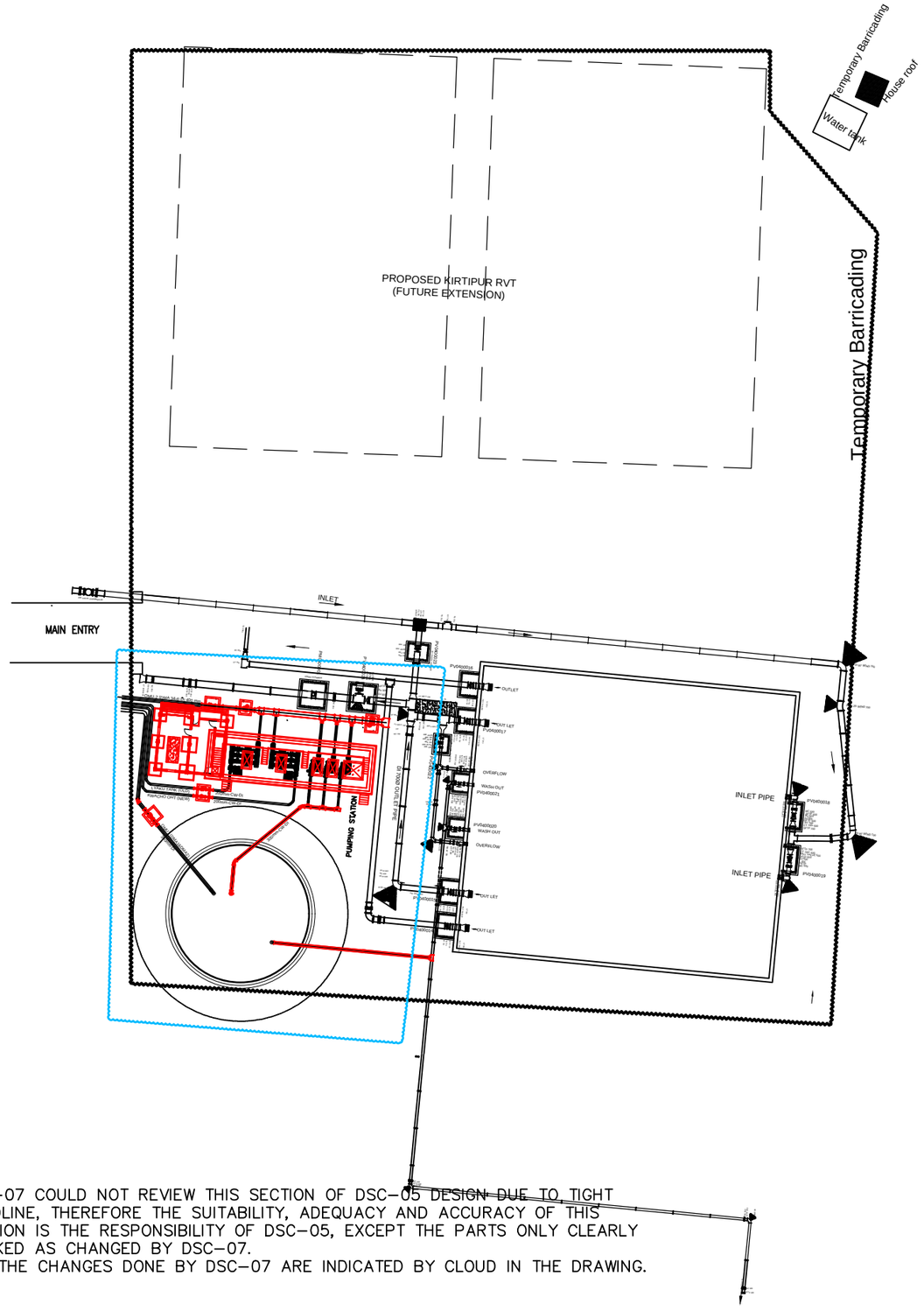
KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: KIRTIPUR PUMP STATION ELECTRICAL WORK MCC DETAIL DIAGRAM

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRETE	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-E-4	5	

SITE LAYOUT OF KIRTIPUR



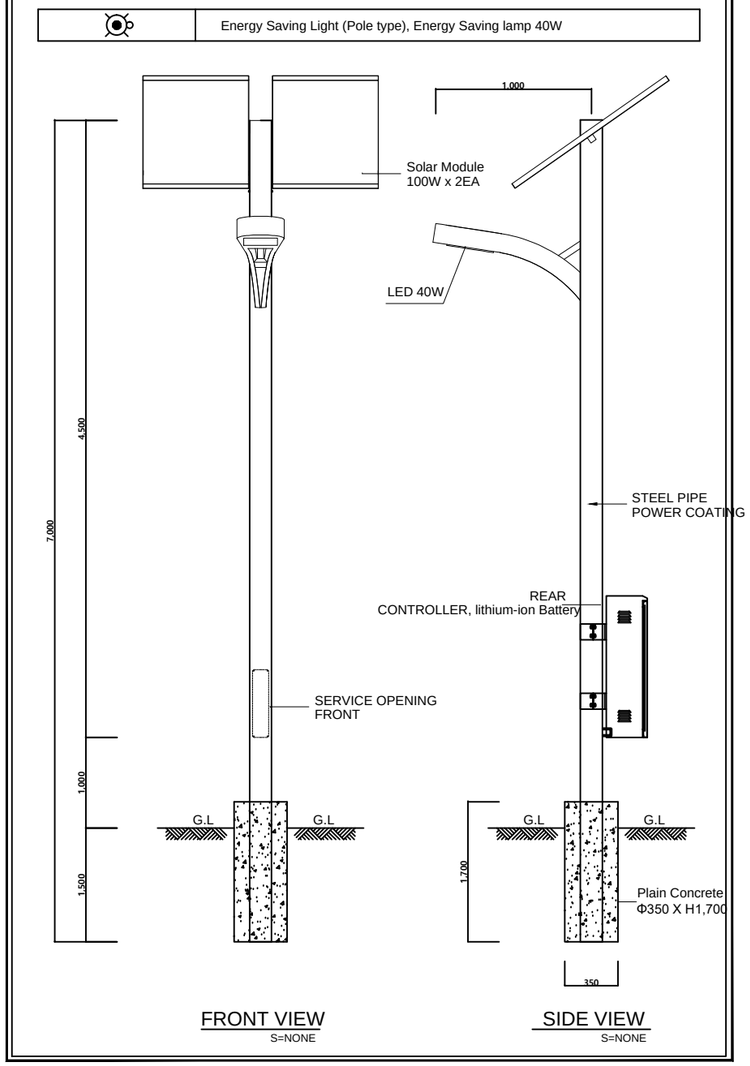
NOTE:

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NOTE

- The location of the 11kV incoming point can be changed by status of NEA distribution line.
- Since the existing facilities are currently under construction, this may vary according to the local condition.
- P.B (PULL BOX) : 300X300x300

Outdoor Lighting Fixture



KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

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IN ASSOCIATION WITH:

Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION ELECTRICAL WORK SITE LAYOUT OF KIRTIPUR

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRETE	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-E-5	5	

CABLE SCHEDULE

S = NONE

CABLE SCHEDULE

	NO.	Discription	Capacity (kW)	Distribution		Cable size	Ground wire	Conduit	Remark
				From	To			PE	
	1	TR.	150kVA	TR.	MCC-K	0.6/1kV CU/XLPE 185㎟ - 1Cx4LINE	-	104C	
	2	GENERATOR	161kVA	GEN.	MCC-K	0.6/1kV CU/XLPE 150㎟ - 1Cx4LINE	95㎟	104C	
	3	Clear Water Pump	15	MCC-K	MK-101 A,B,C	0.6/1kV CU/XLPE 16㎟ - 3C x 2	10㎟	36Cx2	
	4	Discharge Valve	0.4	MCC-K	MK-103 A,B,C	0.6/1kV CU/XLPE 4㎟ - 4C	4㎟	36C	
						Control cable : CU/PVC 2.5㎟ - 15C		42C	
	5	Water Hammer Control System	-	MCC-K	MK-104	0.6/1kV CU/XLPE 4㎟ - 2C	4㎟	28C	
	6	Clear Water Pump	22	MCC-K	MK-201 A,B	0.6/1kV CU/XLPE 25㎟ - 3C x 2	16㎟	42Cx2	
	7	Discharge Valve	0.4	MCC-K	MK-203 A,B	0.6/1kV CU/XLPE 4㎟ - 4C	4㎟	36C	
						Control cable : CU/PVC 2.5㎟ - 15C		42C	
	8	Water Hammer Control System	-	MCC-K	MK-204	0.6/1kV CU/XLPE 4㎟ - 2C	4㎟	28C	
	9	Clear Water Pump	15	MCC-K	MK-301 A,B	0.6/1kV CU/XLPE 16㎟ - 3C x 2	16㎟	36Cx2	
	10	Discharge Valve	0.4	MCC-K	MK-303 A,B	0.6/1kV CU/XLPE 4㎟ - 4C	4㎟	36C	
						Control cable : CU/PVC 2.5㎟ - 15C		42C	
	11	Sump Pump	0.75	MCC-K	MK-304 A,B	0.6/1kV CU/XLPE 4㎟ - 3C	4㎟	28C	
					LS, 4P	Control cable : CU/PVC 2.5㎟ - 4C		28C	
	12	Lighting Panel	2kVA	MCC-K	LP-K	0.6/1kV CU/XLPE 6㎟ - 2C	6㎟	36C	
	13	UPS Panel	2kVA	MCC-K	UPS	SCADA SYSTEM SCOPE			
	14	Existing Guard House Panel	15kVA	MCC-K	LP-E	0.6/1kV CU/XLPE 16㎟ - 2C	16㎟	36C	
	15	Operating House Panel	2kVA	MCC-K	LP-O	0.6/1kV CU/XLPE 6㎟ - 2C	6㎟	36C	
	16	Earth					95㎟		

* Control Cable : 0.6/1kV PVC Insulated PVC Sheath Control Cable
Ground Wire : 0.6/1kV PVC Insulated Copper conductor Earthing Wire

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KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

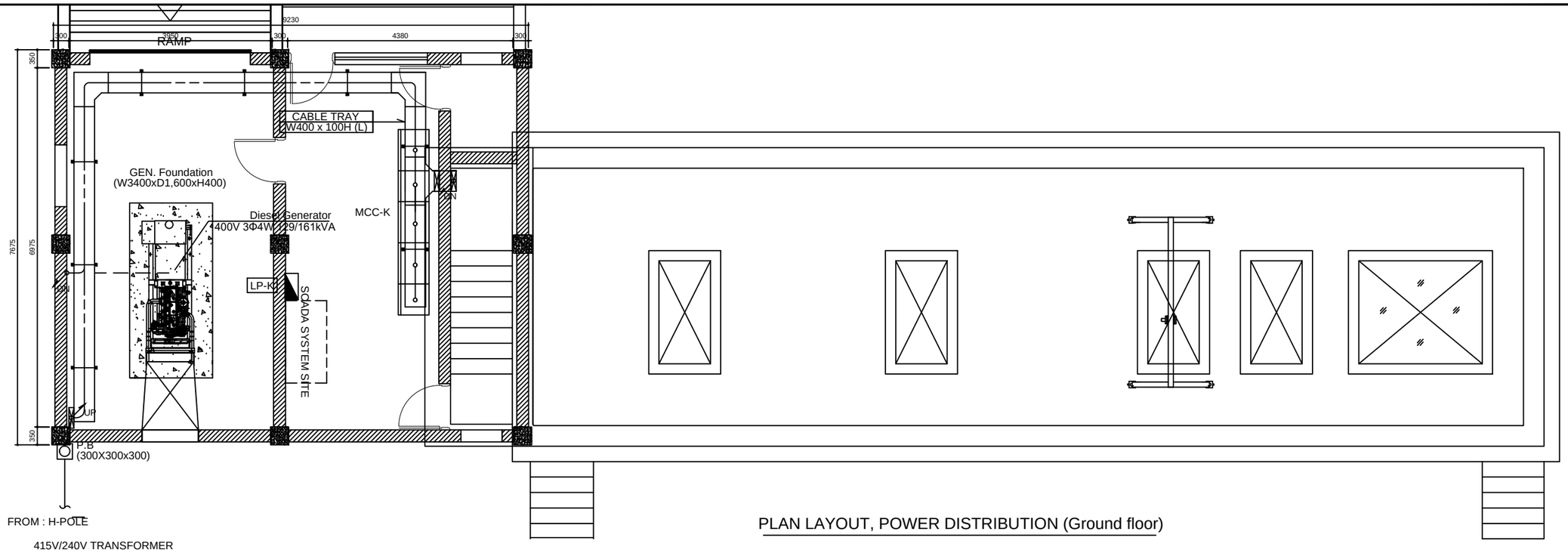
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

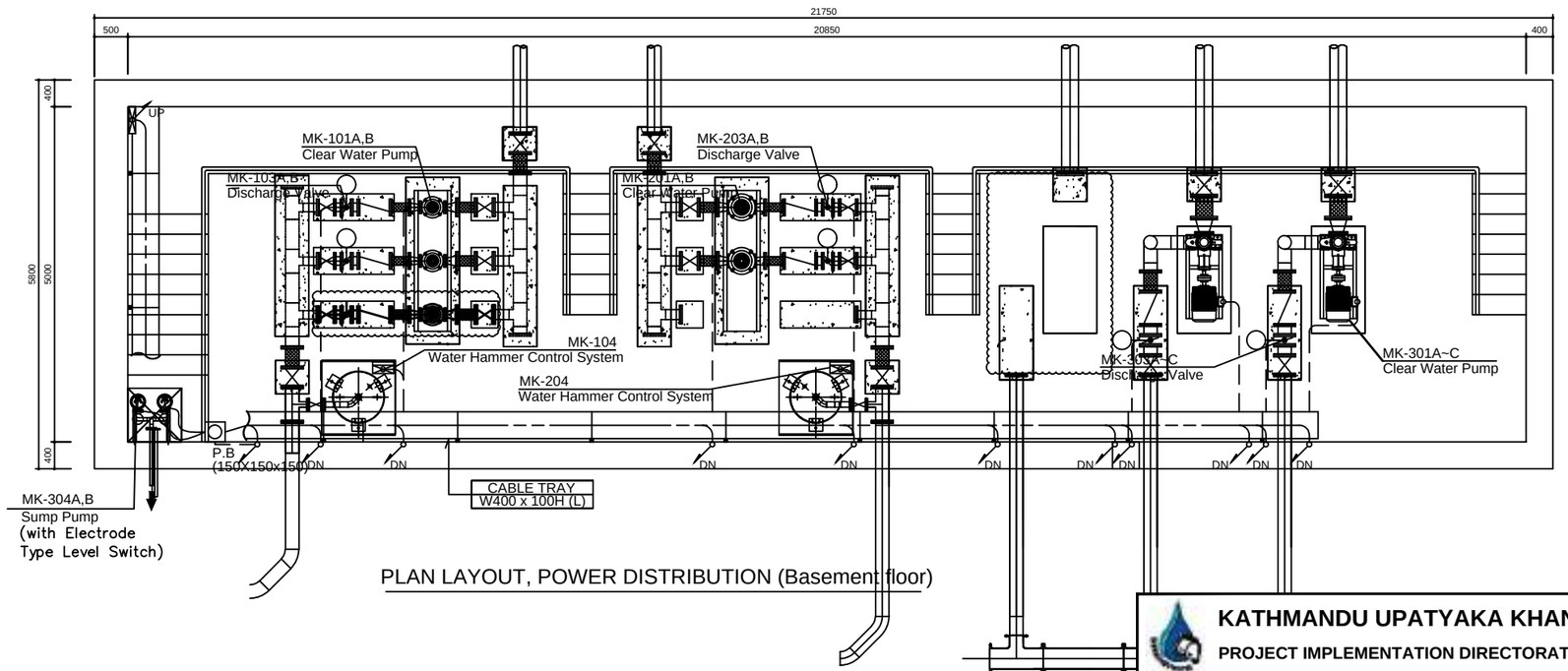
PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION
ELECTRICAL WORK
CABLE SCHEDULE

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRAVO DES -	2	
DATE:	Jan-2024	3	
SCALE:	-	4	
DRAWING No.	PS-E-6	5	



PLAN LAYOUT, POWER DISTRIBUTION (Ground floor)



PLAN LAYOUT, POWER DISTRIBUTION (Basement floor)

NOTE:
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2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

NOTE

1. Supply of submersible cable of intermediate pump should be by machinery work.
2. ⊠ P.B (PULL BOX)
3. A rated capacity, dimensions, and sizes of air supply/exhaust opening, and a pad of Emergency Diesel Generator can be varied by vender.
4. CABLE TRAY(C/S) - C:COVER, S:SEPERATOR
5. Prior to the construction, the contractor shall consult the person in charge of architecture works with approved data from the vender.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

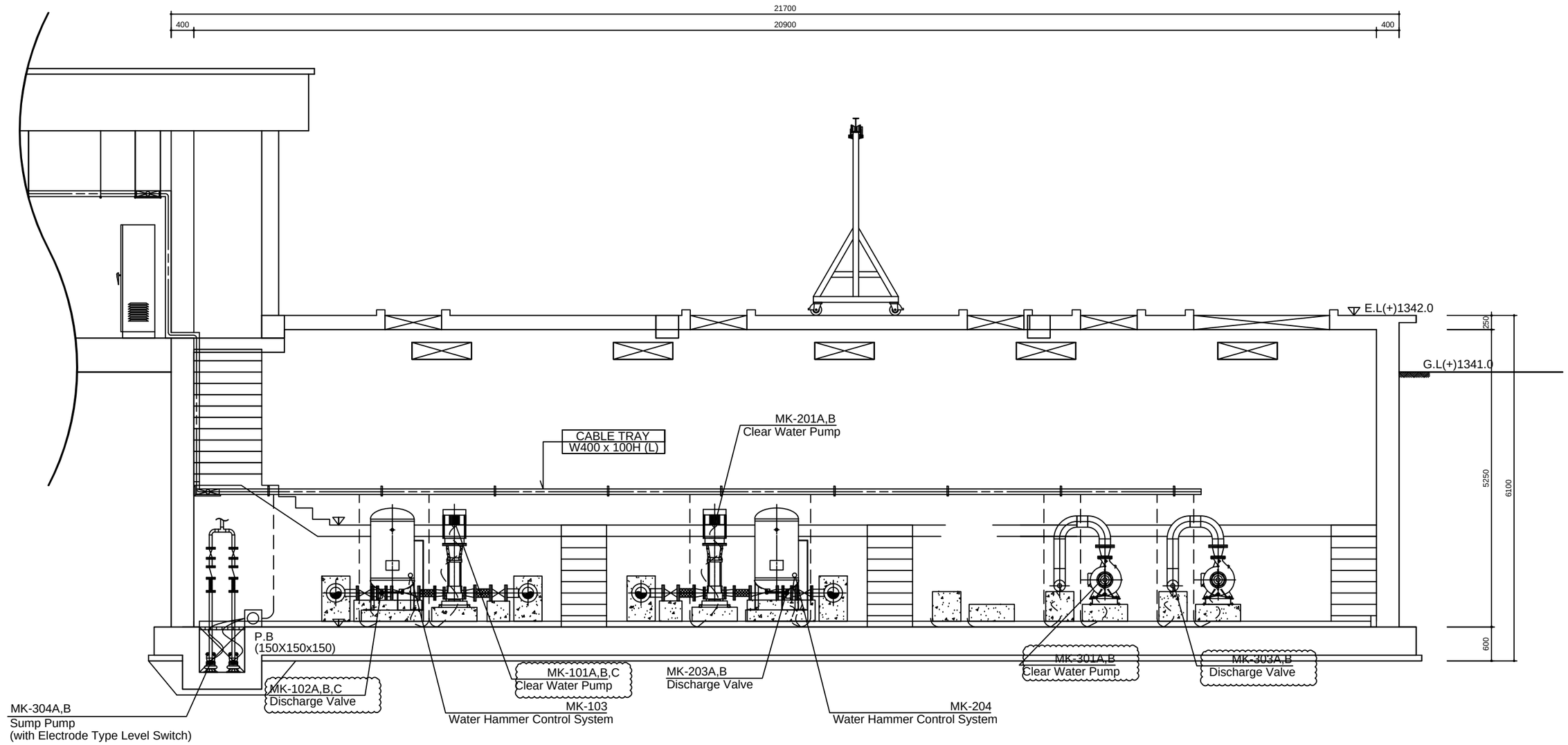
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION
ELECTRICAL WORK
PLAN LAYOUT, POWER DISTRIBUTION

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRAVO BES	2	
DATE:	Jan-2024	3	
SCALE:	1:90	4	
DRAWING No.	PS-E-7	5	



Cross Section, POWER DISTRIBUTION

S=1:50

NOTE

1. Supply of submersible cable of intermediate pump should be by machinery work.
2. ⊡P.B (PULL BOX)
3. CABLE TRAY(C/S) – C: COVER, S: SEPERATOR

NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

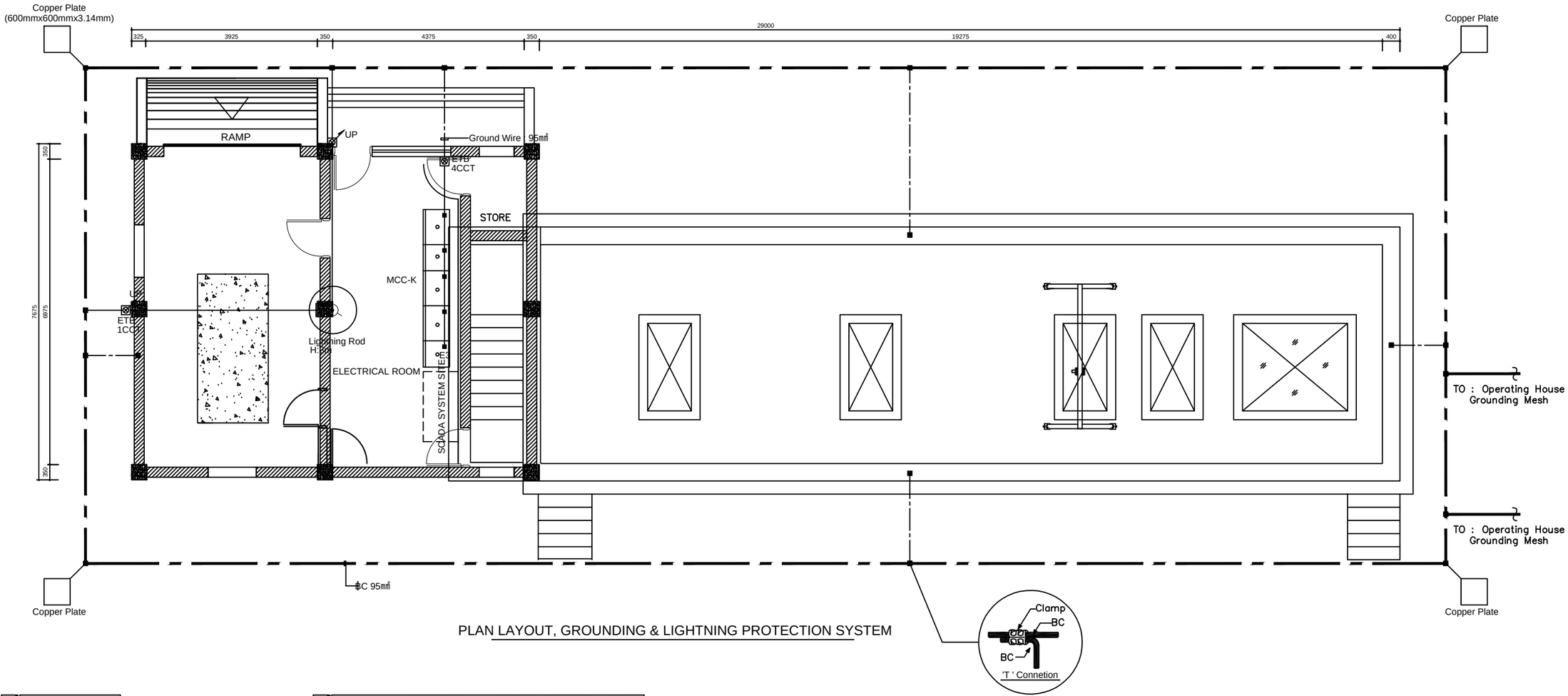
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

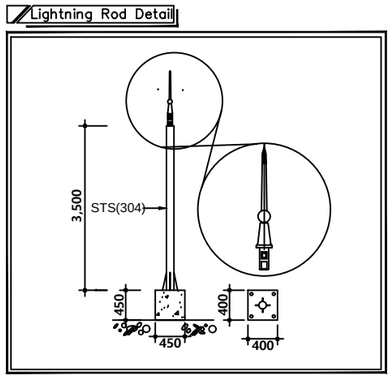
DRAWING TITLE: KIRTIPUR PUMP STATION
ELECTRICAL WORK
PLAN LAYOUT, POWER DISTRIBUTION

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:75	4	
DRAWING No.	PS-E-8	5	

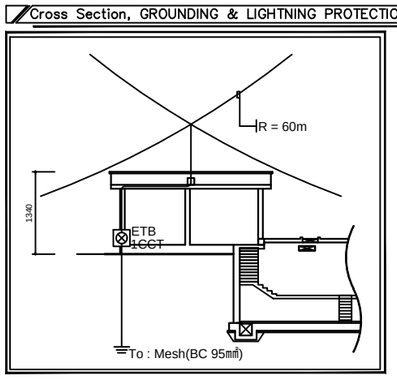


PLAN LAYOUT, GROUNDING & LIGHTNING PROTECTION SYSTEM

Lightning Rod Detail



Cross Section, GROUNDING & LIGHTNING PROTECTION SYSTEM



NOTE:

1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
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KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

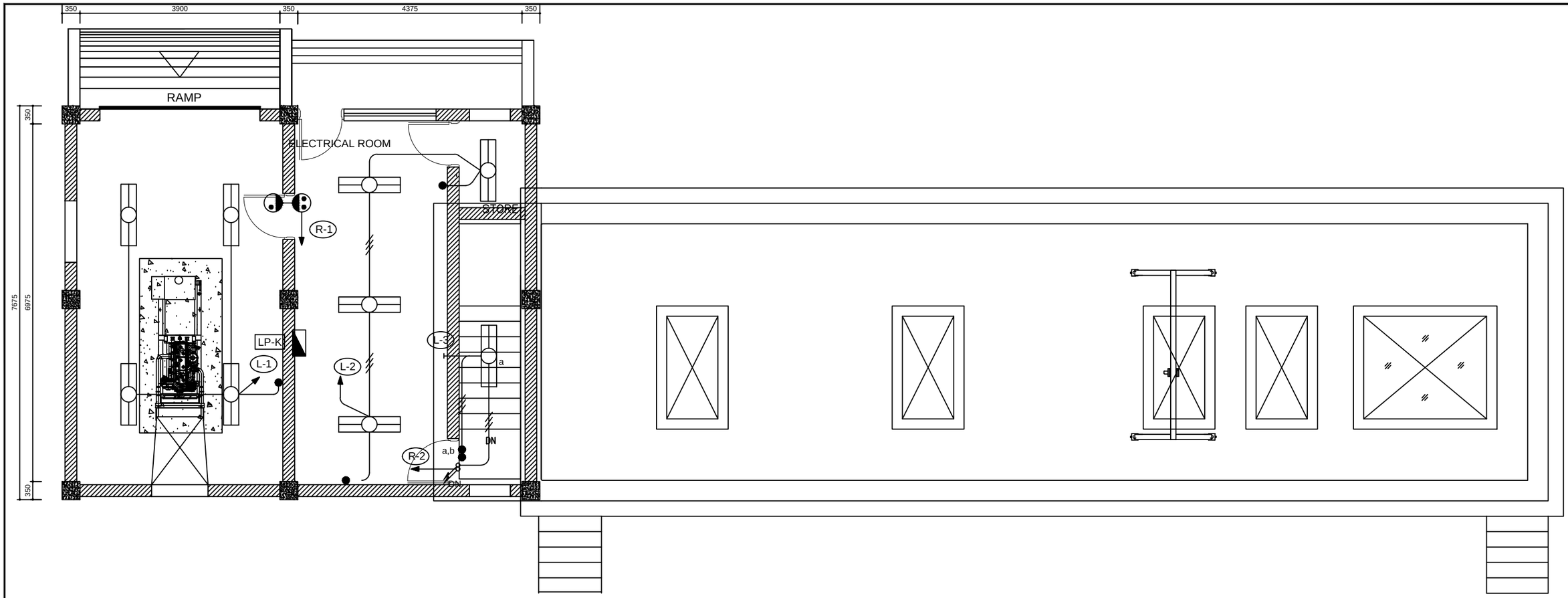
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2 - KIRTIPUR

DRAWING TITLE: KIRTIPUR PUMP STATION
ELECTRICAL WORK
GROUNDING & LIGHTING PROTECTION SYSTEM

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:100	4	
DRAWING No.	PS-E-9	5	



NOTE

	Lighting Distribution Board
	Tube Lighting Fixture (FL 36W X 2)
	Tube Lighting Fixture (FL 36W X 2), Wall Type
●	Light Switch
	Socket
———	PVC Insulated Wire (2.5sq 1C x 2) + (1.5sq(E))
———▷	Homerun circuit to panelboard
(AA)	Name of homerun circuit

1. Mounting heights above the floor shall be as follows unless otherwise noted on the drawings.

   Wall type Lighting fixture : 4000mm to center of fixture
   Panelboard : 1500mm to center of panelboard
   Light switch : 1200mm to center of the switch
   Socket–outlets : 300mm to bottom of the outlet

2. All conduits for consealed electrical wires shall be PVC Insulated unless otherwise noted on the drawings.

PLAN LAYOUT, LIGHTING AND SOCKETS (Ground floor)

NOTE:
1. DSC–07 COULD NOT REVIEW THIS SECTION OF DSC–05 DESIGN DUE TO TIGHT DEADLINE, THEREFORE THE SUITABILITY, ADEQUACY AND ACCURACY OF THIS SECTION IS THE RESPONSIBILITY OF DSC–05, EXCEPT THE PARTS ONLY CLEARLY MARKED AS CHANGED BY DSC–07.
2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

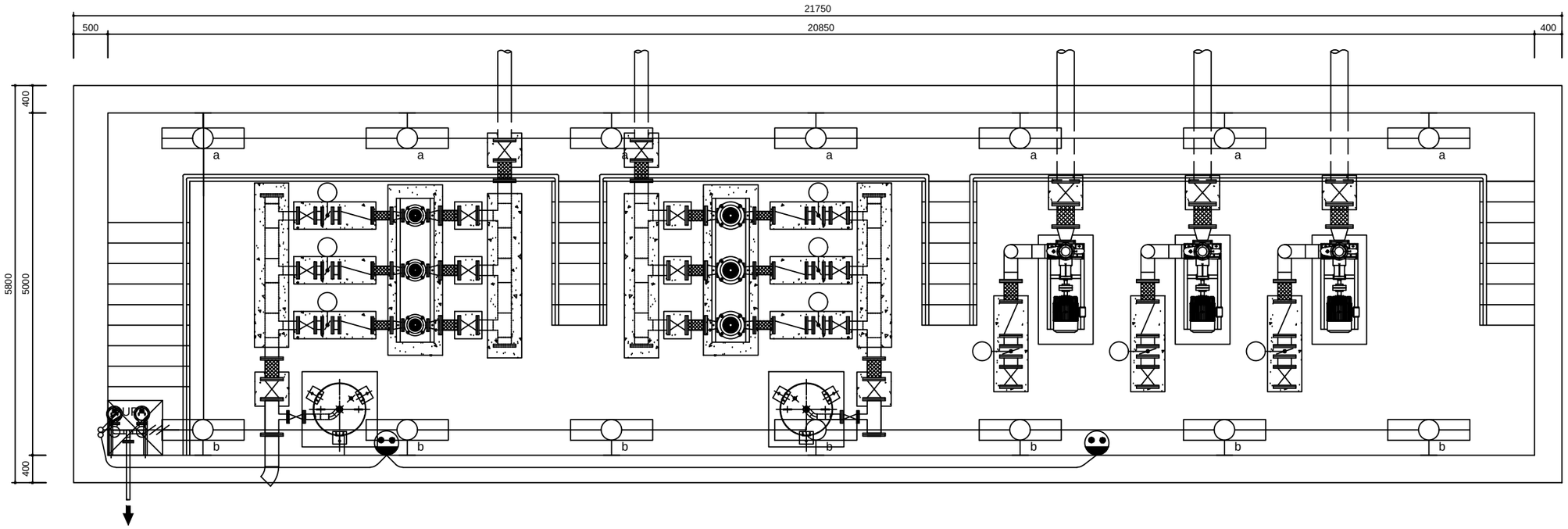
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: KIRTIPUR PUMP STATION ELECTRICAL WORK LIGHTING AND SOCKETS PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BRIAMONES	2	
DATE:	Jan-2024	3	
SCALE:	1:80	4	
DRAWING No.	PS-E-10	5	



PLAN LAYOUT, LIGHTING AND SOCKETS (Basement floor)

NOTE

	Lighting Distribution Board
	Tube Lighting Fixture (FL 36W X 2)
	Tube Lighting Fixture (FL 36W X 2), Wall Type
	Light Switch
	Socket
	PVC Insulated Wire (2.5sq 1C x 2) + (1.5sq(E))
	Homerun circuit to panelboard
AA	Name of homerun circuit

1. Mounting heights above the floor shall be as follows unless otherwise noted on the drawings.
   - Wall type Lighting fixture : 4000mm to center of fixture
   - Panelboard : 1500mm to center of panelboard
   - Light switch : 1200mm to center of the switch
   - Socket-outlets : 300mm to bottom of the outlet
2. All conduits for consealed electrical wires shall be PVC Insulated unless otherwise noted on the drawings.

NOTE:
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2. ALL THE CHANGES DONE BY DSC–07 ARE INDICATED BY CLOUD IN THE DRAWING.

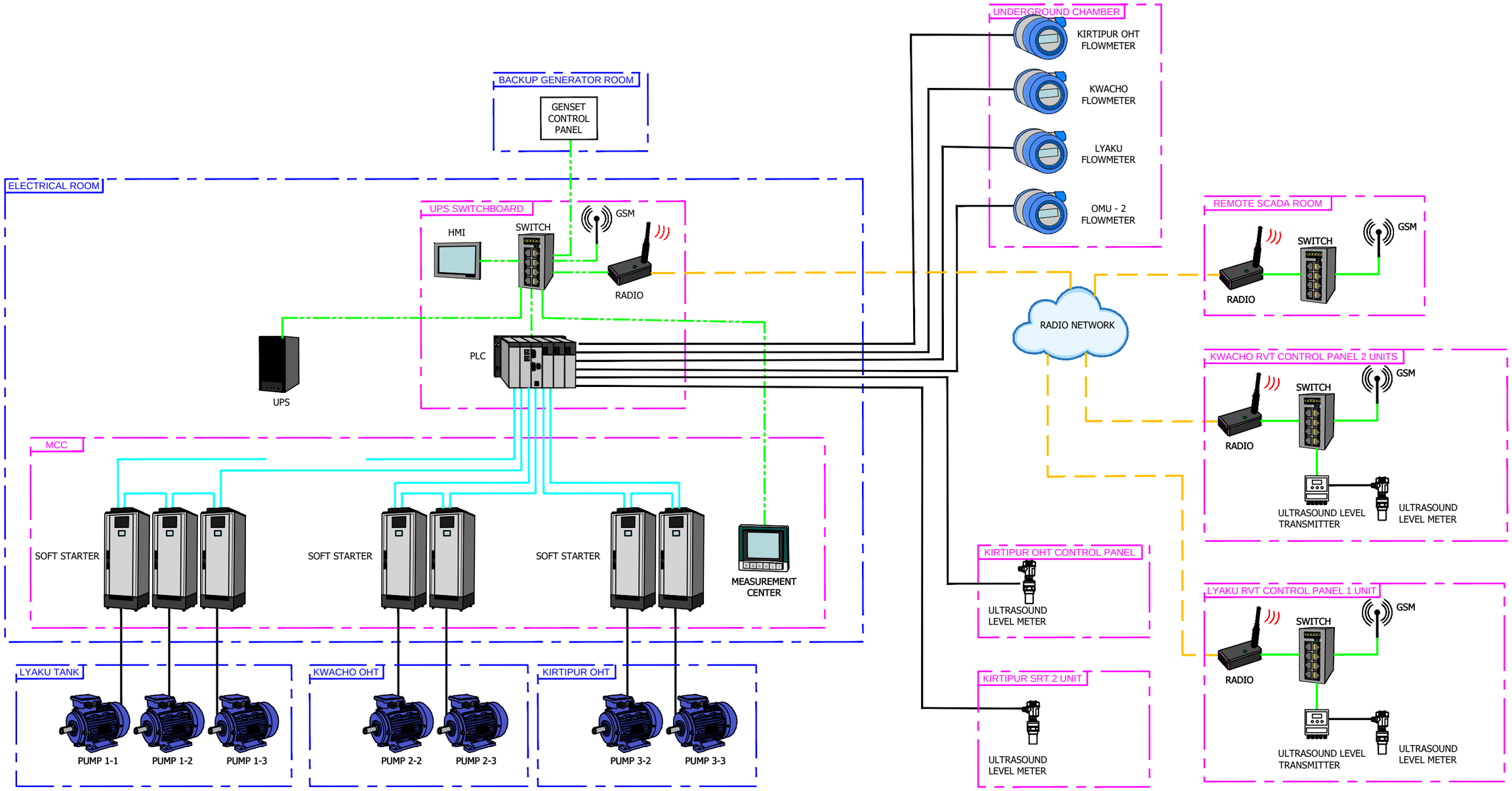
KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
eptisa
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2 - KIRTIPUR
DRAWING TITLE: KIRTIPUR PUMP STATION ELECTRICAL WORK LIGHTING AND SOCKETS PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:70	4	
DRAWING No.	PS-E-11	5	



LEGEND	
———	COPPER CABLE
— · — · —	ETHERNET
- - - - - -	COPPER MODBUS CABLE
- - - - - -	RADIO NETWORK

KATHMANDU UPATYAKA KHANEPANI LIMITED

PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:

eptisa

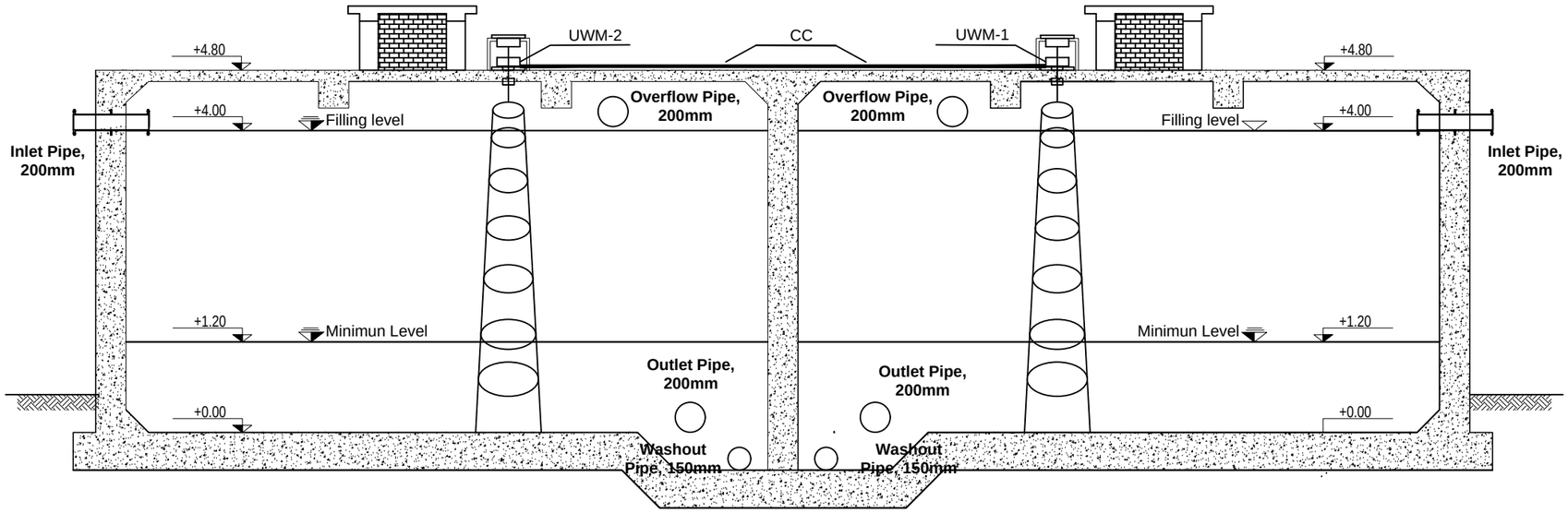
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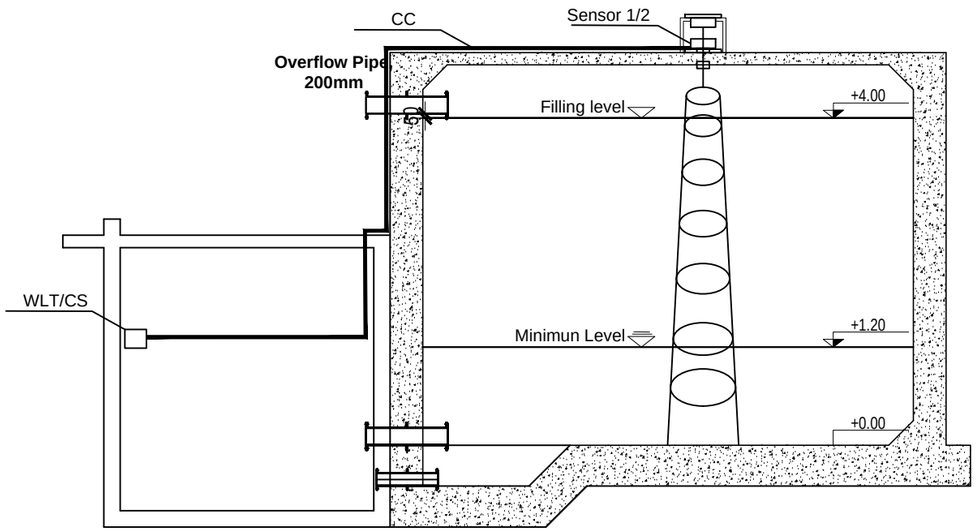
PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS

PACKAGE: PID/SKV/DNI2- KIRTIPUR

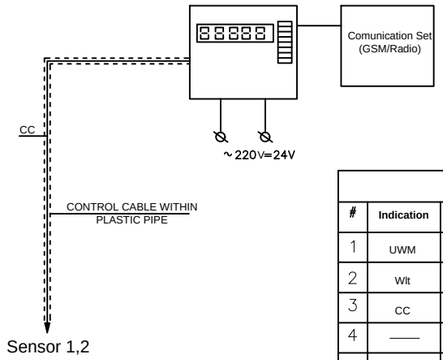
DRAWING TITLE: KIRTIPUR PUMP STATION ELECTRICAL WORK CONTROLS AND COMMUNICATION DIAGRAM

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J. M. NAVARRO	1	
APPROVED:	M. BENAVIDES	2	
DATE:	Jan-2024	3	
SCALE:	1:Custom	4	
DRAWING No.	PS-E-14	5	





WATER ULTRASOUND LEVEL METER (Ulm1.2)



SPECIFICATION

#	Indication	Name	Type	Technical Feature	Dimens.	Q-ty	Note
1	UWM	Ultrasound Level meter	——	=24/v; D=0.46m; H=5m;	set	2	
2	Wlt	Water Level Transmitter	Included in Level meter set	L=80m	pcs	2	
3	CC	Control Cable	Copper	4×1.5mm^2	m	75	
4	——	Conductive wire	Copper	2×1.5mm^2	m	20	
5	——	24v Power Source Adjuster	——	~ 220V=24V; 10~30w	pcs	2	
6	CS	Comunication Set (GSM/Radio)	——		pcs	1	

Note;
Water filling and minimal levels is clarified while performing releasing-assembly tasks in agreement with the technologist
Comunication set should be comunicate with Kirtipur Pumpins Station to operate pumps

KATHMANDU UPATYAKA KHANEPANI LIMITED
PROJECT IMPLEMENTATION DIRECTORATE Anamnagar, Kathmandu

KATHMANDU VALLEY WATER SUPPLY IMPROVEMENT PROJECT (PHASE 2)

IN ASSOCIATION WITH:
Eptisa-ERMC JV (DSC-07)

PROJECT TITLE: DISTRIBUTION NETWORK IMPROVEMENT WORKS
PACKAGE: PID/SKV/DNI2- KIRTIPUR
DRAWING TITLE: KWACHO RVT WATER LEVEL CONTROL ULTRASONIC WATER METER SCHEME LAYOUT PLAN

		Rev.	DATE
DRAWN:	P. N. K.		
DESIGNED:	J.M. NAVARRO	1	
APPROVED:	M. BRAVO DES -	2	
DATE:	Jan-2024	3	
SCALE:	1:75	4	
DRAWING No.	LCR-1	5	