PERFORMANCE SPECIFICATION AND PARAMETERS FOR DESIGN, BUILD, TESTING & COMMISSIONING OF PROPOSED 4,000 CMD SEWAGE & SEPTAGE TREATMENT PLANT

November 2022

Location: Materials Recovery Facility (MRF) Compound, Gov. Lim Avenue (Magay), Zamboanga City

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Definition of Terms

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
FRP	Fiberglass Reinforced Polyester
UHW-PE	Ultra-High Molecular Weight Polyethylene
API	American Petroleum Institute
TDH	Total Dynamic Head
UV	Ultraviolet

RVAT	Reduce Voltage Auto Transformer Type
ACB	Air Circuit Breaker
MCCB	Molded Case Circuit Breaker
PFC	Power Factor Capacitor
MCC	Motor Control Center
MCB	Miniature Circuit Breaker
FLC	Full Load Current
O/L	Overload
RSC	Rigid Steel Conduit
uPVC	Unplasticized Polyvinyl Chloride
ELCB	Earth Leakage Circuit Breaker

References

ANSI/ASTM D4066	Nylon Standard
AISI 304/ASTN A276-98b 431	American Society of Testing and Materials
AISI A48-40B	Cast Iron Standard
AISI 4340	High Tensile Steel
AISI 9840	Alloy Steel
ASTM A153-73	Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A167-74	Stainless and Heat Resisting Chromium – Nickel Steel Plate, Sheet and Strip
ASTM A307-74	Carbon Steel Externally/Internally Threaded Standard Fasteners
ASTM A48/ASTM A126 Class B	Gray Iron Casting for valves, flanges, and fittings.
ASTM A743/AISI 303	Stainless Steel for General Application
ASTM B584/UNS C86700,C85800, C86200	Copper Alloy Sand Castings for General Application
ASTM B584-74	Copper-Alloy Sand Castings for General Applications
ASTM B62	Composition Bronze or Ounce Metal Castings
ASTM D3011	Polystyrene Standard
ASTM D3935	Polycarbonate Standard
ASTM D4181	Acetal Standard
AWWA C504-74	Rubber Seated Butterfly Valves
DIN 2532	Cast-Iron Flanges, Nominal Pressure 10 ISO 2084-1974 (e) Pipeline Flanges for General Use – Metric Series – Mating Dimensions
DIN 30677 T2	Internal and External Protection for Grey cast Iron Castings
ISO R261-73	IS General Purpose Metric Screw Threads – General Plan
B.P. 334	An Act to Enhance the Mobility of Disables Persons by Requiring Certain Buildings, Institutions, Establishments and Public
DA AO 26 s. 2007	Guidelines on Safe Reuse of Wastewater
DENR DAO 2021-19	Water Quality Guidelines and General Effluent Standards
DPWH Blue Book	Standard Specifications for Highways, Bridges and Airports (2013 edition)
IEC	Institute of Electromechanical Commission
	Fire Code of the Philippines

IEE	Institute of Electrical and Electronics Engineers
IEEE Pub. No. 142	Grounding of Industrial Power System
IEEE STD 141-1976	Protection and Coordination
IPCEA	Insulated Power Cable Engineering Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NPCP	National Plumbing Code of the Philippines
NSCP	National Structural Code of the Philippines (latest edition)
OSH	Occupational Safety and Health Standards 2017 edition
PD 1586	Philippine Environmental Impact Statement System
PD 856	Code on Sanitation of the Philippines
PEC	Philippine Electrical Code
PGBC	Philippine Green Building Code
PMEC	Philippine Mechanical Engineering Code
RA 9003	Ecological Solid Waste Management Act
RA 9275	Clean Water Act

Other applicable local ordinances

RATIONALE

Zamboanga City

Zamboanga City is a highly-urbanized city since 1983 located at the southwestern-most tip of the Zamboanga Peninsula. As of the 2015 census of the Philippine Statistics Authority (PSA), it has a population of 861,799 and ranked sixth largest city in terms of population. Its level of urbanization or the percentage of population residing in the urban areas in the city was recorded at 89.8% in 2015 as per PSA classification.

The city is composed of 98 barangays divided into two (2) political districts, namely, District 1, which is the West Coast section of the city and is facing the Sulu Sea, and District 2, which is the East coast section and is facing the Moro Gulf. District 1 is composed of 37 barangays while District 2 is composed of 61 barangays.

The Local Government Code of 1991 (R.A. 7160) provides the following:

- Under Section 3, the enhancement of the capabilities of LGUs by providing them with opportunities to participate actively in the implementation of national programs and projects (item g); for the LGUs to share with the national government the responsibility in the management and maintenance of ecological balance (item i); and the participation of the private sector in local governance, particularly in the delivery of basic services (item l).
- Under Section 17, LGUs are mandated to effectively provide basic services and facilities to their constituents, including drainage and sewerage; as well as to encourage the active participation of the private sector in local governance and through the sale, lease and disposal of public economic enterprises owned by the local government units in their proprietary capacity.

Thus, the Code provides for the relationship of each LGU with national government agencies (including government owned and controlled corporations such as water districts) and the private sector, and thus, a mandate to work with various sectors and encourage people's participation in local governance in the pursuit of local autonomy. Likewise, with a mandate to enhance the right of the people to a balanced and healthful ecology, each LGU shall endeavor to provide resource utilization, conservation and protection projects; aside from its powers to legislate and enforce laws towards the utilization, conservation and protection of its territorial resources.

Zamboanga City Water District

The Zamboanga City Water District is a premiere water district in the southwestern part of the Philippines. It has been established in April 1974 by virtue of Zamboanga City Council Resolution No. 446 in accordance with Presidential Decree 198. The resolution in effect transferred the ownership, management and operations of the existing waterworks and sewerage facilities from the former Zamboanga Waterworks and Sewerage System, which was then owned and managed by the local government to the Zamboanga City Water District.

Zamboanga City Sewerage System

The sewerage system has a total of 887 service connections and has an average flow rate of 4,000 cubic meters per day as of May 2017. It is among the few water service providers in the country which operates and maintains a sanitary sewer system. It was turned over to the water district in 1976 along with the transfer of the water supply system. The existing system has limited coverage but it provides a sanitary means of sewage collection from the high-density commercial areas of the city. Outside the existing sewerage service areas, residents and other establishments rely on the on-site systems specifically septic tanks for wastewater treatment and disposal.

Historically, the water and sewerage system in Zamboanga City was constructed during the period 1911 to 1913 under the United States Colonial Government with the Tumaga River as the source of water supply. The system was purposely built to serve the needs of the United States forces during that time. With the declaration of Philippine Independence in 1948, the system was taken over by the local government operating until 1974.

It covers an area of approximately 80 hectares covering most of the city's downtown area. The collection system consists of approximately 11,400 linear meters of vitrified clay pipes with lengths and sizes broken down as follows: 830 ln.m. of 100 mm Ø, 5390 ln.m. of 150 mm Ø, 4,960 ln.m. of 250 mmØ, and 220 ln.m. of 300 mmØ. Excluded are private lines of large establishments connected into the system.

The Magay Creek (Sucabon Creek) divides the sewer service area into the East and West catchment areas. Sewage flow from the East Catchment is conveyed by gravity to the East Pumping Station, which are then pumped to the West Pumping Station via two 200 mm Ø Cast Iron (CI) pressure pipes. Likewise, sewage flows generated from the West Catchment are collected in the receiving tanks of the West Pumping Station where together with the flows from the East Catchment are now being discharged into the Magay Creek.

All major mechanical and appurtenant equipment at the two sewage pump stations is the same original equipment installed in 1933.

National Sewerage and Septage Management Program

R.A. 9275 or the Philippine Clean Water Act of 2004 mandates water utilities in highly urbanized areas, in coordination with the local government units, to connect existing sewage lines to available sewerage systems. At present, there are only 887 service connections in the sewered area that are connected to the sewerage system. This system is composed of a sewerage line within the central business district and two (2) pumping stations with an outfall draining into the Basilan Straight. The remaining population are either using septic tanks or are directly discharging their wastes in the drainage system which is draining to the Cawa-Cawa Bay. In order to protect the coastal and inland waters of the city, it is imperative that the discharge of wastewater into water bodies must be in compliance with the effluent standards set by the Department of Environment and Natural Resources, through its line agency, the Environmental Management Bureau. Thus, in order that the sewage discharged into the Cawa-Cawa Bay comply with the said standards sets, a 4,000 cubic meter capacity Sewerage Treatment Plant (STP) will be constructed.

On April 21, 2014, ZCWD and the Local Government of Zamboanga City, entered into a Memorandum of Agreement for the use of the Materials Recovery Facility (MRF) compound for the construction of an underground STP. However, it is necessary that during the construction period, the MRF operations will not be hampered and that existing facilities and structures which will be affected during the construction will be restored.

In August of the same year, the United States Agency for International Development (USAID) through the Water Security for Resilient Economic Growth and Stability (Be Secure) Project began providing technical assistance to ZCWD in its water and sanitation projects, including this project. A Geotechnical Investigation was conducted at the proposed project site which found that the soil condition therein is potentially liquefiable in the event of strong ground motion (major earthquake). Thus, it was necessary to revise the earlier plan of constructing an underground facility because of this.

On August 1, 2016, an amended MOA was signed by the parties for an additional area in order that the facility may be constructed above ground and for the original MRF to be transferred and rebuilt at an area within the main public market recently vacated due to conflagration. Thus, from original area of 1,800.00 square meters, it has now been expanded to a total of 2,196.00 square meters.

It is hoped that with the implementation of this project, Zamboanga City will soon be compliant with the requirements of the Clean Water Act and ensure cleaner waters for the future generations of the city.

SCOPE OF WORKS

1. GENERAL PROVISIONS

1.1. The design, build, testing and commissioning of the 4MLD sewage-septage treatment plant is open to all technologies, solutions, design, and construction method. The Contractor should be able to design the process and construct a sewage and septage treatment plant (SSTP) capable of treating 4,000 cubic meter per day of sewage collected from the existing sewerage system of the Zamboanga City Water District that would meet the effluent quality requirements set under this specification. The capacity of the SSTP must be expandable to 6,000 cubic meters per day at any time when the full capacity of 4,000 cubic meters per day has been achieved. Furthermore, should also be able to treat 15 cum/day of septage.

1.2. An allotted area of 2,196.00 square meters at the Materials Recovery Facility (MRF) Compound, Gov. Lim Avenue (Magay), Zamboanga City will be used for this project. The construction of the facility must give due consideration to the soil quality of the project site based on the results of the geotechnical investigation attached herein.

2. BIDDING REQUIREMENTS

The contractor shall include in its bid offer all costs of maintaining the treatment plant such as the consumables, qualified personnel assigned on the site (on shift basis) who shall conduct sampling and carryout the tests. A complete record has to be maintained for all the tests carried out at regular intervals. The lowest bidder has to pass and be responsive to the other requirements as stated in the bidding documents and the *Performance Specifications and Parameters* as stipulated in the revised IRR of the RA 9184, to declare as the winning bidder.

2.1. REQUIREMENTS UNDER RA 9184

The statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid referred to under Sec. 23.1 v. of the IRR of the RA 9184 shall refer to ***"Design and build of wastewater treatment facility."*** Also, the requirements for SLCC are stated in the Invitation to Bid and Instruction to Bidders, and in this Performance Specifications.

2.1.1. Considering that a Septage Treatment Plant project is a wastewater treatment project, then a purely septage treatment plant is project is acceptable for an SLCC attachment.

2.1.2. The Preliminary Conceptual Design Plans (PCDP) must show the complete assembly of the plant with all components, equipment, support structures and access facilities in accordance with Section 10.1 i. of Annex G of the Revised IRR of RA 9184. It shall include the architectural layout, details and the dimensions of the structure and facilities.

2.1.3. The PDCP shall be supported with the Site Development Plan and perspective and aerial view relative to the location with respect to the boundary of the lot allocated for all the plant, structures and other facilities.

2.1.4. The bidder shall have a PCAB License size range of *Medium B* with License Category A as per *PCAB Categorization - Classification Table* (PCAB Board Resolution No. 201, Series of 2017).

2.1.5. The bidders shall comply with the eligibility requirements as set forth in the Section 23 to 24 of the revised IRR of RA 9184. The bidder shall also comply with the Section 9.2 of Annex “G” of the revised IRR of RA 9184.

2.1.6. NPM 079-2014 [A] prospective bidder's business as stated in the Mayor's Permit should allow it to legally engage in identified business/ endeavor within the City or Municipality where it has its principal place of business. In the case of Acebedo Optical Company, Inc. v. the Court of Appeals, et al., the Supreme Court held that "a business permit authorizes the person, natural or otherwise, to engage in business or some form of commercial activity."

NPM No. 126-2016 [I]t is necessary for the Bids and Awards Committee (BAC) to determine whether the Mayor`s Permit and BIR Certificate of Registration issued to the supplier authorizes it to engage in the business stated therein, such that a finding to the contrary would amount to noncompliance by the bidder and will result to its disqualification. A prospective bidder`s business as stated in the Mayor`s Permit should at the very least be similar to the project to be bid.

2.1.7. All documents that require notarial seal shall have the dry seal of the notary public, considering it is a requirement under the notarial law. Also, site inspection is not a requirement for eligibility.

2.1.8. The following are the obligations and responsibilities of the Contractors as specified under the Annex “G” of the Revised IRR of RA 9184:

As a rule, contract implementation guidelines for the procurement of infrastructure projects shall comply with Annex “E” of Revised IRR of the RA 9184. The following provisions shall supplement these procedures:

2.1.8.1. No works shall commence unless the contractor has submitted the required documentary requirements and the procuring entity has given written approval. Work execution shall be in accordance with reviewed and approved documents.

2.1.8.2. The contractor shall be responsible for obtaining all necessary information as to risks, contingencies and other circumstances which may affect the works and shall prepare and submit all necessary documents specified by the procuring entity to meet all regulatory approvals as specified in the contract documents.

2.1.8.3. The Contractor shall submit a detailed program of work within fourteen (14) calendar days after the issuance of the Notice to Proceed for approval by the procuring entity that shall include, among others:

2.1.8.3.1. The order in which it intends to carry out the work including anticipated timing for each stage of design/detailed engineering and construction;

2.1.8.3.2. Periods for review of specific outputs and any other submissions and approvals;

2.1.8.3.3. Sequence of timing for inspections and tests as specified in the contract documents;

2.1.8.3.4. General description of the design and construction methods to be adopted;

2.1.8.3.5. Number and names of personnel to be assigned for each stage of the work;

2.1.8.3.6. List of equipment required on site for each major stage of the work; and

2.1.8.3.7. Description of the quality control system to be utilized for the project.

2.1.8.4. Any errors, omissions, inconsistencies, inadequacies or failure submitted by the contractor that do not comply with the requirements shall be rectified, resubmitted and reviewed at the contractor's cost. If the Contractor wishes to modify any design or document which has been previously submitted, reviewed and approved, the contractor shall notify the procuring entity within a reasonable period of time and shall shoulder the cost of such changes.

2.1.8.5. As a rule, changes in design and construction requirements shall be limited only to those that have not been anticipated in the contract documents prior to contract signing and approval. The following guidelines shall govern approval for change or variation orders:

i. Change Orders resulting from design errors, omissions or nonconformance with the performance specifications and parameters and the contract documents by the contractor shall be implemented by the contractor at no additional cost to the procuring entity.

ii. Provided that the contractor suffers delay and/or incurs costs due to changes or errors in the procuring entity's performance specifications and parameters, he shall be entitled to either one of the following:

a. an extension of time for any such delays under Section 10 of Annex "E"; or

b. payment for such costs as specified in the contract documents, provided, that the cumulative amount of the variation order does not exceed ten percent (10%) of the original contract price.

2.1.8.6. The contract documents shall include the manner and schedule of payment specifying the estimated contract amount and installments in which the contract price will be paid.

2.1.8.7. The contractor shall be entitled to advance payment subject to the provisions of Section 4 of Annex "E".

2.1.8.8. The procuring entity shall define the quality control procedures for the design and construction in accordance with agency guidelines and shall issue the proper certificates of acceptance for sections of the works or the whole of the works as provided for in the contract documents.

2.1.8.9. The contractor shall provide all necessary equipment, personnel, instruments, documents and others to carry out specified tests.

2.1.8.10. All design and build projects shall have a minimum Defects Liability Period of one (1) year after contract completion or as provided for in the contract documents. This is without prejudice, however, to the liabilities imposed upon the engineer/architect who drew up the plans and specification for a building sanctioned under Article 1723 of the New Civil Code of the Philippines.

2.1.8.11. The contractor shall be held liable for design and structural defects and/or failure of the completed project within the warranty periods specified in Section 62.2.3.2 of the IRR.

2.2. GUIDELINES FOR ORAL PRESENTATION

2.2.1. Each presenting bidder will be given a maximum of two (2) hours for their oral presentation, 1 ½ hour of which will be allotted for the question and answer. The presence of the designer during the oral presentation is highly encouraged to be able to resolve any technical questions that may arise.

2.2.2. In order to achieve a more dynamic discussion, face-to-face presentation is highly encouraged but not required. Should the bidder opt for a face-to face presentation, please coordinate with the BAC Secretariat at email bac@zcwd.gov.ph. However, in adherence to the Health Protocols implemented by the local IATF, bidders/presenters will be limited to two (2) persons. The bidder may opt to present their design via an online platform.

2.2.3. The presentation materials may include but not limited to the following: company profile, design and specifications of the facility, construction approach and methods, facility features not specified in the SOW, green and climate resiliency features of the facility design, and others that may enhance the merits of the technical proposals. Maps may be used if needed.

2.2.4. The presentation must focus on the process and the technology offered, particularly on the mass balance of the proposed treatment process and the structural and architectural layout. It should explain how the present system, with a capacity of 4,000 cmd, will be expanded to 6,000 cmd.

2.2.5. Bidders/presenters are requested to submit their presentation in PDF/PPT format to the BAC Secretariat at email bac@zcwd.gov.ph one (1) day before the scheduled oral presentation. The file must be password protected to ensure the integrity of the presentation and that the file may be opened only immediately before the time allotted for the bidder to present.

2.2.6. The presentation will use MS PowerPoint or PDF and should not exceed 30 minutes. An hour and a half (1 ½) will be allotted for questions and answers. The presenter-bidder is expected to provide the answers during this allotted time.

2.3. CONTRACT IMPLEMENTATION REQUIREMENT

Upon award of the design and build contract, the winning bidder shall also submit, together with the detailed engineering requirements:

2.3.1.1. Projection of the Monthly Operating Expenses for the next twenty-five (25) years and the replacement cost for the next twenty-five years using the 10% discount rate over the life of the project for 25 years.

2.3.1.2. In relation to the Projected Monthly Operating Expense computed for the next 25 years, the following shall also be submitted as a functional guarantee which shall form part of the contract:

b.1 Guaranteed Power Consumption

Power Usage	kW/m^3 wastewater		kW/day	
	0-1.59 MLD	2-4 MLD	0- 1.59 MLD	2-4 MLD
Base Power (not influenced by inlet flow)				
Main process (liquid stream)				

Power Usage	kW/m^3 wastewater		kW/day	
	0-1.59 MLD	2-4 MLD	0- 1.59 MLD	2-4 MLD
Sludge Treatment				

b.2 Guaranteed Chemical Consumption

Chemical Usage	L/m^3 wastewater		L/day	
	0- 1.59 MLD	2-4 MLD	0-1 MLD	2-4 MLD
Main process (liquid stream)				
Sludge Treatment				

b.3 Guaranteed Sludge generation

Sludge generation	m^3 sludge/m^3 wastewater		m^3 sludge/day	
	0- 1.59 MLD	2-4MLD	0- 1 MLD	2-4 MLD
Sludge				

2.3.1.3. The following shall be the basis in the preparation of the following item:

- Electricity/Fuel = follow the rates of ZAMCELCO/DTI
- Manpower = follow DOLE Standards for Region IX at the time of bid
- Chemicals = DTI

2.3.1.4. The bidder should provide end-user certification or performance data stating that a similar sewage/wastewater treatment system being offered in the bid has been satisfactorily operating continuously; except during plant shut-down for maintenance purposes or due to force majeure where the operation has to be stopped to prevent damage. It must show the compliance of the effluent discharged to the DENR Standards all throughout

its operation excluding the testing period. Failure to comply with this requirement is a ground for technical disqualification.

2.3.1.5. The above requirements shall be submitted together with the other contract implementation requirements under Sec. 13, Annex "G" of R.A. 9184.

2.4. CONCEPTUAL DESIGN

2.4.1. The treatment process may include the pre-treatment, primary, secondary and tertiary treatment of the wastewater. Technologies being offered by the contractor may omit or change to its equivalent any of the mentioned processes, provided that the discharge of wastewater into water bodies is compliant with the effluent standards.

2.4.2. ***Pre-treatment*** may include at the minimum, screens, grit removal, flow equalization, oil and grease removal.

2.4.3. ***Primary Treatment*** may include at the minimum, primary settling basins, primary sedimentation tanks or primary clarifiers.

2.4.3.1. The purpose of requiring primary treatment of the wastewater is to remove floating and settleable solids in the wastewater. If the proposed treatment process has an equivalent process that meets the same objective of reducing floating and settleable solids in the wastewater, then a primary settling tank can be dispensed with.

2.4.3.2. The proposal to dispense the primary sedimentation tank will be considered if it complies with the intended purpose of the primary sedimentation tank, which is to remove floating and settleable solids in the wastewater, if this be the case, then a primary settling tank can be dispensed with.

2.4.4. ***Secondary treatment*** may either be a fixed film or attached growth systems, suspended-growth systems or a hybrid or combination thereof.

2.4.5. ***Tertiary treatment*** may include disinfection or effluent polishing before finally discharging to the Magay Creek or reclamation for reuse.

2.4.6. ***Sludge Treatment*** may either be belt press, screw press, filter press, centrifuge or volute.

2.4.7. ***Septage Acceptance Unit*** capable of accepting, screening and pre-treating septage conveyed by vacuum trucks.

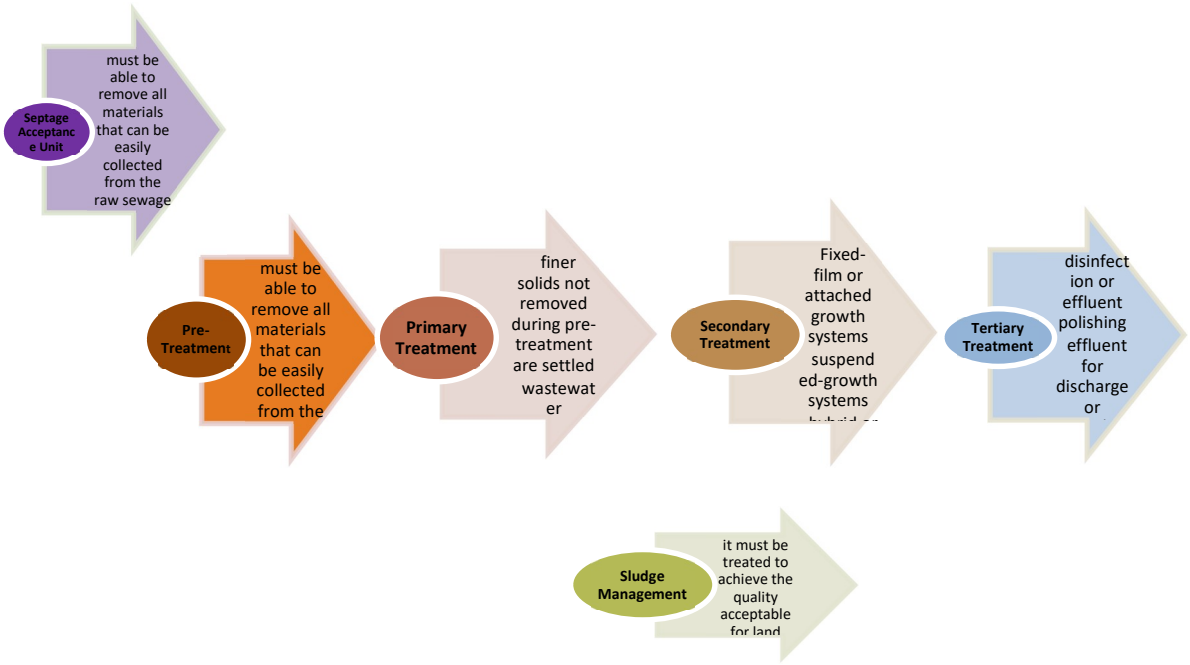


Figure 1 Conceptual Design for the Septage and Sewage Treatment Plant

2.4.8. The following facilities must also be included in the project:

- Guard House
- Administration Building (Office, Conference Room, Storage Room (for chemicals) and Laboratory)
- Control Room
- Electromechanical Room
- Force Main/Sewer Pipe connecting the West Pumping Station and the STP
- Storage (for tools and for dried sludge)
- Perimeter Fence
- Perimeter/Plant Lighting
- Parking Space, Driveway and landscaping works
- Equipment Lifting Facilities
- Generator Room
- Storage Tank for Recycled Water (capacity: 100 cubic meters)

2.4.9. In the event that there are other structures not stated in the above list but which are necessary to the complete and successful operation of the bidder's designed STP, the same shall be constructed with no additional cost to the ZCWD, notwithstanding the award of the contract.

2.4.10. In addition to the above facilities, the following support system must also be included:

- Potable Water Supply System
- Drainage System
- Service/Recycle Water Supply System
- Electrical, Control, Monitoring and Instrumentation System
- Generator System
- SCADA (Supervisory Control and Data Acquisition)
- Surveillance camera/Closed Circuit Television (CCTV) showing all critical areas of the STP
- Personal Protective Equipment (PPE) and other safety device in the plant per Occupational Safety and Health standards
- Install new motor pumps at West Pumping Station ~~with a pipeline~~ that can transfer the six (6) MLD wastewater from West Pumping Station going to the proposed SSTP through the proposed sewer pipeline connecting pumping station and SSTP

  The following is the detail of the existing pumps at West Pumping Station:

Pump & Motor	**Brand**	**Date Installed**	**Issues and Concern**
1 Unit of 7.5 hp, 220 Volts, 19 Ampere, 3 phase at 8675 RPM, Multi Stages Pump with 550 GPM Capacity	Fairbanks Morse	1938	Only 1 unit are running but all motors are rewind multiple times. The pump shafting had bead milled and fabricated multiple times also. the pumps bearing is replaced quarterly due to shafting misalignment. ***(2 units are already defective)***

2.4.11. In making the design, reference should be made to the list of codes and standards herein stated and such other applicable standards and guidelines, local or international.

2.5. PREPARATION OF BILL OF QUANTITIES, DETAILED ESTIMATES AND PAYMENT

2.5.1. The preparation of the Bill of Quantities and Detailed Cost Estimates shall be in accordance with the attached Bill of Quantities (BOQ) format and shall follow DPWH DO 197 Series of 2016 or the latest issuance as specified in below. The quantity in the Bill of Quantities (BOQ) shall be consistent with the Detailed Cost Estimate and shall be categorized into major components, the detailed resources for each scope of work should be provided therein, to wit:

2.5.1.1. **GENERAL REQUIREMENTS** – this shall include but not limited to the Mobilization and Demobilization, Construction Safety and Health Program, Construction of Temporary Facilities. ZCWD will assist in coordination with the appropriate agencies to secure the necessary permits.

2.5.1.2. **PLANNING AND ENGINEERING DESIGN PHASE** – includes the planning and engineering design phase of the project.

2.5.1.3. **CONSTRUCTION PHASE-** includes the earth works, civil works, electrical works, mechanical works on treatment process, instrumentations and automations.

2.5.1.4. **TURNOVER PHASE-** includes the testing and commissioning of the SSTP, the conduct of one year proving period which includes the needed manpower, chemical and energy costs, turnover of the laboratory tools and equipment, office equipment and other items that needs to be turned over per the Performance Specifications.

2.5.2. In the preparation of the estimates, the following shall be considered:

2.5.2.1. The Estimated **DIRECT COST** shall consist of the following:

2.5.2.1.1. ***Cost of materials*** to be used in doing the work item called for, which shall include, inter alia, the following:

- Cost at source, including processing, crushing, stockpiling, loading, royalties, local taxes, construction and/or maintenance of haul roads, etc.
- Expenses for hauling to project site.
- Handling expenses.
- Storage expenses.
- Allowance for waste and/or losses, not to exceed 5% of materials requirement.

2.5.2.1.2. ***Cost of Labor*** this shall include the following:

- Salaries and wages, as authorized by the Department of Labor and Employment.
- Fringe benefits, such as vacation and sick leaves, benefits under the Workmen's Compensation Act, GSIS and/or SSS contributions, allowances, 13th month pay, bonuses, etc.

2.5.2.1.3. ***Equipment Expenses.***

Rental rates of equipment shall be based on the prevailing "Association of Carriers and Equipment Lessors, (ACEL) Inc." approved for use by the DPWH (Presently it is the 2014 ACEL Rates). Rental rates of equipment not indicated in the ACEL booklet shall be taken from the rental rates prepared by the Bureau of Equipment. For simplicity in computation, the operated rental rates are preferred over the bare rental rates as the former includes operator's wages, fringe benefits, fuel, oil, lubricants and equipment maintenance. The make, model and capacity of the equipment should be indicated in the detailed unit cost analysis.

2.5.2.2. The ***INDIRECT COST*** shall consist of the following:

2.5.2.2.1. ***Overhead Expenses*** which include the following:

- Engineering and Administrative Supervision.
- Transportation allowances
- Office Expenses, e.g., for office equipment and supplies, power and water consumption, communication and maintenance.
- Premium on Contractor's All Risk Insurance (CARI).
- Financing Cost such as Premium on Bid Security, Premium on Performance Security, Premium on Surety for Advance Payment, Premium on Warranty Bond (one year)
- Fees, Permits and clearances
- Provision of service vehicle

2.5.2.2.2. ***Contingencies*** -this includes the following:

- Expenses for meetings, coordination with other stakeholders, billboards (excluding Project Billboard which is a pay item under the General Requirements), stages during ground breaking & inauguration ceremonies, and other unforeseen events.

2.5.2.2.3. ***Miscellaneous Expenses*** - These include laboratory tests for quality control and plan preparation.

2.5.2.3. **Contractor's Profit Margin**

The margin of contractor's profit shall be in accordance with the table below. The profit is computed as the profit mark-up multiply by the Estimated Direct Cost.

2.5.2.4. ***Value Added Tax (VAT) Component*** – which shall be the five (5) percent of the summation of Estimated Direct Cost, Overhead**,** Contingencies & Miscellaneous (OCM) and Contractor's Profit.

2.5.2.5. The following items shall not be subjected to OCM and Profit mark-up:

- Mobilization and demobilization

2.5.2.6. The following non-civil works items shall not be subjected to OCM mark-up:

- Field/Laboratory Office & Living Quarters (Rental Basis)

- Furnishing of Furniture, Laboratory Equipment, Survey Equipment and Consumables
- Assistance to the Engineers
- Photographs
- Health and Safety
- Environmental Certificate
- Traffic Management
- Communication Equipment, etc.

2.5.2.7. All materials specification stated herein shall be incorporated in the estimate.

2.5.2.8. The detailed estimates for this project shall not exceed with the following mark-ups.

Estimated Direct Cost	OCM	Profit	Value Added Tax (VAT)
Above P50Million to 150Million	**10%**	**8%**	**5%**
Above P150Million	**8%**	**8%**	**5%**

Per: DPWH D.O. No. 197, Series of 2016

2.5.3. **PAYMENT**

All costs that will be incurred for General Requirements, Planning and Engineering Design Phase, the Construction Phase, Turnover Phase, shall be to the account of the contractor. Power consumption, chemicals, third-party laboratory testing during these phases of the project shall be borne by the contractor. **Moreover,** materials and equipment as part of the items of work which have been delivered on site but not yet installed or in-placed, shall not be paid; unless the said materials and equipment have been used, utilized or consumed to complete an item of work. The payment shall be based on the quantity accomplished of the item of work as stipulated in the BOQ. For each component of work shall be paid in the following manner:

1. **GENERAL REQUIREMENTS –** payment for General Requirements or the Non-Engineering Works shall be by progress billing the manner by which shall be in accordance with Sec. 5 of Annex E of the Revised IRR of RA 9184. No payment will be made unless all documentary requirements stated therein has been complied with.

2. **PLANNING AND ENGINEERING DESIGN PHASE -** payment for the component on the planning and design phase shall be by progress billing the manner by which shall be in accordance with Sec. 5 of Annex E of the Revised IRR of RA 9184. No payment will be made unless all documentary requirements stated therein has been complied with.

3. **CONSTRUCTION PHASE -** all civil structures that are not integral part of the treatment process (i.e., fence, office building, etc.), and all fixed structures which are integral part of the process (i.e., tanks, basins) may be billed in progress. On the other hand, Mobile Treatment Facilities/Modules, electro-mechanical and mechanical works that are integrated to the treatment process shall not be billed unless the process performance requirements have been complied with pursuant to Treatment Plant Performance and Effluent Requirements of the Performance Specifications and Parameters.

4. **TURNOVER PHASE-** Payment for the turnover of items such as laboratory equipment and tools, and the office equipment as stipulated in the *Performance Specifications and Parameters* shall be made when the items have been delivered and inspected by the ZCWD that the same have complied with the requirements. Mobile Treatment Facilities/Modules, electro-mechanical and mechanical works that are integrated to the treatment process shall comply first with the performance requirements before payment shall be made. However, the payment for testing the performance shall be made after the submission of Completion/Commissioning Certificate issued by the authorized ZCWD officials along with the billing statement. Further, the payment for the proving period shall be made after the submission of Final Acceptance Certificate issued by the authorized ZCWD officials along with the billing statement.

2.5.3.1. The total direct cost shall include the Materials Cost, Labor Cost and Expenses of Equipment to be used in project implementation. OCM, Profit and VAT shall be consistent with the DPWH DO 197 Series of 2016.

2.5.3.2. Provision for subcontracting shall be in accordance with the Philippine Bidding Document (PBD) and the requirements of this bid.

2.5.3.3. The estimates shall contain the correct list of materials to be used for the certain item of work. Unit costs of the same item with same specs, and model shall be consistent otherwise the lowest unit cost will be used in the computation/ arithmetical corrections.

2.5.3.4. The number of pumps, equipment or devices which shall be used in the project must be consistent with the submitted conceptual design, estimates/BOQ of the bidder.

2.5.3.5. The Estimates and the BOQ must be consistent. Per Section 32.2.3 of the revised IRR of RA 9184, in case of discrepancies between: (a) bid prices in figures and in words, the latter shall prevail; (b) total price per item and unit price for the item as extended or multiplied by the quantity of that item, the latter shall prevail; (c) stated total price and the actual sum of prices of component items, the latter shall prevail; (d) unit cost in the detailed estimate and unit cost in the bill of quantities, the latter shall prevail.

2.5.3.6. Per NPM 090-2014, Generally, the Procuring Entity's evaluation of bids shall only be based on the bid price quoted in the Financial Bid Form. However, if there is a discrepancy in the amount in the bid form and other documents, where the amount in the bill of quantities, detailed estimate and cash flow are similar, the prevailing bid price shall be determined upon consideration of the rules provided in Sections 32.2 and 34.4 of the revised Implementing Rules and Regulations (IRR) of Republic Act (RA) No. 9184. The bid form which shall be submitted shall indicate **"Zamboanga City Water District"** as the Procuring Entity.

3. DESIGN REQUIREMENTS

3.1. GENERAL PROVISIONS

The Contractor shall be responsible for obtaining all necessary information as to risks, contingencies and other circumstances which may affect the works and shall prepare and submit all necessary documents specified by the procuring entity to meet all regulatory approvals as specified in the contract documents.

3.2. GEOTECHNICAL INVESTIGATION OF THE PROJECT SITE

Please refer to the attached Geotechnical Investigation Report (Annex 5). As integral part of the bidding documents for the soil condition at the site. The depth of sheet piling during excavation shall be at the point that it will protect the adjacent structures/building as well as those who are working in the project. As well as the foundation design of the SSTP shall be design in accordance with the attached Geotechnical Investigation Report.

3.3. DESIGN PARAMETERS

3.3.1. GENERAL CONSIDERATIONS

3.3.1.1. The SSTP shall be capable of treating 4,000 cubic meters per day of sewage collected from the existing ZCWD sewerage system. Its capacity must be expandable to up to 6,000 cubic meters per day. The diameter of the proposed pipeline from West Pumping Station to the proposed SSTP as well as the new motor pump (to upgrade the existing motor pump) shall be designed to carry the 6.000 cu.m./day wastewater from West Pumping Station going to the proposed SSTP.

3.3.1.2. The proposed SSTP shall treat sewage collected from the East and West Pumping Station collected from its current service area. Accumulated sewage from the East and West Pumping Station will be pumped from the West Pumping Station to the Sewage Treatment Plant. The construction of the connecting pipeline must be undertaken by the winning bidder. Attached is a reference design for the force main connected from the West Pumping Station to the STP (Annex 8 - Reference Design and Drawings). The contractor shall also undertake the upgrading and improvement of the pumps at the West Pumping Station to ensure its full workability in pumping sewage to the STP.

3.3.1.3. In addition, the SSTP shall be capable of treating at least 15 cubic meters of septage collected from ZCWD concessionaires within the sewered area but are not connected to the sewerage system. The pre-treated septage may be combined with sewage during the secondary treatment of the wastewater.

3.3.1.4. Should the bidder propose the installation of Pipeline (Sewer line) above and along the riverbank, then, it shall be upon the bidder designer's discretion based on sound engineering will be allowed subject to approval and/or issuance of permits by concerned government agencies. The pipeline diameter and the new motor pump (to upgrade the existing motor pump) will be designed to have a carrying capacity of 6MLD.

3.3.1.5. The SSTP is receiving wastewater from the Central Business District. Bidders must study the project area and its customer profile for them to be able to come up with the most appropriate treatment design.

3.3.1.6. Project Duration: The expected date of completion of this contract, which includes the design, build, testing and commissioning, is six hundred and ten (610) calendar days from the receipt of Notice to Proceed. The one (1) year process proving period is excluded in the 610 calendar days. All necessary permits such as excavation, building permit, fencing permit, and electrical permit, among others shall be included in the 610 calendar days project duration.

3.3.1.7. Discussions regarding the allowable working hours of the project for the reason that establishment of religious groups that is located near the project, which may cause disturbances to any activities of the said group whereby affects the working hours of the project. This concern can be arranged during the project Implementation stage in coordination with the City of Zamboanga.

3.3.1.8. The project shall be constructed within the allotted 2,196.00 square meter area as defined in the Memorandum of Agreement (see attached Annex). A copy of the said MOA will be furnished for the guidance of the winning bidder.

3.3.1.9. The processes and facilities shall be designed to meet the performance requirements of the overall treatment plant. In particular, the interconnections between various equipment and processes, support system and other structures must be an integrated approach, which meets operational performance, flexibility, maintenance and reliability criteria.

3.3.1.10. It is intended that this STP shall be suitable in every way for the service required, and the Contractor shall design and supply all materials, labor,

equipment and do all work which may be reasonably implied as being required, at no additional cost to ZCWD.

3.3.1.11. The winning bidder shall design an STP that will continuously treat sewage coming from the existing ZCWD sewerage network and septage collected from ZCWD concessionaires. They shall make the necessary verification as to the flow and quality of the sewage that will be treated. The design capacity of the STP shall not be lower than 4,000 cubic meters per day, expandable to 6,000 cubic meters per day.

3.3.1.12. In designing the STP, reference must be made to the Geotechnical Investigation of the project site. The result of this study is also attached in this document. The type of cement to be used must consider the presence of chloride, sulphate and organic soil in the project site.

3.3.1.13. The tanks which will be constructed for the various stages in the treatment process must be so designed and constructed as to ensure its integrity and stability of the surrounding structures. Furthermore, it must be resilient from ground water or salt water intrusion.

3.3.1.14. The design shall also ensure that there is applicable odor control in the STP. Odor must be controlled in such a way as it will not create a nuisance within the compound as well as to its neighboring areas.

3.3.1.15. During low flow conditions, the treatment process must be able to cope with the diminished quality and quantity of the sewage. Otherwise, the bidder must specify the minimum flow and quality which the system can accommodate. The bidder must also specify the maximum flow which the system can accommodate during high flow events or sudden change in flow.

3.3.1.16. Appropriate landscaping should be introduced to create an atmosphere of sanitation and eliminate the negative impression of sanitary facilities, like STPs. Waste receptacles, made of durable materials, must be properly labelled and strategically located at visible sites within the compound.

3.3.1.17. Site development of the STP shall ensure climate change resiliency based on a 20-year projection. It must be so designed as to incorporate green innovations such as, but not limited to, the reuse of treated wastewater, use of solar panels for the perimeter and parking lighting. Landscaping must be such that the negative impressions of sanitary

facilities will be eliminated and an ambiance of cleanliness and harmony with nature will be imbibed. The overall architectural and structural design, as well as the landscaping of the STP should not only fit within the allotted area but must also be climate change resilient based on a 20-year projection and is environmentally sustainable.

3.3.1.18. Storm drainage shall be designed on the basis of a 20-year flood and storm surge projections. It shall include all necessary physical interventions/improvements, even outside the STP property boundaries, to ensure that storm water is conveyed to an acceptable existing to drainage system.

3.3.1.19. Treated effluent from the STP shall be conveyed to the storm drainage system, provided that there is a means to monitor effluent quality prior to discharge to the drainage system or if not feasible, provide a separate effluent line both of which will drain to the Magay Creek.

3.3.1.20. At the effluent drain, the contractor must provide a means of collecting effluent sample for regular effluent quality monitoring.

3.3.1.21. The facility must be structurally designed in accordance with NSCP 2015 edition or its latest edition, and in a manner which allows it to withstand flooding and storm surges. The table below shows the historical climatological extremes experienced in the city based on PAG-ASA records, which the contractor may use as basis for their design

Month	Temperature °C				Greatest Daily Rainfall (mm)		Highest Wind (mps)		
	High	Date	Low	Date	Amount	Date	SPD	DIR	Date
JAN	35.5	01-23-2002	15.8	01-22-1965	128.0	01-23-1916	22	NE	01-30-1982
FEB	35.5	02-28-2010	15.6	02-27-1905	156.5	02-26-1928	16	SSE	02-01-1988
MAR	36.0	03-26-2002	17.5	03-10-1911	79.6	03-21-2010	17	NNE	03-05-1972
APR	36.9	04-22-1987	16.7	04-07-1967	106.0	04-30-2004	14	W	04-22-1990
MAY	36.1	05-24-1987	20.7	05-11-1954	88.9	05-13-1990	20	NE	05-09-1978

JUN	36.0	06-05-2010	20.4	06-02-1904	123.5	06-20-2008	21	W	06-23-1984
JUL	35.2	07-07-1988	20.0	07-18-1958	140.4	07-09-1940	20	WSW	07-21-1989
AUG	35.7	08-31-1992	19.0	08-12-1917	136.6	08-29-1952	23	ENE	08-17-1988
SEP	35.8	09-02-2004	19.9	09-07-1911	193.2	09-29-1990	22	W	09-13-1986
OCT	36.0	10-01-1999	18.4	10-05-1955	199.1	10-09-2001	23	WSW	10-06-1984
NOV	35.5	11-11-1988	18.5	11-11-1910	163.3	11-27-1955	22	W	11-07-1988
DEC	35.2	12-13-2004	16.7	12-28-1950	161.0	12-02-1910	18	NE	12-22-1992
ANNUAL	36.9	04-22-1987	15.6	02-27-1905	199.1	10-09-2001	23	ENE	08-17-1988
Period of Record	1903-2010				1902-2010		1950-2010		

- Reference: PAG-ASA Climatological Data as of 2010.

Table 1 Climatological Extremes Data in Zamboanga City as of 2010

	Observed baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**
Seasonal temperature increases (in °C) in 2020 and 2050 under medium-range emission scenario in provinces in Region 9												
ZAMBOANGA DEL NORTE	27.0	27.9	27.6	27.5	1.0	1.1	1.1	1.0	2.0	2.1	2.2	2.0
ZAMBOANGA DEL SUR	26.8	27.6	27.3	27.2	0.9	1.1	1.0	1.0	1.9	2.1	2.0	1.9
ZAMBOANGA SIBUGAY	27.1	27.9	27.5	27.5	1.0	1.0	1.0	1.0	2.0	2.0	1.9	2.0

Seasonal temperature increases (in °C) in 2020 and 2050 under medium-range emission scenario in provinces in Region 9												
ZAMBOANGA DEL NORTE	324.5	279.7	599.1	718.1	11.0	3.2	-3.2	13.8	2.6	1.7	-0.7	5.4
ZAMBOANGA DEL SUR	294.5	298.7	593.5	663.2	11.2	2.2	-0.4	13.8	3.6	0.0	9.9	7.1
ZAMBOANGA SIBUGAY	284.1	290.5	597.2	674.1	9.9	6.6	6.5	14.8	4.8	10.3	22.0	8.9

Frequency of extreme events in 2020 and 2050 under medium-range emission scenario in provinces in Region 9										
	STATIONS	No. of days w/ Tmax >35°C			No. of Dry Days			No. of days w/ Rainfall >150mm		
		OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
ZAMBOANGA DEL NORTE	Dipolog	217	2155	4004	7481	5384	5470	10	13	9
ZAMBOANGA DEL SUR	Zamboanga	54	114	714	8531	7058	6781	1	8	9

Reference: Climate Change in the Philippines, February 2011, PAG-ASA

Table 2 Climate Projections in 2020 and 2050 in the Provinces in Region IX

Note: Zamboanga Sibugay, use values of Zamboanga City
OBS – Observed Baseline

3.3.1.22. The contractor should also establish protocols for various scenarios when water level rises at the creek or in cases of sudden changes in and extreme weather conditions. A document which reflects these protocols must be submitted during commissioning.

3.3.1.23. The process technology must be capable of addressing extreme cases of salt water intrusion. It must also take into consideration incidence of salt water intrusion by backflow in the outfall system.

3.3.1.24. There has been no record of salt water intrusion by the ZCWD but when the case it happens this aspect is entrusted to sound discretion of the bidder. Should this happen during the process proving, the elected technology must still be able to provide an effluent that complies with relevant DENR Administrative Orders.

3.3.1.25. The system must be flexible to accommodate wastewater from commercial establishments draining to the sewerage system.

3.3.1.26. The STP must be designed for a maximum total plant shutdown time of 4 hours per year for corrective maintenance.

3.3.1.27. At least two process modules must be provided to allow the plant to operate with at least half the desired efficiency during equipment replacement or maintenance servicing. All process equipment, including those for which the whole STP is dependent for full operation, must be provided with standby. The overall plant power efficiency must be in tune to the frequent power outage in the city.

3.3.1.28. It must have a disinfection unit capable of eliminating pathogenic microorganisms in the effluent prior to discharge. It must result to the wastewater being treated with a quality compliant with the standards for re-use.

3.3.1.29. A chlorine contact tank may be included to provide disinfection to meet the microbiological standards of DAO 2016-08 for Total Coliform and Fecal Coliform. Measures should be incorporated to eliminate residual E. coli in the re-use water.

3.3.1.30. It must be operated at minimum chemical addition, aeration and maintenance without compromising compliance to effluent limits.

3.3.1.31. All materials necessary to complete the works required during the commissioning and process proving shall be supplied and be included in the bid.

3.3.1.32. Survey and Mapping and other data are provided in this Performance Specifications through Annexes as reference only. Per Section 7 of Annex "G" of the IRR of RA 9184, the procuring entity does not guarantee that these data are fully correct, up to date, and applicable to the project at hand. The contractor is responsible for the accuracy and applicability of all data, including the above, that it will use in its design and build proposal and services.

3.3.2. CIVIL, STRUCTURAL AND ARCHITECTURAL

3.3.2.1. Considering the soil bearing capacity of the project site based on the results of the Geotechnical Investigation, bored piling shall be the method employed in the installation of piles, unless a safer and more appropriate method may be used, Provided, that when the contractor recommends for a safer method other than bored piling, the contractor shall secure prior approval from ZCWD in writing. The contractor must exercise due diligence in the execution of this works considering the existing structures in the vicinity of the project site. Any damage to the neighboring structures which may be incurred as a result of the piling activity, the contractor shall be held liable thereto.

3.3.2.2. Sheet Piling shall be provided during excavation works. It shall comply with the standards set by the Department of Public Works and Highways.

3.3.2.3. **Access and Support Facilities:** Access and Support facilities shall be provided by the contractor and designed in accordance with B.P. 334 National Building Code, the National Structural Code, and Occupational Safety and Health Standards. It shall include at the minimum the following:

- Walkways and Platforms
- Access Stairway or Ladder
- Handrails
- Lighting, Ventilation and Hoisting

3.3.2.4. **Control Room:** Control room must be provided for centralized operations management and control of the STP. Location of the control room must be such that it overlooks the major areas of the overall facility. It must include a sufficient work station space for at least three staff, storage space for all plant data, drawings, manuals and records, at least two personal computers allocated to the plant control system complete with set of network servers and digital storage devices. It must include a computer network linked to the administration building network covering an

additional work station complete with personal computer, an A3 laser printer, uninterruptible power supply and full suite of office software.

It must include adequate staff amenities, air conditioning, power, lighting, telecommunications, fire extinguishers, water supply and sewerage services for the building with suitable connection to emergency power generation to ensure safety.

3.3.2.5. **Administration Building & Laboratory:** The total floor area for this structure shall be at least 120 square meters. An administration building shall be provided which includes a covered front entrance, pantry, reception area, office for the managers, a conference room accommodating at least 10 people, first aid room with first aid kits, storage cabinets, wheeled stretcher and adequate doorways for rapid movement, records storage room, male and female amenities for office staff, change rooms with showers, lockers for 7 employees. It should include, but not limited to, the following:

- Storage room
- Electrical switch room –Rooms for air conditioning equipment and standby generator –Locker room complete with lockers for 7 personnel

The specifications herein indicated shall be without prejudice to applicable guidelines particularly the latest edition of the following standards, National Building Code, Mechanical Engineering Code, B.P. 334 and the Philippine Electrical Code.

3.3.2.6. The offices shall be provided with telephone and LAN systems, in addition to equipment monitoring and control systems to be installed in the control room.

3.3.2.7. It must include adequate air conditioning, power, lighting, water supply and sewerage services for the building with suitable connection to emergency power generation to ensure safety. It must comply with the guidelines under the Revised National Building Code on fire egress and the Fire Code of the Philippines.

3.3.2.8. The building must be equipped with all necessary office equipment and furniture including computer network covering all office workstations complete with desktop personal computers, A3 laser printers, photocopiers, facsimile machines, internet connections, scanners, uninterruptible power supply and required office software.

3.3.2.9. The entire facility must be equipped with wireless surveillance camera system capable of capturing the audio and video details of the 24 hours activities all throughout the year. Also, it can be viewed online by the ZCWD authorized user.

3.3.2.10. **Toilet and Pantry**: Toilet and Pantry wastewater must be conveyed to the STP. Re-use water should be used for sanitary purposes. On the other hand, potable water should be used at the Pantry.

3.3.2.11. **Laboratory**: A laboratory must be provided on-site to conduct regular monitoring of the following effluent parameters in compliance to Water Quality Guidelines and General Effluent Standards of 2016 of DENR Administrative Order No. 2016-08, (w/ instrumentation):

- BOD_5
- TSS
- Fecal Coliform
- Nitrate
- Phosphate
- Ammonia
- Surfactants
- Oil and Grease
- Moisture Content of Solids/Sludges
- Microbiological Analyses

3.3.2.12. This project is for a design and build contract. Thus, consistent with No. 7 Annex "G" of the IRR of R.A.9184, the contractor is responsible for the accuracy and applicability of all data that it will use such as influent parameters among others in its design and build proposal and services. Thus, it is incumbent upon the bidders to secure such data.

3.3.2.13. All laboratory facilities and equipment shall be provided, including but not limited to, exhaust hood systems, chlorine dosing and laboratory safety and emergency facilities (shower, sprinkler, etc.). All such facilities and equipment shall be in accordance to applicable standards. A certification to that effect must be presented. Laboratory design must be in accordance with the laboratory safety design guidelines.

3.3.2.14. **Electromechanical Room**: If the treatment facility requires an electromechanical equipment, it must have a minimum floor area of 33.47 square meters.

3.3.2.15. **Perimeter Fence**: The perimeter fence shall be of full masonry with a minimum height of at least 2.40 meters from finished floor line of the driveway.

3.3.2.16. **Guard House:** A security building shall be provided near the gate of the STP. It shall serve as a control for incoming and outgoing vehicles, staff and visitors, and a base for all security personnel. A telephone line system shall be installed therein. It shall have a minimum area of at least 3.00 square meters

3.3.2.17. **Parking Space**. It must be able to accommodate at least three (3) 4-wheel vehicles, wherein 1 slot is allotted for PWDs.

3.3.2.18. **Utilities**: Power and water supply facilities to be provided will include tapping/interconnection to nearest ZAMCELCO power line and water supply line. Continuous water supply storage shall be provided.

3.3.2.19. A recycled water system using disinfected water from the STP system shall be provided. Pressure filters with automatic backwash shall be installed to improve water quality prior to distribution. Backwash shall be directed to the STP.

3.3.2.20. Recycled water shall be used for watering landscape, truck/tanker washing, toilet flushing, and for specific processes that allow use of recycled water. The required pipe network for such purposes shall be provided.

3.3.2.21. Recycled water outlets and exposed pipe segments shall have adequate labels and warnings. Pipes shall be of a specific color different from other pipes conveying different fluids/materials. Hose bibs for landscape watering shall be installed inside a lockable vault.

3.3.2.22. Recycled water must be contained in a 100 cubic meter storage tank which will be situated in an area easily accessible to water tankers. This storage tank must not require pumping to convey recycled water in it. Hosing and fittings and other appurtenances for the conveyance and use of the reclaimed water shall be provided. Its quality must be compliant with the physical, chemical and bacteriological parameters under Department of Agriculture Administrative Order No. 35. Storage for recycled water with a capacity of at least 20 cubic meters per day for the internal use of the facility must be provided on-site. The remaining 80 cubic meters shall be made available to PPA and the City Government for their use.

3.3.2.23. Back-up power shall be provided for the provision of the continuous operation of the facility. Diesel storage shall be sufficient to provide 48 hours of continuous operation. Fuel storage must comply with the Occupational Safety and Health guidelines (OSH yellow book).

3.3.2.24. The Genset room shall depend on the size or capacity of the generator that will be designed by the contractor base on the total connected load of the entire system. Oil discharge of the genset shall be properly disposed and compliant according to the environmental standards.

3.3.2.25. Notwithstanding the above provision, the following shall be the minimum requirements for interior finishes of floor, wall and ceiling, exterior finishes and for doors and windows with quality and workmanship acceptable to the engineering practices:

Room Designation	**Interior Finishes**		
	Floor	**Wall**	**Ceiling**
Administration Office	Granite tiles	Plain cement plaster painted finish	Painted finish cement fiber ceiling board with metal furring joist
Guard House	Granite tiles	Plain cement plaster, painted finish	Painted finish cement fiber ceiling board with metal furring joist
Screening and Degritting Room	Colored Hardened	Plain cement plaster painted finish	Painted finish, no ceiling, provide roof insulation
Genset Room	Elastomeric paint	Plain cement plaster painted finish	Painted finish, no ceiling, provide insulation
~~Pump/~~Electro-mechanical Room	Colored Hardened	Plain cement plaster painted finish	Painted finish no ceiling, provide roof insulation
Laboratory	Granite tiles	Plain cement plaster painted finish	Painted finish cement fiber ceiling board with metal furring joist
T & B	Ceramic unglazed tiles	Ceramic glazed tiles	Painted finish cement fiber ceiling board with metal furring joist

Sludge storage	Colored hardened	Plain cement plaster painted finish	No ceiling bd., provide roof insulation

Table 3 Architectural Finish of Floors, Walls and Ceilings

Description	Exterior Finishes
Concrete and Masonry	Acrylic solvent base paint
Wooden Surfaces	Acrylic solvent base paint
Steel surfaces	Acrylic paint
Ceiling	Acrylic solvent base paint

Table 4 Exterior Finishes

ROOM DESIGNATION	DOOR	WINDOWS
Office	Panel Door	Alum. Frame Sliding Window, Corrosion resistant
Guard House	Panel Door	Steel casement
Genset Room	Steel door, corrosion resistant, sound proofed	Metal louver, corrosion resistant
~~Pump/~~Electromechanical Room	Steel door, corrosion resistant, sound proofed	Metal louver, corrosion resistant
Laboratory	Panel Door	Alum. Frame sliding window, corrosion resistant
T & B	PVC Door	Steel casement, corrosion resistant
Sludge storage room	Panel door	Steel casement, corrosion resistant

Table 5 Schedule of Doors and Windows

3.3.3. MECHANICAL

3.3.3.1. The contractor shall be responsible in determining the parameters such as soil bearing capacity, weight of equipment among others, which shall be used in the pump, blower and other mechanical equipment foundation design.

3.3.3.2. Mechanical design and installations shall comply with the Philippine Mechanical Engineering Code;

3.3.3.3. The scope of works to be provided under this contract shall be enumerated in Schedule of Quantities and Unit Prices.

3.3.3.4. The contractor shall undertake the installation of pumps at the West Pumping Station to ensure its full workability in pumping sewage to the STP.

3.3.3.5. Should there be a need to propose a valve in this project, the said valve shall have a pressure rating of at least 16 bars supported by the brochure for it to withstand a hydrostatic pressure of 150psi., it doesn't need to undergo 150psi hydrostatic pressure at the SSTP. The valve shall be of either solenoid type, motorized or pneumatic valve.

3.3.3.6. The Contractor shall be responsible for the design, selection and procurement of all valves required under this project.

3.3.3.7. All electro-mechanical installations must be elevated, unless they are meant to be submerged. This is to avoid the said electromechanical equipment from being submerged in case of flooding. Generator unit/s shall be skid-mounted generator and must be sized according to the total connected loads of the entire system. It shall be installed/supplied with an automatic transfer switch (ATS). The objective is to ensure that all electromechanical installations are climate resilient and will be safe in case of flooding. If the genset housing will be at an elevation that will ensure that this will not be affected by flooding, the contractor may so offer and this will be considered.

3.3.3.8. **Equipment:** Whenever possible and applicable, all equipment shall be installed indoors for security purposes and to avoid undue exposure to weather. All buildings/rooms shall have closed sides.

3.3.3.9. **Flow Measurement:** Magnetic flow meters shall be installed in following locations:

- Influent to the STP;
- Any other point necessary for the efficient control of operations of the proposed facilities;

3.3.3.10. Flow meters flow rate unit display at the control station shall be in International System of Unit (S.I.), it shall be capable in displaying units in Liter per Second (lps) and Cubic Meter per Hour (cm/hr), while its total flow shall be capable in displaying units in Liter and Cubic Meter. Display of flow

rate and total flow shall also be displayed at each loading bay, visible to the vacuum tanker drivers and sludge acceptance operator. Resetting of total flow at each loading bay, by the sludge acceptance operator, shall be possible. Flow meter data shall be stored and processed to automatically generate daily and weekly load/flow reports. The storage capacity of Flowmeter Data Logger shall be at least 2 years at 15 minutes interval logging.

3.3.3.11. Fire sprinkler shall follow the National Fire Code of the Philippines.

3.3.3.12. Wherever the supply and installation of submersible centrifugal pump is called for by a pay item in the Schedule of Quantities and Unit Prices, it shall be construed to include all its accessories and/or appurtenances for maintenance and safety use.

3.3.3.13. **References**: This specification shall be read in conjunction with the applicable standards.

3.3.4. ELECTRICAL

3.3.4.1. Electrical design and installation works shall adhere to the latest edition of the Philippine Electrical Code;

3.3.4.2. The electrical/instrumentations control system shall include main and branch circuit breakers, starters, contactors, variable speed drives and reset buttons selector switches, push buttons and pilot lights, circuit control items for electrical control or liquid level control of the various plant components and all necessary wiring and conduits. All electrical/instrumentations controls shall be wired so that the plant equipment can be operated either manually or automatically using PLC to achieve the intended sequence of operation and for remote monitoring purposes and shall be enclosed in a steel type floor mounted cabinet. The system should be installed with Supervisory Control and Data Acquisition (SCADA) System. All electrical controls for all processes shall be at the Motor Control Centers and located in buildings. The Motor Control Center shall be air conditioned such that the control cabinets will not heat up.

3.3.4.3. Electrical components of mechanical equipment and systems shall be provided as necessary for complete and operable systems. Interconnecting

wires for factory wired-wired plant components shall be provided as an integral part of the plant.

3.3.4.4. The electric power would be 400V 3Phase/ 230V Single Phase to be sourced from the Zamboanga City Electric Company (ZAMCELCO). The contractor should provide the transformers that must be able to take into consideration future load especially when the plant should be operating at 6000 cu.m. per day already. Fault current calculation and load coordination must be presented. The initial energization deposit fee shall be bourn also by the contractor.

3.3.4.5. The reference Codes and Standards in the prefaces are applicable in respect of all the materials and workmanship of the items of works to meet with the *Performance Specifications* of the proposed SSTP.

3.3.4.6. **CODES AND REFERENCES**

This specification shall be read in conjunction with the applicable codes and references.

3.3.4.7. **TECHNICAL SPECIFICATION**

The following supply conditions apply:

Voltage:	13.2kV primary; 400V Three Phase / 230V Single Phase secondary
Frequency:	60 Hz
Phases:	3, 4 Wire
Neutral:	Earth Neutral Link at the star point of transformer
Control Voltage:	400V AC or 230V AC depending on the contractor's design

No other voltage shall be used unless approved in writing by ZCWD.

3.3.4.8. **CLIMATIC CONDITIONS**

Temperature:	Highest Maximum 45°C
Humidity:	Average annual range 72-95% RH non-condensing

3.3.4.9. **DEGREE OF PROTECTION**

3.3.4.9.1. The degree of protection as listed below shall refer to NEMA.

Switch Board:	NEMA 12
Control stations:	NEMA 12
Field Devices:	NEMA 3R

3.3.4.9.2. **Protection from Water**

- □ All outdoor equipment shall be fitted with a cover to provide effective protection against rain;
- □ All enclosures housing electrical equipment must be capable of preventing water penetrating to live parts. Design must take into account the likelihood of deliberate hosing in some locations;
- □ Enclosures having doors or removable panels exceeding 0.4 m2 in area should, where possible, be located indoors
- □ No electrical component is to be located where it will be permanently wet without authority from ZCWD;
- □ Thermostatically controlled low surface temperature heaters shall be provided where necessary to prevent condensation of water

3.3.4.10. **CORROSION PROTECTION**

3.3.4.10.1. Carbon steel conduits, ducting, cable ladders, 'unistrut', etc are all to be hot dip galvanized, suitably plated or manufactured from non-corrodible material;

3.3.4.10.2. Fixings such as screws, rivets, bolts, brackets, etc. are to be galvanized, suitably plated or manufactured from non-corrodible material;

3.3.4.10.3. Cubicles and enclosures must be manufactured out of mild steel. Carbon steel or glass filled polyester construction is permissible where indicated by ZCWD;

3.3.4.11. **LOW VOLTAGE SWITCH BOARD**

3.3.4.11.1. All equipment shall be designed, built, rated, tested and shall perform in accordance with the latest edition of the applicable Standards.

3.3.4.11.2. The switchboard shall be free standing, totally enclosed, multi cubicle type, and shall be constructed in mild or as specified.

3.3.4.11.3. All electrical cubicles and boxes shall be suitable for bottom cable entry and front access unless otherwise specified. Non- magnetic gland plated shall be supplied for all non-stainless-steel enclosures.

3.3.4.11.4. All doors shall swing about a vertical axis.

3.3.4.11.5. All enclosures mounted directly onto floors shall be supplied with a welded 75 mm RHS hot dip galvanized plinth. In wet process areas hot dip galvanized steel stands or legs shall be supplied.

3.3.4.11.6. The heat generated within the cubicle shall not cause the air temperature around the equipment to rise above the rating of this equipment. Air to air heat exchanges may be used if required but not with refrigeration units.

3.3.4.11.7. All control items shall be DIN rail mounted where possible.

3.3.4.11.8. No inflammable or hygroscopic materials shall be used.

3.3.4.11.9. In all cases, equipment shall be designed, rated, tested and shall perform in accordance with the latest edition of the applicable Standards

3.3.4.11.10. No equipment shall be mounted on the sides, top or bottom of the cubicle (internal light exempted).

3.3.4.11.11. All field wiring shall terminate via terminal rail blocks not connected directly to the control devices.

a. A minimum distance of 50 mm shall be allowed between cable ducting and equipment for the terminating of wires.

b. Conduit or cable entry shall not be made from the top.

c. Desired Starter

The Desire starter shall be dependent on the bidder/contractor's design that is based on standards of the latest edition of the Philippine Electrical Code and other codes as to meet the performance specifications of the proposed SSTP.

d. **Control Circuits**: The same as the desired starter, the control circuits shall be dependent on the bidder/contractor's design as to meet the performance specifications of the proposed SSTP.

e. **Soft Starters**

The soft starters shall be dependent on the bidder/contractor's design that is based on standards as to meet the performance specifications of the proposed SSTP.

□ **Monitoring:** The controller shall provide the following monitoring functions indicated through the built-in LCD display:

- Three phase line current
- Per phase current
- Phase-to-phase supply voltage
- Line voltages
- kWh

3.3.4.12. **LOW VOLTAGE FREQUENCY DRIVE**

3.3.4.12.1. The VFD shall be dependent on the bidder/contractor's design that is based on standards of the latest edition of the Philippine Electrical Code and other codes or regulations that is related to the VFD as to meet the performance specifications of the proposed SSTP.

3.3.4.12.2. The VFD shall maintain the line power factor at no less than 0.95, regardless of speed and load.

3.3.4.12.3. The VFD shall be capable of operating existing motor induction motor, regardless of manufacturer, with a horsepower and current rating as indicated.

3.3.4.12.4. Power stabilizer shall be installed to protect the variable frequency drive (VFD) from erratic power supply to ensure continuous operation.

3.3.4.12.5. **Standard Operating Condition**

Ambient temperature range:	0 to 40 °C
Elevation:	up to 3300 ft
Atmosphere:	non condensing relative humidity to 95%
AC line Frequency Variation:	+/- 3%

a. **Monitoring and Displays**

The VFD's display shall be LCD type capable of displaying text and indicators. The following are to be available for monitoring at minimum:

- □ Output Frequency
- □ Motor line current
- □ Motor per Phase Current
- □ Kilowatt hour meter

VFD shall have the capability of communicating via an RS-232, RS-422 or RS-485 port. It shall have an integral Modbus

communication capability and its parameters, fault log and diagnostic log shall be downloadable via the RS-232, RS-422 or RS-485 port.

b. **Protective Functions**

The VFD shall include the following protective features at minimum:

- □ Overcurrent
- □ Overvoltage
- □ Under voltage
- □ Ground/Earth fault

Inverter fault

- □ Phase loss
- □ Output phase loss
- □ Under temperature/Over temperature
- □ Motor overload/under load

c. **Enclosure**

All VFD components shall be factory mounted and wired on a dead front, grounded, NEMA-12 enclosure. If a free-standing enclosure is provided, it shall be suitable for wall mounting.

d. **Control Functions**

The operator shall be able to scroll through the menu to choose between the following:

- □ Monitor
- □ Operate
- □ Parameter setup
- □ Actual parameter values
- □ Active Faults
- □ Fault History

The following setups and adjustments, at a minimum, are to be available:

- □ Start command from keypad, remote or communication port
- □ Speed command from keypad, remote or communication port
- □ Motor direction selection
- □ Maximum and minimum speed limits
- □ Acceleration and deceleration times, two settable ranges
- □ Multiple preset speed adjustments
- □ Catch a spinning motor start or normal start selection

e. **Diagnostic Features and Fault Handling**

The VFD shall include a comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

A "Fault Log" shall be accessible via a RS-232, RS-422, or RS-485 serial link as well as line on the keypad display. The "Fault Log" shall record, store, display and output to a serial port upon demand, the following for the most recent events:

- □ Date and time of day
- □ Type of fault
- □ A historic log shall record, store and output to a RS-232, RS-422 or RS-485 serial link port upon demand.

f. **Drive Options**

Provide the following options to the VFD. All special features shall be factory mounted and wired within the VFD enclosure unless otherwise specified.

- □ Pressure transducer in the VFD to convert a 0-100 psi pneumatic signal to an electrical signal for automatic speed control.

- □ The VFD shall be provided with circuit breaker for disconnecting power supply. This will provide the ability to

isolate the VFD for maintenance and service. All switches include handle operators, door interlocking and are pad lockable.

g. **SOUND LEVELS:** Transformer average sound levels shall not exceed 40 db based on ANSI and NEMA levels for self-cooled ratings.

3.3.4.13. **Standards and Frame Sizes**: All motors shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and ANSI.

3.3.4.14. **Enclosure and Protection**: Motors shall be totally enclosed fan cooled and waterproof. Motor fans shall be bidirectional. Motors shall be rated for continuous running at full rated load. (IP 56).

3.3.4.15. **Thermistor**: Thermistor to be fitted to all motors rated above 22 kW (30 Hp). It may be fitted to motors with variable speed drives (frequency converters). It shall be PTC type.

3.3.4.16. **Rating**: Motor shall operate on a 400 Volts, 3 phase, 60 Hz power. Written approval is required for all motors which deviate from these requirements.

3.3.4.17. **Starting**: Squirrel cage motors shall be suitable for direct on line starting however, all winding ends shall be brought out. Each motor shall be rated for the maximum frequency of starting. Starting or stall current shall not be greater than 7 times the motor full load current.

3.3.4.18. **Noise**: Noise level shall not exceed 85 dB (A) at 1 M for all conditions.

3.3.4.19. **Temperature**: Temperature rise to agree as per standard.

3.3.4.20. **Insulation**: Shall be class ‘F’ for ‘B’ temperature rise

3.3.4.21. **MOTOR PROTECTION:** The circuit should employ an auto resetting overload.

3.3.4.22. **LIGHTING AND SMALL POWER**

a) **Distribution System:** The circuits for lighting and power outlets shall be from a 400/230V, 3-phase, 4-wire system with the neutral directly grounded.

b) **Lighting Fixtures**: Illumination design shall be dependent on the contractor's design to meet the standard illumination level with the use of Light Emitting Diode (LED) bulb pursuant to the latest edition Philippine Electrical Code (PEC).

c) **Illumination Level:** The standard illumination levels shall be based on the latest edition of PEC.

d) **Indoor Lighting:** Lighting for offices, control room, rest rooms, etc. shall be provided by LED tube lamps, either directly mounted to the ceiling or by pendant suspension.

e) **Outdoor Lighting**

- Outdoor lights may use solar lighting with photocell or other equivalent automatic sensors for perimeter, parking areas, and other outdoor places that requires lighting. It shall last for at least 3 years with batteries that can easily be replaced, maintained and suitable to the weather or working conditions of the proposed SSTP. Also, it shall be high power solar LED lamps mounted on steel structures or steel poles (hot dip galvanized).

f) **Emergency Lighting**

- Emergency lighting shall be provided where necessary in order to secure the minimum lighting required with respect to equipment maintenance and personnel safety.

- For emergency lighting, fixtures with built-in batteries shall be used with sufficient battery power to give one-hour continuous running during power failures.

- Emergency lighting shall be arranged so as to immediately switch on automatically in the event of power failure.

g) **Socket Outlets**

- □ All outlets located outside the plant shall be rated to IP 56 except in offices and must be installed with ground fault circuit interrupter (GFCI) type.

- □ 1-phase 230 V – 2 flat pin + E

3.3.4.23. **INSTRUMENTATION AND CONTROLS**

a) General:

- □ Instrumentation for controlling and monitoring the process shall be of a robust design and manufactured by recognized supplier. The manufacturer shall be represented in the Philippines having both spare parts and engineering support.

- □ All field instrumentation and junction boxes shall be rated to IP65.

- □ Analogue signals shall be 4-20mA dc for transmission on a 2-wire system.

- □ Digital signal s shall be of the 24V DC PNP type (unless otherwise specified or approved by ZCWD.

- □ Sensors installed to give signals for totalizing shall give digital output pulses. The generation of pulses shall be integral within the unit together with calibration and output signal pulse rate and width adjustment. Conversion of analogue signals to pulses by either remote devices or software will not be accepted. These sensors are usually required to give both analogue and digital signals such as flow and volume, kW and kWh.

b) Flow and Level Transmitters

- □ Pressure and differential pressure transmitters shall be electronic solid state type instruments constructed from corrosion-resistant materials.

- □ Wetted parts shall be of stainless steel for level or ceramic for flow, body shall be of a non-corrosive material or alloy with screwed connections.

- □ Span and zero adjustments shall be continuously adjustable. The span and zero adjustment should be externally accessible.

□ Accuracy of the instrument shall be ±0.25% of span repeatability ±0.20% of span.

c) Control Sensors and Equipment

□ All field sensors shall be of industrial quality and entirely suitable for their intended purpose.

□ All field sensors shall be constructed of a high impact none corrosive material or encased in stainless steel.

□ Digital signals from sensors shall switch the DC control voltage in either a positive current driving mode (PNP type) or via clean contacts. Sensors having outputs of the PNP type shall be 3 wires, and have protection against short circuits, overloads and switching of inductive loads. All sensors are to have LED indication to show the operated state.

□ Proximity switch or photocell shall have a terminal box attached to the body.

3.3.4.24. **PROGRAMMABLE CONTROLLERS**

a) **General:** This specification has been developed to establish minimum requirements for a solid-state programmable controller designed to provide high reliability in industrial applications. The controller shall be supplied with the CPU, input/output scanner, inputs, outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable programmable controller system.

b) **Service**: The supplier shall provide operating instruction manuals with adequate information pertaining to the following:

- □ System Specifications
- □ Electrical power requirements
- □ Application considerations
- □ Assembly and installation procedures
- □ Power up procedures
- □ Troubleshooting procedures
- □ Explanation of internal fault diagnostics
- □ Shut down procedures
- □ Recommended spare parts list

c) Design Description

- □ Programmable controller system shall be modular, field expandable design allowing the system to be compatible to the machine and/or process control application. The capability shall exist to allow for expansion of the system by the addition of hardware and/or user software.
- □ The logic processor, power supply, I/O scanner, and communication interface as well as input and output circuitry shall be of a modular design with interchangeability provided for all similar modules.

- □ The programmable controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant.

- □ Each input and output module shall be a self-contained unit housed within an enclosure. These input/output enclosures with their respective modules shall be field expandable.

3.3.4.25. **COLOR AND IDENTIFICATION**

a) **Color Coding**: The colors shall be:

□ Logical states of devises monitored and controlled by the control system shall be differentiated with colors as follows:

Red:	Danger, stop, emergency stop. Measures required in emergency situations;
Yellow:	Caution, take action to avoid danger, avoid changes.
Green:	Safe start, on
Black, white, gray:	Neutral, can be used for all purposes except those covered by red, e.g., reset, inching
Blue:	Special, must not be used for purposes covered by red, yellow, or green, e.g., thermal/light

□ **Wires Color**

400 V 3-phase:	Red, White, Blue
230 V single phase:	Phase color, when switched – red
Earth:	Green/Yellow
Neutral:	Black
24 VDC	+ ve Brown -VE Violet

□ Multicore cables and their cores do not have to be colored as above but must be uniquely identified at both ends.

b) **Label Colors**: Labels shall be engraved black lettering on a white background. Warning labels shall white lettering on a red background

3.3.4.26. **INSTALLATIONS**

3.3.4.26.1. **Mains/Power Cable**: Mains cables shall be THW single core stranded copper cables at 90^{o}C temperature rating min. (unless otherwise specified or approved by ZCWD).

3.3.4.26.2. **Motor Cable**: Motor cables shall have a minimum cross section of 3.5 mm2 and shall be a multicore or single core PVC insulated, PVC sheathed multi stranded copper cable at 75^{o}C temperature rating minimum. (Unless otherwise specified or approved by ZCWD).

3.3.4.26.3. **Control Cable**: Control cables shall be PVC insulated multicore cables having multi stranded copper conductors with a minimum cross section area of 1.5 mm2 min. All control cables shall be rated for a minimum of 600/1000 V and 75 °C.

3.3.4.26.4. **Signal Cable**: General purpose signal cable 4-20 mA or any other signals for electronic devices shall be multicore, having stranded copper conductors with a minimum cross-sectional area of 1.5 mm2 (unless otherwise specified and approved by ZCWD) and be PVC insulated, overall screened, PVC outer sheath construction with a maximum working voltage of 230 VAC.

3.3.4.26.5. **CONDUIT** shall be one size larger than is required by Regulation for the number of cables to be drawn in and not less than 20 mm. It shall be of the high impact, rigid, PVC pattern, resistant to ultra violet light.

3.3.5. PLUMBING

3.3.5.1. The plumbing works design and installation shall follow the National Plumbing Code of the Philippines.

3.3.5.2. The pipe material to be used for the sewer mains connecting the West Pumping Station and the STP shall be **HIGH DENSITY POLYETHYLENE:** High Density Polyethylene (HDPE) pipe. The sizing of HDPE pipe shall be in accordance with ASTM F714 and shall be based upon the DIPS, outside diameter sizing system. The dimension ratio (DR) of pipe to be installed shall also be either shown on the drawings or as directed by the Engineer.

3.3.5.3. Joints between mainline HDPE pipes shall be constructed by using butt fusion techniques in accordance with ASTM specification D2657. The recommendations of the pipe manufacturer shall govern the fusion process, including the specification of the ideal temperature for fusion. Fittings shall not be joined to mainline piping using heat fusion joining techniques.

3.3.5.4. **PIPE MATERIAL FOR WATER PIPES**

3.3.5.4.1. For exposed pipes: Use steel flanged pipes (Painted with Blue)

3.3.5.4.2. For buried pipes: Use PVC pipes PN 65 Standard at least Series 8.

3.3.6. PROCESS MODULES

3.3.6.1. The STP will be operating on a continuous basis, i.e. 24 hours a day and 365 days per year. The design and construction of the facilities shall be based on the sewage volume and characteristics which must be determined by the contractor.

3.3.6.2. The contractor shall be constructing the STP with an overall capacity of 4,000 cubic meters per day of sewage from the existing sewer network. However, tanks which will be constructed for various stages of the

treatment must be so constructed as to allow future expansion of up to 2MLD. It must be so designed/constructed/supplied/installed such that all civil works and electro-mechanical facilities will meet the design capacity.

3.3.6.3. The contractors/ bidders may adopt any technologies capable in removal of inert and other floating solids and debris, and removal of grit / oil and grease to prevent it from entering the main treatment system. The proposed treatment plant may include the following facilities:

3.3.6.4. Screens: Preliminary screens or bar racks should be included for the removal of inert and other floating solids and debris that may have entered the sewer lines, and desludging trucks in the case of septage.

3.3.6.5. Grit, Scum and Oil and Grease Removal: A grit and oil and grease removal mechanism/system must be included in that system to prevent grit and oil and grease from entering the main treatment system and ensure smooth operation of the downstream processes

3.3.6.6. As necessary to maintain the desired efficiencies of the processes, scum, oil and grease collection equipment shall be provided. Two (2) day storage of scum, oil and grease shall be provided.

3.3.6.7. Disposal of scum, oil and grease shall be the responsibility of ZCWD or its designated operator/contractor after the 1-year process proving period shall have lapsed. Until then, the contractor shall be responsible for the disposal of scum, oil and grease in accordance to relevant environmental standards. Currently, there are no service providers in Zamboanga City for the collection and disposal for scum, oil and grease. The nearest service provider is located in Cagayan de Oro City.

3.3.6.8. The system must be able to accommodate sewage peak-flows and shock loadings by employing such methods that will equalize the sewage flow

3.3.6.9. Each major module in the treatment process must be connected to the SCADA system for a step-by-step monitoring of the treatment efficiency and for ease of detection in case of system failure. It must be able to provide a complete overview of the entire system, that is user friendly, reliable, flexible, and communicates real time data with quick and easy access to critical information of the operating environment. It must be equipped with an appropriate SOFTWARE, the required personal computers for HMI

(Human Machine Interface) monitoring, PLCs and RTUs Communication and Telemetry associated with the field instrumentations. It must be able log history/data storage which is easily retrievable.

3.4. SEPTAGE ACCEPTANCE AND SLUDGE MANAGEMENT

3.4.1. Septage Acceptance Unit must have the capability to partially treat septage from ZCWD concessionaires not connected to the sewerage system.

3.4.2. Septage Acceptance Unit shall have pre-treatment of waste water from the septic tanks received directly from the tanker trucks or septage truck collector.

3.4.3. The effluent (filtrate) quality from the pre-treatment of the septage acceptance unit should be equivalent or better than that of the sewage influent. The same shall be conveyed directly to the pre-treatment of the sewage treatment plant.

3.4.4. At least one (1) sludge dewatering unit, with sufficient capacity, is required in a complete system to perform the separation of mixed septic and wasted biological sludge from the plant process streams, and to produce a sludge cake with dry solids content of 20% to 25%. The bidder has the prerogative to propose the appropriate technology for the dewatering unit.

3.4.5. Main machine parts including the dewatering unit must be stainless steel with a minimum or equivalent grade of Type 316. Certain other small components like bearing, etc. must be of an equivalent material with a proven reliability and durability under these particular operational conditions.

3.4.6. Each unit shall be completely covered and enclosed and incorporate all functions in each unit for a compact and complete system, in which the septage is treated for the separation and dewatering of solids. Desired technology is submitted to the sound discretion of the bidder.

3.4.7. Dewatered sludge shall be discharged via enclosed discharge chutes into enclosed inclined screw conveyors. It shall be accurately discharged in a collector system that will be automatically conveyed to the sludge storage facility.

3.4.8. The STP must be provided with a facility for loading of dewatered sludge to 5 m^3 bulk haul trucks. At least one (1) hopper with a one-day capacity shall be installed for this purpose.

3.4.9. At the minimum, the septage acceptance must have a shed with a floor area of 88.00 square meters.

3.5. DEMOLITION AND CONSTRUCTION OF MRF

3.5.1. The Materials Recovery Facility (MRF) is operated and managed by the local government thru the City Environment and Natural Resources (OCENR). As part of its commitment to the local government, and in order to give way to the construction of the STP at the project site, it is necessary that the facility be demolished at its present location and reconstructed at the vacated site due to conflagration within the main public market. The winning bidder/contractor shall be responsible for its reconstruction in the pre-identified location.

3.5.2. Pursuant to the Memorandum of Agreement by and between the City of Zamboanga and ZCWD executed on February 18, 2021, the former is to provide any other technical assistance needed and coordinate with the ZCWD before, during project implementation, testing, and until commissioning of the project and carry out all other appropriate administrative arrangements as may be necessary to facilitate the implementation of the project. ZCWD, together with contractor, will be assisted by the LGU to move the existing vendors at the site.

3.5.3. Those materials or debris from demolition of existing MRF which are for disposal will be disposed and sorted at the Cabatangan (Lupong Road) property of ZCWD and the hauling and transportation of which shall be on the account of the contractor.

3.5.4. The MRF is a property of the LGU, as well as the property upon which the new MRF will be constructed. As such, the LGU will be designating its new service entrance at the public market.

3.5.5. The items/equipment to transferred from the existing to the new MRF facility are those which are currently found therein. This can be viewed upon ocular inspection of the site. For reference, a lay-out (as-built) of the MRF is provided in this *Performance Specifications and Parameters,* attached as Annex 17.

3.5.6. The specifications and dimensions in the design herein mentioned shall be without prejudice but must be compliant with the latest edition of the following standards, National Building Code, Fire Code, National Plumbing Code, Philippine Electrical Code, Philippine Mechanical Code and other applicable standards.

3.5.7. The works shall include demolition of the MRF at its present site, the construction of its office building and shed in a 660 square meter area within the Zamboanga City Public Market, 10 meters from the mosque, previously identified and the transfer of the rotating digesters and other MRF equipment to the new location. Equipment that is movable and transferable such as Drum Composter shall be transferred to the new MRF Facility by the contractor. The shed for the drum composter and for other equipment, the office for the MRF Personnel and the Perimeter Fence shall be constructed with new construction materials without re-using demolished materials. Attached in this document is a copy of the location and reference design and drawing for the proposed MRF.

3.5.8. It shall also include the demolition of the office/storage building, restrooms and the shed at the existing site. At the MRF transfer site, a perimeter fence should be constructed with ingress facing the public market. The entrance must be wide enough to allow the entrance and exit of garbage trucks from the public market. A perimeter fence must also be constructed around the 660 square meter area. The storage room must have an area of 100 square meters while the office/supply room should have an area of 26 square meters while the restroom will have an area of 10.5 square meters (see attached reference drawing of the site development of the MRF).

3.5.9. **Perimeter Fence Specifications:** The perimeter fence may be at least a combination of concrete and interlink with a height of not less than 2.40m. However, the part facing the mosque must be made of masonry firewall. Finish grade line (finish pavement) inside the transfer site of the MRF shall be even plain finish with a capacity to carry a traffic load.

3.5.10. **Shed Specifications:** Shed Column/Post and roof frame shall be made of Steel and painted with Enamel Paint. Roof material shall be at least corrugated roof sheet painted with acrylic paint. Electrical wires must be provided for each of the Rotating Digesters from the top. All materials recovered from demolition shall be turned over to ZCWD.

3.5.11. **Office Room Specifications:** It shall be plastered finish painted with masonry paint, floor finish shall be a ceramic tile, ceiling shall be fiber cement board w/ metal furring ceiling joist. All windows shall be at least of jalousie glass.

3.5.12. **Storage Room Specifications:** It shall be plastered finish painted with masonry paint, plain cement floor finish, provide ventilation by means of grills or steel mesh matting.

3.5.13. **Leachate collection drainage** must also be provided from the composting area and drained to a three-chamber septic tank constructed on-site.

3.5.14. **Utilities:** The works identified herein includes the transfer of existing utilities (*i.e.,* electricity and water), which includes incidental works necessary for the complete transfer of the MRF to its new location based on the contractor's inspection of the MRF prior to its demolition.

3.5.15. A provision for electrical supply overhead of each of the Rotating Digesters must be provided.

4. CONSTRUCTION REQUIREMENTS

4.1. GENERAL REQUIREMENTS

4.1.1. It shall be the responsibility of the contractor to secure all the necessary and applicable permits to undertake the project, including, but not limited to, building and fencing permits and excavation permits. No work shall commence unless said permits have been secured. All the permits that ZCWD already applied for but not yet paid, thereof will be charged to the winning contractor since it is a requisite activity for the process proving. Notarial seals must have the dry seal of the notary public, considering it is a requirement under the notarial law.

4.1.2. All works and installations shall be in accordance with the manufacturer's specifications and standards.

4.1.3. Shop drawings, manufacturer's literature and structural calculations that may be required elsewhere in this Section shall be submitted to ZCWD for review and approval. Shop drawings shall show details of the products and systems, and connections to adjoining materials. Schedules showing sizes, types, and locations of louvers and glass shall also be submitted for approval along with manufacturer's installation instructions.

4.1.4. All materials for the works herein involved shall be delivered, stored and handled so as to prevent damage of any nature. Materials that have been damaged shall be removed from the site and shall be replaced with good ones.

4.1.5. **INSPECTION AND TESTING**

4.1.5.1. The Contractor shall furnish copies of Contractor's inspection and quality control plan prior to the commencement of project implementation.

4.1.5.2. Materials and workmanship shall be subject to inspection.

4.1.5.3. Unless otherwise specified, at least three (3) samples of each material shall be submitted a minimum of fourteen (14) working days prior to ordering such material or equipment. Submission shall be in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delay in the work. All samples shall be individually and indelibly labelled or tagged indicating thereon all specified physical characteristics and manufacturer's names for identification. Upon receiving approval, one set of samples will be stamped and dated by ZCWD and returned to the Contractor for safe keeping in the site office until completion of the work. Unless otherwise specified, all colors and textures of specified items shall be selected by ZCWD from the manufacturer's standard colors and standard product lines. All materials to be used under this contract shall be ISO certified and applicable for industrial applications under Class D environment.

4.1.5.4. The inspection will check as a minimum, equipment components, dimensions and quality of workmanship against certified drawings and data.

4.1.5.5. All materials must be inspected by the Inspection Committee or any authorized designated personnel of ZCWD prior to installation. Otherwise, the end user has the authority to remove and replace such item at the expense of the contractor.

4.1.5.6. Before erection, the Contractor and the Manufacturer's representative shall jointly inspect the installed materials and equipment on site to determine compliance with the specifications and manufacturer's data.

4.1.5.7. Upon completion, and before final acceptance, the hoist, trolleys and monorails shall be given the rated load test specified in ASME B30.11. Should this provision be applicable, before final acceptance, the hoist, trolleys and monorails shall be tested and given the rated load test in accordance with ASME B30.11 standards.

4.1.5.8. For the laboratory testing, there are at least four (4) testing laboratory in Zamboanga City. The Bureau of Soils, Department of Science and Technology (DOST), Environmental Management Bureau (EMB), and Zamboanga City Medical Center (ZCMC) testing laboratories. The Zamboanga City Water District (ZCWD) does not accredit laboratories; therefore, the testing laboratories mentioned above are not accredited by ZCWD. For DENR-EMB latest accredited list of laboratories, the bidder is advised to inquire with the latter agency.

4.2. ENVIRONMENT, HEALTH AND SAFETY

4.2.1. ZCWD shall be responsible for the preparation of the Environmental Impact Assessment (EIA) Report and for the application of an Environmental Compliance Certificate (ECC) with the Environmental Management Bureau IX. However, the contractor shall be bound to implement the implement the Environmental Management Plan (EMP) and the Environmental Monitoring Program (EMoP) applicable for the construction phase of the project, as well as those applicable during the operation phase must be implemented by the winning bidder until the one (1) year process proving period expires. They shall also be bound to comply with the conditions enumerated in the ECC.

4.2.2. Upon receipt of the Notice to Proceed, the contractor shall install on the entrance of the project site a billboard containing this message: "*Notice to the Public, This Project (name of the Project) of (Name of Proponent) has been issued an Environmental Compliance Certificate (ECC No. R09-1509-0066) by the Environmental Management Bureau of the Department of Environment and Natural Resources, Region IX, on (October 20, 2015).*"

4.2.3. A copy of the EMP, EmoP and ECC shall be furnished to the contractor.

4.2.4. During the construction period, the winning bidder must designate a Pollution Control Officer (PCO) for the project who shall ensure that the implementation of the Environmental Monitoring Program (EmoP) and the Environmental

Management Plan (EMP) is strictly complied with. Said PCO should be duly accredited by the DENR-EMB and shall be working closely with the Corporate PCO of ZCWD to ensure the smooth implementation of the EMP and EmoP. It is not necessary for the PCO to be available at all times.

4.2.5. Odor control, malodorous gases produced from operation shall be contained, collected and treated. A bio-filter or soil filter odor treatment system is highly encouraged. However, if the odor control used is mechanical in nature, it must be able to resume normal operation after power interruption, even if unmanned, without causing damage to or undue shortening of the economic life of the electric motors.

4.2.6. The plant itself shall be free from discernible odor and noise which must meet DENR standards on noise levels (ambient and source-specific standards). Please refer to the standards being adopted by the DENR and DOLE on noise limits. In case of non-compliance, the Contractor shall make revisions of their design to meet the requirements without additional cost to ZCWD.

TIME	CLASS				
	AA	A	B	C	D
Daytime (0700Hr-700Hr)	50	60	65	70	75
Evening (1700Hr-100Hr)	45	50	60	65	70
Nighttime (2100Hr-500Hr)	40	45	55	60	60
Morning (0500Hr-700Hr)	45	50	60	65	70
Class AA – a section of contiguous area which requires quietness, such as areas within 100 meters from school sites, nursery schools, hospitals and special homes for the aged. Class A – a section or contiguous area which is primarily used for residential purposes. Class B – a section or contiguous area which is primarily a commercial area. Class C – a section primarily zoned or used as light industrial area. Class D – a section which is primarily reserved, zoned or used as a heavy industrial area					

Table 6 DENR Standards for Noise in General Areas

4.2.7. Occupational health and safety measures must be properly implemented. Engineering Control, Administrative controls and PPE must be implemented. Workers at the project site must be equipped with proper safety personal protective equipment (PPE) during project implementation. This shall also include all necessary PPE during operation of the STP which must be turned over to ZCWD.

4.2.8. Fire safety must be considered in the facility. All facilities must be provided with fire protection system as per the latest National Building Code and the

National Fire Protection Association. At the very least, fire extinguishers must be easily accessible at strategic locations within the facility.

4.3. CIVIL WORKS

4.3.1. GENERAL REQUIREMENTS

4.3.1.1. Structural design shall follow the National Structural Code of the Philippines (NSCP) 2015 edition, Philippine Green Building Code, B.P. 344 Accessibility Law and other renowned and globally accepted standards.

4.3.1.2. All civil works shall follow DPWH Blue Book Standards for construction requirements, material testing, method of measurement, and basis of payment.

4.3.1.3. The design for deep foundation shall be designed in accordance with the attached Geotechnical Investigation Result; use a methodology for deep foundation that will not damage the adjacent structure or else the contractor shall be held liable for any damages.

4.3.1.4. Architectural designs shall follow the latest edition of National Building Code of the Philippines and the Philippine Green Building Code. All setback requirements shall follow the provision of the National Building Code of the Philippines.

4.3.1.5. Wastewater/water retaining structures shall be waterproof/leak-free.

4.3.1.6. Exposed surfaces shall have a smooth finish concrete and shall be painted with acrylic solvent-based paint.

4.3.2. DRAWINGS

4.3.2.1. The Contractor shall prepare detailed working drawings of the whole of the Works to be carried out in this Contract. All drawings shall be to an acceptable and professional standard. Poorly prepared or insufficiently detailed drawings will be rejected. Drawings which were not initialed or signed as having been checked by a responsible member of the Contractor's organization will also be rejected.

4.3.2.2. All Drawings shall include the Manufacturer's detail or serial number of all plant/equipment so that sufficient information is available for the ordering of replacement parts.

4.3.2.3. All plans/drawings shall be created in CAD file & the same shall be submitted and printed in paper size 24” x 36” or A1.

4.3.3. **SURVEYING AND SETTING OUT WORK:** The Drawings show the available survey information for the sites included in this Contract. Should the Contractor have any disagreement with this basic survey information and the relevant drawings, it shall inform ZCWD in writing not later than two (2) weeks after the Notice to Proceed. The Contractor shall perform all calculations, surveys and setting-out necessary to establish the accurate location of the structures as shown on the Drawings. The Contractor shall submit to ZCWD for review in advance of any setting-out work, a description of the methods and procedures it intends to use. The Contractor shall entrust the surveying works only to persons who, by their training and experience, have sufficient qualifications and knowledge to ensure proper fulfilment of the survey tasks assigned to them. For the performance of the survey, the Contractor shall provide a sufficient number of reliable and accurate instruments.

4.3.4. PAVEMENTS & LANDSCAPING

4.3.4.1. **Roads & Pavements**: Aggregate sub base and base course and Portland cement concrete pavement materials and methods of construction shall be in accordance with referenced sections of the latest edition of "Standard Specifications for Highways, Bridges, and Airports" published by the Department of Public Works and Highways.

4.3.4.2. **Landscaping Works.** The Contractor shall furnish all plants, labor, materials, tools and equipment necessary for the performance of all landscaping complete to include springing, seeding, loaming, sodding, planting of trees, topsoil supply and spreading and all other incidentals which are deemed necessary in the completion of this work item. All unpaved areas shall be sodded. Border plants to be used shall be subject for approval of ZCWD

4.3.4.3. List of plants and landscaping materials shall be submitted together with landscaping layout to be approved by ZCWD.

4.3.4.4. Plants shall be subject to inspection and approval or rejection by ZCWD at place of growth and upon delivery to the site at any time before or during progress of the work based on the following criteria:

- Quality, size and variety;

- Ball and root condition;
- Quantity of stock; and
- Latent defects and injuries resulting from handling, disease and infestation.

4.3.4.4.1. Plants approved at pre-planting inspection shall still be subject to rejection during planting if found to be unsatisfactory.

4.3.4.4.2. Rejected plants shall be identified in an obvious manner, removed from the site and replaced with acceptable equals.

4.3.4.5. **Maintenance of Landscape Planting Prior to Acceptance**

4.3.4.5.1. **General.** The Contractor shall be responsible for protecting, wearing and maintaining all planting and irrigation systems until final acceptance of all work under the contract.

4.3.4.5.2. At time of acceptance of the complete project, the lawn shall be totally established with no bare spots, mowed a minimum of 4 times and grass is at least 40 mm to 50 mm in height.

4.3.4.6. All maintenance works, including watering and protection of the landscaped area and its plants shall be undertaken by the contractor until final commissioning and turn-over over the project to ZCWD. Acceptance shall not be made unless ZCWD shall not be satisfied with it.

4.3.5. **DRAINAGE SYSTEM.** The contractor shall design drainage system for storm and sewer for the entire facility and it should follow the standards of the DPWH Blue Book. The system's size should be adequate to drain any type of water.

4.3.6. **METAL DOORS, WINDOWS AND FRAMES.** All work shall be coordinated with appropriate related work to assure proper installation. Field conditions and dimensions shall be verified prior to fabrication.

4.3.6.1. **HOLLOW METAL DOORS, WINDOWS AND FRAMES**

4.3.6.1.1. **General.** All work shall be shop-fabricated and shop assembled where possible. Temporary stiffeners, spacers, etc. necessary to facilitate handling and accurate erection shall be provided. After fabrication, all tool marks, and other surface imperfections shall be filled and ground smooth.

4.3.6.1.2. Doors, windows and frames shall be chemically-treated to ensure maximum paint adhesion and shall have all exposed surfaces painted with a rust-inhibitive primer after fabrication.

4.3.6.1.3. **Metal Doors.** Metal doors shall be full flush design. Face sheets shall be not less than cold rolled stretcher-levelled 1.4 mm steel, hollow metal construction. All doors shall have flush seamless face sheets. The door top and bottom shall be internally reinforced by steel members welded in place. Tops of exterior doors shall be provided with flush weather tight tops.

4.3.6.1.4. Door louvers for metal doors shall be of metal of the type which integrally frames the opening and can be securely attached. Louvers shall be of the "Z" blades type for exterior and interior use. Exterior louvered openings shall be provided with removable type insect screens. Door louvers shall be uniformly located in doors and be of sizes shown.

4.3.6.1.5. Doors shall be rigid, and neat in appearance, free from warpage, or buckle. Corner bends shall be true and straight and of minimum radius for the gauge of metal used.

4.3.6.2. **ALUMINUM SLIDING WINDOWS**

4.3.6.2.1. **Scope**: The work covered by this section consists of furnishing all equipment, materials, and labor in the fabrication and installation of aluminum sliding windows.

4.3.6.2.2. **Materials**

4.3.6.2.2.1. **Weather-stripping**: Weather-stripping shall be vinyl and wool pile and shall form a continuous weather seal. They shall be installed snugly in integrally extruded keyways and shall not be loosened nor removed by operating the windows. Weather-stripping for the panels will be one-piece channel shaped gaskets.

4.3.6.2.2.2. **Finish:** Exposed aluminum surfaces shall be powder coated, white. Surfaces shall be completely sealed requiring no further application additional coating or preservatives.

4.3.6.3. **WOOD DOORS**

4.3.6.3.1. **General**: Doors shall be of the quality and workmanship acceptable to the ZCWD. The Contractor shall guarantee finished doors against twisting, warping, crack and such other defects due to construction and installation for a period of one year after the final acceptance of the building.

4.3.6.3.2. **Solid Core, Hollow Core, Plywood Flush Type, Materials**: Where indicated, plywood flush doors shall be provided with louvers of sides shown. Louver blades shall be kiln-dried wood as indicated in the schedules. Louver blades shall be uniformly cut finished and fastened to frame in an approved manner. Sufficient reinforcement shall be provided for installation of door closers.

4.3.7. CONCRETE AND FORMWORK

4.3.7.1. **Surface Finishes Produced Without Formwork:** Surfaces where people may step on shall be wood floated under light pressure to eliminate surface irregularities. Vertical surfaces and others not intended as walkway or stepping board shall be steel-troweled under firm pressure to produce a dense, smooth, uniform, surface free from trowel marks.

4.3.7.2. **Surface Finishes Produced With Formwork**: Exposed surfaces shall be fair finish while those to be covered by soil can be rough finish.

4.3.7.3. **TILES**. All tiles shall be installed by competent tradesmen and in accordance with the best practices of the trade. Finished surfaces shall be produced in the true plans, free of damage, scratches, or otherwise faulty tile in all places solidly backed up and firmly secured. All tiling work shall be laid out so that field or pattern is exactly centered on the area to preclude the use of tiles less than full size; do any cutting along edges of area. Joints of uniform standard width and in true alignment shall be maintained throughout; completely fill with grouting or pointing mortar and finish smooth and flush with tile. Cut and drill without marring tile, smooth cut edges with a fine stone. Fit carefully around pipes, outlets and similar items so that cover plates or trim will cover the cut edges. Remove surplus mortar and grout from tile surfaces before these have set.

4.3.7.3.1. **Plain Cement Finish:** Mix mortar one (1) part Portland cement to two (2) parts sand.

4.3.7.3.2. **Granite Tiles**

4.3.7.3.2.1. Install flooring after all other trades, including painting, have been completed. All surfaces to receive resilient flooring finishes shall be dry, clean and smooth.

4.3.7.3.2.2. Inspection: Examine substrate and conditions under which flooring is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

4.3.8. Demolition and Construction of Materials Recovery Facility

In order to ensure that the winning bidder will limit their construction works within the prescribed area, a representative from the local government (City Engineer's Office, City Assessor's or City Legal Office) should be present during the verification survey/staking works of the project. Furthermore, constant coordination should be made with the Philippine Ports Authority, which is the property located at the southern portion of the MRF compound, and with the Office of the City Environment and Natural Resources, who operates the materials recovery facility.

4.4. MECHANICAL WORKS

4.4.1. Scope of Works

This Specification establishes the mechanical features and minimum or equivalent level of quality required for all permanent mechanical plant in this contract.

All equipment directly involved in the treatment process shall have redundancy. The items referred herein are those which the bidder contractor deems to be "of specialized nature." It is the bidder/contractor who will therefore determine whether certain equipment's are of "specialized nature" or are not easily available in the country.

4.4.1.1. **Drawings and Information:** The following drawings and documents as a minimum shall be submitted for review:

- Pump mounting and general arrangement drawing, complete with parts and materials listing, dimensions and weight.
- Pump sectional drawings detailing all internal components and associated parts lists;
- Typical performance curves;
- Pump data sheet;
- Valve and actuator datasheets

4.4.2. Outline general arrangements showing overall dimensions and all pertinent details including equipment, valves and pipes including all supports and clamps/guides etc., and any requirements for access for installation and maintenance.

4.4.3. Methodology in Executing the Extent of the Contract

4.4.3.1. **Certification:** Prior to installation works, the Contractor shall submit three (3) clear copies of all Test Certificates (including results of tests) as required by the Contract.

4.4.4. Product Specifications

4.4.4.1. **Pump Sets**

4.4.4.1.1. Pumps, whether submersible or centrifugal, shall suit the duty requirement of the project.

4.4.4.1.2. The casing shall be of close-grained cast iron or approve equal, designed for maximum heat transfer to the surrounding liquid. The casing shall be fitted with renewable wear rings.

4.4.4.1.3. The pump shall be direct driven by a close-coupled electric motor.

4.4.4.1.4. The submersible pump impeller material shall be of stainless steel / bronze to the manufacturer's standard grade to satisfy the requirements for corrosion, erosion and/or cavitation, preferably secured to the shaft by keying.

4.4.4.1.5. All seals shall be selected for a long service life. The choice of face material shall be suitable for the pumped media and to the recommendation of the seal manufacturer.

4.4.4.1.6. All bearings shall be heavy duty ball type grease packed and sealed-for-life and shall be designed with minimum life of L10, 100,000 hours at the guaranteed duty point.

4.4.4.1.7. The pump-set shall be fitted with a lifting handle designed for simple, safe and speedy removal of the pump-set using a permanently installed lifting chain and shackle.

4.4.4.1.8. Characteristic curves for the pump-set performance shall be submitted by the Contractor and appended to the completed data sheets.

4.4.4.1.9. The pump-set shall accommodate the variation in the water level or as required by the particular installation in the Water Treatment Plant.

4.4.4.1.10. The bolts and nuts specifications for fixing shall depend on the design in relation to its applications and the required torque, also, the bolts and nuts shall not be lower than stainless steel grade 304.

4.4.4.2. **Air Blowers**

The air blower design in the proposed SSTP shall depend on the Bidder/Contractor design following the Performance Specifications of the proposed SSTP and it shall be in accordance with the Philippine Mechanical Engineering Codes and Standards.

4.4.4.3. **Pipe Work**

4.4.4.3.1. All pipework associated with pumping unit and associated fittings shall be flanged to PN 16 or greater. The ZCWD requires PN 16 for all pipework associated with the pumping unit and associated fittings regardless of the actual operation pressure.

4.4.4.3.2. All pipework design shall include sufficient flanges or unions to allow for the disconnection of the major items of plant without disturbing the main pipework. The contractor shall supply flexible couplings as necessary to achieve this requirement.

4.4.4.3.3. Flange gaskets shall be natural rubber or equivalent suitable for water application for the wash-down pump.

4.4.4.3.4. All pipework installed shall be adequately supported with pipe supports of an acceptable design. These supports shall allow for removal of any section of pipework for maintenance purposes. All pipe

supports shall be fabricated from either concrete or hot dip galvanized mild steel; in either case adequate clamping and guides shall be designed and installed. Air, sludge piping & support under the tank shall be suitable and non-corrosive type.

4.4.4.3.5. The Contractor shall be responsible for the detailed design and dimensioning of the pipework.

4.4.4.3.6. The pipeline color coding in this project shall follow the rules and regulations set forth in the Presidential Decree No. 984, otherwise known as the "National Pollution Control Decree of 1976, chapter V, as follows:

Sludge Line:	Brown
Gas Line:	Orange
Potable Waterline:	Blue
Chlorine Line:	Yellow
Sewage Line:	Gray
Compressed Airline:	Green

4.4.4.4. **Valve Specification**

4.4.4.4.1. The Contractor shall submit specification and a complete valve schedule including manual and actuated valves for review;

4.4.4.4.2. All manually actuated valves shall be clockwise closing and shall have the direction arrow to signify opening;

4.4.4.4.3. All manually operated and actuated valves shall be supplied with permanently installed hand wheels orientated in such a position as to allow easy operation. All hand wheels shall be manufactured from cast iron, or equivalent, and shall be located via a keyway onto the shaft. A locking nut shall secure the hand wheel to the shaft;

4.4.4.4.4. Should there be a need to propose a valve in this project, the valve shall be of either type: solenoid type, motorized or pneumatic valve.

4.4.4.4.5. All valves shall include, but not be limited to, the following markings, which shall be raised and cast in a prominent position into the main valve body:

- Manufacturer's name and address;
- Identification and/or serial number;
- Month and Year of manufacture;
- Working and Test Pressure;
- The direction of flow in the form of an arrow.

4.4.4.5. **GATE VALVES**

4.4.4.5.1. All Gate Valves AWWA C509. Shall be design suitable for water system. Valves shall be cast iron bodied with electrostatically applied epoxy resin (internal and external) Stem shall be stainless steel with stem sealing made of NBR/EPDM. Wedge shall be made of ductile iron and shall be core fully vulcanized with EPDM rubber with integral wedge nut of dezincification resistant brass. Bonnet bolts shall be made of stainless steel with bonnet gasket made of EPDM rubber.

4.4.4.5.2. The valve shall have a 50 mm square operating nut with the word “OPEN” and an arrow cast on showing that the valve opens by turning the operating nut counterclockwise.

4.4.4.5.3. Manually hand wheel operated isolation and actuated valves shall be of the non-rising spindle type.

4.4.4.6. **BUTTERFLY VALVES**

4.4.4.6.1. All pump control valves shall be of the butterfly type, designed and manufactured in accordance to AWWA C504 Class 150 B or ISO 106311994 standards.

4.4.4.7. **CHECK VALVES**: All check valves shall be of the ball/swing type, and shall comply with the applicable AWWA standard. The seat ring shall be cast from 85-5-5-5 bronze or approved equal. The body seat ring shall be accurately threaded and screwed into a machine seat within the body. The face of the ring shall be machine finished;

4.4.4.8. **AIR- VACUUM AND AIR-RELEASE VALVES**

4.4.4.8.1. **Air and Vacuum Valves:** Valves shall conform to ANSI/AWWA C512 – Air-Release/ Air Vacuum, and Combination Air Valves for Waterworks Service and the following: Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipeline are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.

4.4.4.8.2. **Air Release Valves:** Air-release valves shall vent accumulating air while system is in service and under pressure and be of the size indicated and shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.

4.4.4.8.3. **Combination Air Valves**: Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filed or drained, respectively. Valves shall have the same general characteristics.

4.4.4.9. **Chlorine Dosing**

4.4.4.9.1. Chlorine dosing shall be provided high quality metering pump & HDPE tank;

4.4.4.9.2. **Metering Pump**: The unit shall be weather proof motor and must be compatible for automation It shall be suitable to the system. It shall be 230 V, 60 Hz. Power shall be design above maximum requirement as per manufacture standard and it shall be in conjunction with flow and total dynamic head of the system;

4.4.4.9.3. **HDPE Tank**: The tank shall be UV stabilized to withstand prolong exposure to sunlight and shall be suitable for Chlorine operation. All of the Chlorine pipe work shall be suitably supported and restrained from

excessive movement. All brackets shall be included within this Contract and shall be corrosion resistant. The tank should be installed onto smooth flat surface making sure that the whole base is fully supported. It shall be corrosion proof, durable, lightweight, high performance and high quality. The tank shall be provided with sight glass with appropriate volume level indicator on it. Sight glass shall be protected with stainless steel guard (tube type). Both end of sight glass shall be provided with gauge cock. Gooseneck type air vent with appropriate insect screen shall be provided. Tank shall be provided with drain;

4.4.4.9.4. **Pipes**: All of the Chlorine pipe work shall be suitably supported and restrained from excessive movement. All stainless-steel brackets shall be included within this Contract and shall be corrosion resistant;

4.4.4.9.5. **Valves**: All gate valves (for isolation/control) and check valve (for isolation) shall be included within this scope of works and shall highlight their positions on the design drawings to be submitted for approval;

4.4.4.9.6. The Contractor shall submit the design of the said system for the approval of the ZCWD. All fittings and pipe work shall be from a suitable material suitably selected for a chlorine application and to endure external impact. Details of said coating and pipe work materials shall be for review by the ZCWD;

4.4.4.10. **Execution**

4.4.4.10.1. **Health and Safety**

4.4.4.10.1.1. The Contractor may not start on site until approval of the Construction Health and Safety Program is attained from the Department of Labor and Employment. The contractor shall observe all Health and Safety Regulations of the Philippines throughout the course of his works;

4.4.4.10.1.2. The Contractor shall ensure that prior to the commencement of site installation a method statement of installation of all plant noting specific health and safety issues shall be submitted in writing to both the Engineer and the Operational representative;

4.4.4.10.2. **Testing of Pump before Delivery**

4.4.4.10.2.1. All equipment installed or in-placed shall only be tested at the project site with the presence of the ZCWD representatives. Manufacturer testing reports shall be submitted to the ZCWD for reference.

4.4.4.10.2.2. Pump-sets shall be tested to ISO 2548, or other renowned testing standards.

4.4.4.10.2.3. The Contractor/Manufacturer shall conduct tests and furnish certified copies or reports describing the procedures and results of tests in accordance to AWWA C504 and ISO 10631-1994 prior to deliver to the site.

4.4.4.10.3. **Installation**

4.4.4.10.3.1. The Contractor shall install the entire pump as indicated in the manufacturer's drawings. All written instructions from the pump supplier shall also be observed;

4.4.4.10.3.2. **SIGNAGE:** The Contractor shall be responsible for the provision of the following signs on the equipment to be used on the system;

4.4.4.10.3.3. All items of equipment shall be identified by permanent labels giving the item designation. All labels shall be in English, engraved black lettering on white background. All necessary warning labels to be engraved on approved material with white letters on a red background. Provide signage arrow for the piping system.

Example: Chlorine Tank – Engraved "CHLORINE TANK" & "CT-1"

4.4.4.10.4. **Testing and Start-up**

4.4.4.10.4.1. The pump installation shall be tested before commissioning **commences. All tests shall be performed in accordance with the** manufacturer's instructions. General testing shall include, but not be limited to, the following tests:

4.4.4.10.4.1.1. Security and integrity of all fixtures and fittings

4.4.4.10.4.1.2. Pressure testing of the installation

4.4.4.10.4.1.3. Check operation of all valves included with the installation;

4.4.4.10.4.2. **Specific Tests** to be performed on site shall be in accordance with the following:

4.4.4.10.4.2.1. **Pump-sets;**

The Contractor shall perform the following tests as a minimum:

- Pipework leak test to closed valve conditions;
- Demonstrate the removal of the pump-set using the lifting davit, chain and guide rail(s) for submersible pump;
- Demonstration of running amps at the duty point;
- Demonstrate that the pump performance meets the specified duty;
- Undertake electrical testing in accordance with electrical specification;

□ The Contractor shall be responsible for providing all power requirements and special tools required to undertake the aforementioned. Furthermore, if additional instrumentation (portable in nature) is required to undertake the testing described herein then it shall be the responsibility of the Contractor to provide the same;

□ Should any of the above test results (and others undertaken as detailed within the plant manufacturer's instructions) be not to the satisfaction of the ZCWD then rectification of the same shall be required and re-testing be performed until the ZCWD is satisfied with the said works. Any costs incurred for required modification works and re-testing shall be to the account of the Contractor;

□ After testing {re-testing} has been undertaken to the satisfaction of the ZCWD all ancillary items left on site shall be removed and the site tidied. Only after satisfactory inspection of the working area by the ZCWD shall final hand-over be complete;

4.5. ELECTRICAL WORKS

4.5.1. GENERAL

4.5.1.1. SPECIFIC CONDITIONS

4.5.1.1.1. The performance of the equipment and materials installed shall be as specified and the quality of the installation is in accordance with the specification and good trade practice;

4.5.1.1.2. The works shall be carried out in accordance with the requirements of all authorities having jurisdiction over the works and/or approval required therefrom. Such notice shall be provided and the application shall be prepared accompanied by such plans and information as may be called for and /or obtain such approvals;

4.5.1.1.3. All wiring and tests shall be carried out in strict accordance with the current edition of PEC part 1 and 2 including amendments and rulings;

4.5.1.1.4. If there is any conflict between latest edition of the Philippine Electrical Code Part 1 & II and other standard the most stringent rule shall apply;

4.5.1.1.5. All permit and electrical fees required for this work shall be obtained by and at the expense of the Contractor. The Contractor shall furnish and transmit to ZCWD, copies of Certificates of Inspection and Approval after completion of the work. The Contractor shall prepare all as-built plans and all other paperwork required by the approving authorities;

4.5.1.2. SPARE PARTS AND SPECIAL TOOLS

Where a machine is fitted with components of a specialized nature, such as electronic components, etc. for which spares are not already held at or are not held elsewhere Manila (ex. stock), or which cannot be replaced by other components dimensionally and functionally identical, which are held or available in Manila (ex. stock), then such spares shall be provided as part of the original equipment.

4.5.2. *LOW VOLTAGE SWITCHBOARD*

4.5.2.1. It will be permissible to obtain access to live parts through a door or cover while the equipment is alive by defeating mechanical interlock or using special tools. Such interlock must be automatically restored on refastening the door or cover.

4.5.2.2. Any item of apparatus must be capable of being removed for replacement without requiring any other item to be removed first. Captive nuts or threaded steel shall be used so all apparatus can be replaced without removing the gear plates or other parts of the cubicle. Self-tapping screws are not acceptable.

4.5.2.3. **Construction**

4.5.2.3.1. Main switchboards to be fabricated from at least 2mm mild steel. Control panels to be fabricated from at least 1.6 mm thick.

4.5.2.3.2. All panels or doors supporting equipment in which large cutouts are required shall be constructed of at least 2.0 mm sheet steel.

4.5.2.3.3. All joints shall be continuously welded and ground to be smooth finish.

4.5.2.3.4. All doors and covers shall be provided with compressible Neoprene gaskets.

4.5.2.3.5. Switchboard doors will be fitted with key lockable handles. Doors over 1500 mm high will be fitted with two door handles at top and bottom. A single handle and locking rods will not be accepted. Drawing pockets will be provided for each switchboard, mounted on the inside of the cabinet door.

4.5.2.3.5.1. Doors are to be effectively earthed by 6 mm^2 insulated flexible copper bonding straps.

4.5.2.3.5.2. Painting mild steel metalwork shall be as follows: After construction and all cut outs completed, the sheet metalwork shall be thoroughly rubbed down to a smooth blemish free surface free of all defects and rush. All metalwork shall be Zinc Chromate primed and passivated, undercoated, two topcoats of high gloss enamel paint “gray” exterior and white interior.

4.5.2.3.5.3. The switchboard shall be so arranged that it may be readily extended in either direction. Each shipping section shall have provision for top lifting and lifting eyes or beams shall be provided.

4.5.2.3.5.4. The manufacturer shall provide the internal fixings within the equipment necessary for the holding down bolts.

4.5.2.3.5.5. Workmanship shall be of a high standard in all cases and the finished equipment shall present a neat and attractive appearance.

4.5.2.3.5.6. All bolts, nuts, washers and spring washers used in the assembly of components and cubicles shall be of adequate size for the duty required and shall be Zinc plated to prevent corrosion. Cadmium plated components shall not be used.

4.5.2.3.5.7. Cable ducting shall be so sized and arranged that the cables in the duct do not exert pressure on the lid or cause deformation of the duct.

4.5.2.3.5.8. Cable ducts are to be dedicated to electrical cables only. Under no circumstances are pneumatic lines to run in these ducts.

4.5.2.3.5.9. Any cables entering through the top of sides of an envelope shall pass through cable glands. Where circuits or sub mains exceeds 100 Amps and are single cored and gland plates shall be designed to prevent currents in the plates.

4.5.2.4. **Main Switchboards**

4.5.2.4.1. All main switchboards are required and shall be of a type-tested design as defined in and of comparative type construction.

4.5.2.4.2. Main switchboards supplied directly from transformers shall have:

4.5.2.4.2.1. One voltmeter with selector switch for phase and line voltage selection;

4.5.2.4.2.2. One multi-function relay with the following minimum features:

- Phase relay;
- Over/Under voltage relay
- Phase unbalance relay
- Ground fault relay
- Under load current relay
- Overload relay

4.5.2.5. **Bus Bars**

4.5.2.5.1. **Phase Bars:**

4.5.2.5.1.1. Bus Bars shall be hard drawn, high conductivity copper supported on approved insulation. The Bus Bar Assembly shall be rated based on short circuit calculation for 1 second minimum and have type tested certificates for an approved testing station.

4.5.2.5.1.2. Main bus bars shall be rated for minimum of 25 % greater than the total loading on them.

4.5.2.5.1.3. Connections for demountable or withdrawable switchgear shall be so arranged as to permit easy disconnection without disturbing the working condition of the bus bar or cable connections. The bus bar is to be pre-drilled to permit easy extension in either direction.

4.5.2.5.1.4. Main connections and bus bars shall be arranged and identified in either by painting, PVC sleeving or other approved means.

4.5.2.5.2. **Earth Bars**. This shall be installed in line with the standards. A suitable sized earth bar shall extend the length of the switchboard.

4.5.3. MOTOR CONTROL CENTERS

4.5.3.1. **General**

4.5.3.1.1. The work covered by this Specification includes the design and manufacture of motor control center (MCC) equipment completely assembled.

4.5.3.1.2. The Vendor shall also provide technical assistance during the installation and placement in service of the equipment, if requested by the Purchaser.

4.5.3.1.3. All equipment shall be designed, built, rated, tested and shall perform in accordance with the latest editions of the applicable standard.

4.5.3.1.4. The standards and regulations of authorities having jurisdiction over the equipment particularly ZAMCELCO shall apply.

4.5.3.1.5. Where the stipulation of this Specifications, the data sheets and the drawings do not comply with the minimum or its equivalent requirements of the applicable regulations and standards; the latter shall prevail. Where the stipulations of this Specification, the data sheets and the drawings are more exacting than the minimum or its equivalent requirements, the former shall prevail.

4.5.3.2. **Service Conditions**. The MCC and all components therein, shall function in a satisfactory manner within the rated capacity under the service conditions specified regardless of whether or not all necessary specific performances are set forth in this Specification or in the applicable standards.

4.5.3.3. **Design Construction Details**

4.5.3.3.1. **General:** The MCC within this Specification shall be compartmentalized.

4.5.3.3.2. **Enclosure:** The MCC shall be constructed with suitably folded and stiffened corners and edges with an integral supporting structure, and shall be manufactured form or mild steel as specified.

4.5.3.3.3. The MCC shall be free standing, front connected and front wired. The front of the MCC shall have doors supported with chrome plated pintle hinges. The door shall not extend more than 450 mm perpendicular to the MCC face. The door locking shall be designed to prevent opening when subjected to forces caused by an internal fault. Master locking system on all doors.

4.5.3.3.4. All openings shall be fitted with a suitable non distorting compressible seal, which shall engage onto the MCC panel's stiffened return surround on one side and the door's rear face within the stiffened return on the other side.

4.5.3.3.5. Each section of the MCC shall be supported on the identical 75 mm RHS hot dip galvanized plinth, fully braced and welded, turned outwards.

4.5.3.3.6. Gland plates shall be fitted to the top and the bottom of the MCC and at the incoming supply cable entry, this gland plate shall be 3.5 mm thickness aluminum, and all other gland plates shall be made out of the MCC construction material. All gland plates shall be gasketed and bolted.

4.5.3.3.7. Wiring diagram pockets shall be provided.

4.5.3.4. **Component Arrangement**

4.5.3.4.1. All electrical equipment shall wherever possible be mounted on DIN rails on metal mountings. If equipment has to be attached directly onto the mounting plate, they shall be secured by screws in the pre-tapped holes, self-tapping screws are not permitted.

4.5.3.4.2. All wiring shall wherever possible be wired in ducts. Cable ducting shall be so sized and arranged that the total number of cables and wires to be installed in the duct do not exert pressure on the lid or cause deformation of the duct. Signal wiring where possible be segregated from other wiring.

4.5.3.4.3. The minimum clearance between panel mounted equipment, cable looms, ducting, terminals and MCC framework or panels shall conform to the latest edition PEC standards.

4.5.3.5. **Shipping**

4.5.3.5.1. Motor Control Center may be delivered in sections provided that it will be installed prior to and in time for testing and commissioning. Each section shall be suitably braced and have lifting points so that during a crane lift no distortion will take place. Assembly instruction shall accompany the equipment.

4.5.3.6. **Other**

4.5.3.6.1. Identification, test and inspections, drawings, wiring and approvals of MCCs shall agree with the relevant sections within this Specification.

4.5.3.6.2. Instrument cubicles shall be separate, the layout shall be approved by ZCWD.

4.5.3.6.3. All fields wiring to remote control panels or instrument shall be terminated into a terminal rail, not wired directly to devices.

4.5.4. DISTRIBUTION BOARDS/CONTROL PANELS

4.5.4.1. **Construction**

4.5.4.1.1. The enclosure shall be constructed as per section on Low Voltage switchboards.

4.5.4.1.2. The door seal shall be of high quality and a pressured catch handle shall be employed.

4.5.4.1.3. Exterior cables (power source cables as well as feeding cables) shall be directly connected to the MCCB or isolator. Adequate space for exterior wiring shall be provided.

4.5.4.1.4. A permanent connection diagram identifying the feeders shall be provided in holder fitted with a transparent cover inside the door on completion of construction.

4.5.4.1.5. Provision for spare space for future expansion shall be provided to accommodate additional load capacity of the STP of up to 6,000 cubic meters per day.

4.5.4.1.6. Grounding Bar shall be provided. The sectional area of the neutral bar shall be equal to the sectional area of the phase bar.

4.5.5. COMPONENTS

4.5.5.1. **General:** All switches shall be of the fault make load break suitably de-rated for their enclosure.

4.5.5.2. **Power Switches and Isolators**: Switches are to be rated for ACB. They are to be lockable and have operating indication of 'OFF' and 'ON'. Main cubicle switches shall be rated for at least the same fault level as the bus bars and shall be able to break the full load current or make onto a fault.

4.5.5.3. **Circuit Breakers**

4.5.5.3.1. The main incoming terminals of the main switch shall be extended by copper 'take offs'. The unit shall be lockable in the 'service', 'test' and 'isolated' position and when the CB is 'Open/Off'.

4.5.5.3.2. ACB's shall be of the withdrawable type and equipped for manual stored energy operation. They shall have shunt release coils. ACB's shall have at least two normally open and two normally closed spare auxiliary contacts over and above those required for operation of the scheme as detailed on the drawings.

4.5.5.3.3. All main CBs shall have thermal, instantaneous overcurrent and earth fault protection with provision for single phasing, and delayed under voltage if required.

4.5.5.3.4. Branch Circuit protective devices shall be molded case circuit breakers providing complete circuit overcurrent protection by having inverse time and instantaneous tripping characteristics.

4.5.5.3.5. Circuit breaker for general purpose convenience outlet shall be ELCB type rated at 30mA.

4.5.5.3.6. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching

mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding alloy. A push-to-trip button on the front of circuit breaker shall be provided local manual means to exercise the trip mechanism.

4.5.5.3.7. Each molded case circuit breaker microprocessor-based tripping system shall consist of three current sensors, a trip unit, and a shunt trip.

4.5.5.4. **Feeder Protection Relay**. Protection relays with the following minimum protection:

- Instantaneous overcurrent relay
- Ground fault overcurrent with time delay
- Thermal overload relay
- Load unbalance, phase sequence overcurrent relay

4.5.5.5. **Motor Protection Relay**: Motor protection shall be provided as specified in Soft Starter Section.

4.5.5.6. **Metering**.

4.5.5.6.1. Three phase digital incoming metering shall be provided by a power quality meter. Metering shall include Ampere, Voltage, Wattage, Watthour, var (Reactive Volt ampere), Volt-Ampere, Hertz, and Power Factor.

4.5.5.6.2. Four switch inputs shall be provided which can be programmed for relay activation, counters, logic, reset and alarms. Four output relays shall be provided which can be programmed to activate on alarms, set points, switch inputs, kWh pulse or communications control. These output relays shall also be able to use demand metering values of A, var, W and VA to control load shedding. PLC interface shall be provided via four isolated 4-20 mA outputs programmable from measured parameters.

4.5.5.6.3. Local user interface shall include a keypad and display for entering all set points and reading all measured values, and LED indicators for output relays, communication status and alarm status. An RS232 computer interface port shall be located on the front panel.

4.5.5.6.4. All metering shall be Solid state digital metering. Metering shall be panel mounted type.

4.5.5.6.5. Ammeter and run hour meter shall be provided to all motors.

4.5.5.7. **Pushbuttons**

4.5.5.7.1. Pushbuttons shall have a heavy-duty oil tight rating, be of the mounting hole type and follow the color coding prescribed by applicable standards.

4.5.5.7.2. Pushbuttons should be of oil tight (hose proof) type.

4.5.5.7.3. Pushbuttons shall be shrouded to minimize the possibility of accidental operation.

4.5.5.7.4. All buttons shall be clearly labelled.

4.5.5.8. **Indication**: Indicator lights shall be of similar design as the pushbuttons of mounting hole type, and should also be hose proof. The lights shall be LED type.

4.5.5.9. **Starters**

4.5.5.9.1. Each starter is to have isolation, overcurrent and thermal protection, a contractor, control voltage C/B and terminals for output power and control cables.

4.5.5.9.2. The power wiring shall be red, white and blue. The minimum size of all power wiring shall be 3.5 mm^2.

4.5.5.9.3. The overcurrent and thermal protection shall be coordinated so that both motor and starter equipment is protected.

4.5.5.10. **Thermal Protection**

4.5.5.10.1. The setting of the relay or starter will refer to the motor full load current.

4.5.5.10.2. Overload elements are required in all three phases. The overload shall be temperature compensated, and have differential single phasing protection.

4.5.5.10.3. Thermal overloads shall be fitted with two pairs of electrically separated auxiliary contacts for indication and tripping purposes. (2 x NO., 2 x NC).

4.5.5.11. **Contactors**

4.5.5.11.1. Utilization Category to be ACB.

4.5.5.11.2. Minimum rated current at duty specified is to be 9 amps.

4.5.5.11.3. All contactors shall be double air break with at least one auxiliary contact and provision for adding more.

4.5.5.11.4. Reversing contactors shall be incorporated electrically and mechanically interlocking where practical.

4.5.5.11.5. Contactors for power factor capacitor shall be provided with on delay relay.

4.5.5.12. **Control Relays**: All control relays shall be of the plug-in type held by retaining clips. All contacts shall be rated for at least 5 amps. All relays shall be in sealed enclosures with means for manual operation from the front. An indication to show relay operation is required.

4.5.5.13. **DC Power Supplies**: Dc power supplies shall have isolated outputs, have regulation to control the voltage within 0.5 % of the rated value over the full load range. The output ripple shall be within 0.2% peak to peak or less than 0.05% RMS. The output shall be protected against short circuits. The gear plate shall have a perforated steel cover mounted such that the cover can be removed while the unit is alive without the possibility of the cover touching live parts. The input and output terminals shall be of the type described under Terminals and shall be rated for clamping on the outgoing side, two cables each rated for the full current of the power supply. The power supplies shall not exceed the nominal voltage at power up more than 1.5 V.

4.5.5.14. **Timers**: All timers shall have electronic timing. They shall be multi voltage and shall accept 12 to 240 volts AC or DC without any wiring or switch changes. They shall be multi-function giving delayed on and true delayed off as selected from a function switch. The time range shall be adjustable between 0.6 seconds and 60 hours. A visible indication shall be given when the timer has timed out. The timer shall have an 11-pin circular plug-in base. The output shall be voltage free contacts rate for a minimum of 5 amps inductive.

4.5.5.15. **Terminals**

4.5.5.15.1. External wiring shall be terminated at terminal blocks within motor control centers and control panels.

4.5.5.15.2. Terminal shall be of Polyamide spring assisted type or approved equivalent.

4.5.5.15.3. Terminal blocks shall be rail mounted.

4.5.5.15.4. Terminal blocks shall be segregated in groups by barriers of blank space to separate extra low voltage terminals from those of higher voltage. It is preferred that both terminals and cables be colored to indicate voltages. This will improve safety and make fault finding easier.

4.5.5.15.5. No more than 2 wires may be terminated in any tunnel or clamp type terminal.

4.5.5.15.6. Approved insulated crimp lugs must be used to terminate multi-strand flexible cables. One cord only in each lug.

4.5.5.15.7. The use of plug-in type strip terminals is not permitted.

4.5.6. SOFT STARTERS (SS)

4.5.6.1. **General**

4.5.6.1.1. This section covers the general requirements applicable to the design, manufacture of Soft Starter Drive to provide ramp starting and stopping of AC motor rated as indicated in the drawing and its associated equipment and accessories completely assembled.

4.5.6.1.2. The supplier shall also provide technical assistance during the installation and placement in service of the equipment, if requested by the Purchaser.

4.5.6.1.3. All equipment shall be designed, built, rated, tested and shall perform in accordance with the latest editions of the applicable standards.

4.5.6.1.4. The controller shall provide a soft start with selectable Kick start and a soft stop option.

4.5.6.1.5. The SS shall be selected to provide a successful start of the relevant connected load by being able to provide sufficient current so that the motor is able to develop the level of torque required.

4.5.6.1.6. The SS shall be equipped with Capacitor to improve the power factor to 80%.

4.5.6.1.7. The soft starters shall be dependent on the bidder/contractor's design that is based on standards as to meet the performance specifications of the proposed SSTP.

4.5.7. LOW VOLTAGE FREQUENCY DRIVE

4.5.7.1. The VFD shall be able to start into a spinning motor. The VFD shall be able to determine the motor speed and resume operation without tripping.

4.5.7.2. Harmonics compliance shall be verified with onsite field measurements of both voltage and current harmonic distortion at the drive input terminals with and without the VFDs operating. A recording type Fluke or equivalent harmonic analyzer and total harmonic currents and voltages must utilize.

4.5.8. TRANSFORMERS

4.5.8.1. The transformer supplied and installed on site must be compliant with the requirements of the electric utility (ZAMCELCO).

4.5.8.2. The design of the transformer shall be either of the following:

i. Three Single Phase with 1 spare single phase;
ii. One three-phase with 1 spare three phase

4.5.8.3. **Tests**: The transformer which shall be used at the project site must be presented to the electric utility (ZAMCELCO) for testing.

4.5.9. EARTHING

4.5.9.1. The installation of copper earthing rods 3.0 meters long and a minimum of 15 mm in diameter with the required number to achieve a ground resistance of 5.0 Ohms or less. The earthing rods shall be arranged, driven into the ground and connected together etc. to the manufacturer instructions. The earthing rods shall be connected together and wired to a new main earth bar via suitably sized copper cable(s).

4.5.9.2. All metallic conduits, cabinets and equipment shall be properly grounded and bonded by means of copper straps. The conduits of each system shall be grounded by connecting to the metallic water service pipe. All ground connections shall have clean contract surfaces and shall be tinned and seated while bolting. Unless otherwise specified, exposed ground cables shall be installed in conduit and connections made readily accessible for inspection. Connections shall not be made underground or concealed in floors and walls.

4.5.9.3. All ground connection shall be clamped and brazed or cad welded.

4.5.9.4. The following equipment shall be grounded:

- Motors;
- Secondary main distribution panel;
- Panels;
- All other equipment as required by the National or Philippine Electrical Code;
- All grounding type receptacle outlets;

4.5.9.5. The resistance of the combined grounding system shall not exceed 5 ohms and shall be in accordance with the standards of the latest editions of the National Electrical Code, Philippine Electrical Code and all governing authorities having jurisdiction;

4.5.9.6. All earthing cables shall where possible include for green and yellow PVC sheaths.

4.5.9.7. The entire installation shall be free from improper grounds and from short circuits. Insulation and earth loop impedance tests shall be made in the presence of ZCWD. Each panel shall be tested with mains connected to the feeder, branches connected and switches closed, all equipment in place and permanently connected. Each individual power feeders shall be tested with the power equipment connected for proper and intended operation. In no case shall the insulation resistance be less than that allowed by the Regulation for Electrical Equipment of Buildings, failures shall be corrected in a manner satisfactory to ZCWD.

4.5.9.8. Above 5.0 kW both ends of each motor winding one to be brought out to the terminal box such that the motor is suitable for Star/Delta starting. Terminal boxes to be of adequate size and shall be easily accessible in the installed position. Cable entry to the terminal box shall be from at least two directions and terminating shall be in suitably robust terminals or studs.

4.5.10. LIGHTING AND SMALL POWER

General area lighting is to be located to allow access for re-lamping without the use of temporary scaffolding. Suitable means of access are ladders not exceeding 2.1 M in height, mobile work platforms or extension handles and lamp changer heads.

4.5.11. INSTRUMENTATION AND CONTROLS

All field sensor types to be approved by ZCWD.

4.5.12. PROGRAMMABALE CONTROLLERS

4.5.12.1. In cases where the programming is done by the supplier, the supplier shall provide a copy of all working programs on cd as well as a printed program listing.

4.5.12.2. The supplier shall have the capability to conduct on-site training programs at a location provided by the end-user.

4.5.12.3. Within the enclosure all I/O racks, processor racks, and power supplies shall be grounded to meet the manufacturer's specifications.

4.5.12.4. **Wiring and Terminal Identification:** All single cores including individual cores of multicore cable to be identified at each end with approved markers. The only exception to this requirement is short lengths not exceeding 100 mm which are used to connect between C/B's and contactors, or loops from one terminal on terminal strips or contact blocks – provide these short lengths are not loomed up or otherwise covered, one end only be numbered. Cable cores shall be identified at the rail terminals only. All terminals should be clearly marked on outgoing side of terminal and common type circuits shall be grouped logically i.e., power, control etc.

4.5.12.4.1. **MCC/Panel wiring:** At every termination the wire shall have crimped connection. The joining of any wire in the duct is expressly prohibited. All external connections (with the exception of the supply and local sub mains) shall be via terminals mounted on the mounting plate. All terminals shall be grouped in a logical order.

4.5.12.4.2. **Panel and Cubicle Wiring:** Wiring with the panels and cubicles shall be installed in an approved PVC wiring duct and any conductors not installed in these ducts shall be laced with PVC ties and strips in an approved manner. The total cross-sectional area of wiring within ducts shall not be greater than 40% of the total cross-sectional area of duct.

4.5.12.4.3. All wiring shall be stranded with minimum size of:

- 1.0 mm2 for Electronics/Instrumentation signals;
- 1.5 mm2 for control
- 2.5 mm2 for Power and CT circuits

4.5.12.4.4. All ducts shall be terminated with suitable crimp lugs. No soldered or bare wires shall be used as terminations.

4.5.12.5. All wiring shall be rigidly supported and where against metal, protective insulation shall be provided. Wiring between hinged panels and fixed All wiring shall be rigidly supported and where against metal, protective insulation shall be provided. Wiring between hinged panels and fixed.

4.5.12.6. **Cables Identification**

4.5.12.6.1. All circuits are to be uniquely identified by an alphanumerical cable number as listed in the cable list, and cable cores shall be identified at the rail terminals only.

4.5.12.6.2. All sheathed cables shall be uniquely identified at each end by means of engraved or embossed labels firmly attached to the cable. For bottom entry this label should be attached just after it enters the enclosure in which it is terminated.

4.5.12.6.3. For top entry this label should be attached just before it enters the enclosures;

4.5.12.6.4. All power, control and instrumentation cabling shall be identified at all terminations by use of a durable type tag and approved by ZCWD.

4.5.12.7. **Item Identification and Equipment Labelling**

4.5.12.7.1. All electrical components shall have all terminals clearly and permanently marked. All items of equipment shall be identified by permanent labels giving the item designation;

4.5.12.7.2. All labels shall be in English, engraved black lettering on white background. All necessary warning labels to be engraved on approved material with white letters on a red background;

4.5.12.7.3. Characters shall be legible for both the equipment label and electrical component, uppercase print type font, mechanically engraved;

4.5.12.7.4. Labels mounted inside electrical enclosures and switchboards may be mounted using approved double-sided adhesive tape, and shall not be attached to removable ducting tops;

4.5.12.7.5. Labels mounted outside electrical enclosures to be fixed with at least two screws, rivets or drive parts on the permanent structure to which the component is mounted, adjacent to the component and readily visible from in front of the component. Where ready access is not available in front of a component then additional labelling that is visible from a readily accessible position will be required, e.g. Solenoids, limit switches etc. positioned behind panels, under

machinery etc. are to be identified also by labels mounted on external surfaces of the machine.

4.5.12.7.6. Instrumentation equipment may be identified by using cable the alphanumeric identification Tag approved by the ZCWD;

4.5.13. INSTALLATION

4.5.13.1. **General**

4.5.13.1.1. All field wiring to motors, control stations sensors and actuators shall be wired using cables. Conduit wire is not accepted. Single wires in conduit will not be accepted.

4.5.13.1.2. Connections of series of contacts such as emergency and motor stops, safety switches etc., are not to be looped in the field. All wiring is to be brought back to a common terminal rail. Indication of the devise being operated is to be provided both locally to the devise and at the approved area control station.

4.5.13.2. **Cable Installation**

4.5.13.2.1. Single core power cables to be clamped in Trefoil Arrangement;

4.5.13.2.2. Cables shall be securely braced with cable clamps or ties as required;

4.5.13.2.3. Vertical rises of cables shall be secured at intervals no less than 1 meters, to allow for cable expansion;

4.5.13.2.4. The arrangement of cables on ladder trays or brackets shall be such that where cables join or leave the ladder or brackets there is not unnecessary crossing or tangling of cables. Where cables are liable to mechanical or environmental damage they shall be protected in a suitable manner;

4.5.13.2.5. Where cables pass through fire rated walls or floors a fire barrier or fire rated sealing compound shall be used to seal the space after installation of the cables.

4.5.13.2.6. All cables, pipes and conduits shall be buried not less than 600 mm below finished ground level in the center of a 150 mm layer of sand. Underground cables, pipes and conduits shall be effectively protected with yellow PVC cable warning marker tape (or equivalent) covered above the run of services 150mm below the surface.

4.5.13.2.7. Cables shall not be cast directly into concrete;

4.5.13.2.8. All instrumentation/data cables shall be segregated from power cables by a minimum of 300mm and from control cables by a minimum of 50mm;

4.5.13.3. **Cable Protection**

4.5.13.3.1. Cables shall be fully protected from mechanical damage. The protection shall not allow liquids to enter or accumulate within the protection;

4.5.13.3.2. All cables are to be protected where they pass through any openings, gaps, holes, or over edges of metalwork, ladders etc. The contractor shall ensure that surrounding surfaces are smooth and free of sharp edges etc., and that holes are bushed with close fitting plastic bushes;

4.5.13.4. **Cable Entrances:** All cable entrances to equipment and buildings shall be vermin proof and shall be firmly sealed to prevent ingress of weather and water.

4.5.13.5. **Cable Glands:** Where cables terminate in cubicles or auxiliary equipment boxes, the cables shall be fitted with suitable cable glands. These cable glands shall grip the cable securely, seal on the outer sheath of cable and be complete with locknuts. They shall for armored cable include provision for securely bonding the earth.

4.5.13.6. **Cable Terminations**

4.5.13.6.1. All terminations shall comply completely with the manufacturer's recommendation instructions.

4.5.13.6.2. Cables joints shall be made only in approved junction boxes.

4.5.13.6.3. All terminations of field cable cores shall be to individual terminal blocks mounted in a group adjacent to each other.

4.5.13.6.4. Connection of power cables shall be with crimp type lugs of the correct size for each size conductor together with electroplated bolts, nuts and lock nuts.

4.5.13.6.5. Connection of control and signals cables, except thermocouples, shall be with appropriate crimp pins or lugs.

4.5.13.6.6. Adjacent to motors (Aerators), motor cables shall terminate at a local isolator for the motor. The isolator shall be rated to ACB. Cabling between the isolator and the motor terminal box shall be enclosed in flexible conduit.

4.5.13.6.7. Cable or core termination shall under no circumstances be under mechanical stress due to lack of support of the cable or vibration.

4.5.13.6.8. The connection of cable screens shall fan out from the signals power supply, with the remote ends being insulated from earth. (Star connection) Screens on screened cables shall be insulated or sleeved and brought out as appropriate. Heat shrink sleeving shall then be fitted over the end of cable sheath.

4.5.13.6.9. All field sensors with molded in leads shall be held by compression glands at the terminal boxes. Where leads are subject to mechanical damage, suitable sized loose flexible or rigid conduit shall be fitted over this lead and fixed to support in an appropriate manner.

4.5.13.6.10. The Contractor may be required to demonstrate his jointing technique, and, if in the opinion of ZCWD, the termination is faulty, the Contractor shall replace all other terminations so jointed at no extra cost.

4.5.13.6.11. Cables, conduits or ducting entering cubicles, junction boxes, motor terminal boxes or like, shall be from the bottom. (Unless otherwise specified or approved by ZCWD).

4.5.13.7. **Cable Support System**

4.5.13.7.1. Cable ladder racking, trays and ducting shall have a minimum of 20 percent spare capacity for ventilation.

4.5.13.7.2. All fixings to concrete or masonry shall be of the expansion type set in holes. Explosive powder-charged fixings shall not be used.

4.5.13.7.3. Fixings to structural steelwork shall be by clamping, not welding or drilling, except with the specific prior approval of the ZCWD.

4.5.13.7.4. Cable support systems shall be installed in accordance with the manufacturer recommendations to give a maximum between support deflection of 10 mm when carrying the final number of cables to be installed.

4.5.13.7.5. All steel supports, frames, hangers and the like shall be electroplated and, in most areas, hot dip galvanized.

4.5.13.7.6. All exposed threads on support systems, conduit and other places where the galvanizing finish has been removed shall be painted with galvanized paint. Use of spray can type of paints is prohibited.

4.5.13.7.7. All lengths of the cable support system shall be bonded to earth.

4.5.13.7.8. The Contractor shall submit to the principal a layout of his proposed method of reticulation throughout the Plant showing positions of all cable ladder, tray or ducting system.

4.5.13.8. **Cable Ladders**

4.5.13.8.1. Cable ladders shall be hot dipped galvanized steel with welded rungs. They shall be completed with accessories including hot-dip galvanized hangers, brackets and cable clips.

4.5.13.8.2. The contractor shall supply and erect all cable ladders and all brackets and fabricated steelwork necessary to support the cable ladder and shall ensure that they are adequate in all respects for the loading imposed.

4.5.13.8.3. All changes in direction shall be made using purpose made slow radius bends and cranks as manufactured for this purpose.

4.5.13.8.4. Cable ladders installed outside the building shall be provided with cover.

4.5.13.9. **Cable Trays**

4.5.13.9.1. Cable trays shall be hot dipped galvanized steel and securely fixed.

4.5.13.9.2. Cable Trays installed outside the building shall be provided with cover.

4.5.13.10. **Conduits**

4.5.13.10.1. All exposed conduit, embedded in concrete, conduit in plant room and equipment area where exposed to damage shall be screwed galvanized conduit.

4.5.13.10.2. Where steel conduits are used, they shall not be utilized as the earth continuity conductor to plant and equipment.

4.5.13.10.3. All steel conduits shall be bonded to earth.

4.5.13.10.4. All conduit runs whether above ground or below shall utilize inspection boxes/draw pits at every change in direction or/and every 50 meters, to enable the cables to be routed through the conduits.

4.5.13.10.5. Where space allows, every conduit run shall include for a nylon draw rope to aid the pulling in of additional cables at a later date.

4.5.13.11. **Flexible Conduit**

4.5.13.11.1. PVC coated gray color flexible conduits shall be used for the final connection to removable field apparatus such as motors, RTD probes and the like.

4.5.13.11.2. Conduit installed outside shall be stabilized against ultra violet light.

4.5.13.11.3. Where mounted on moving parts of machinery or where subject to mechanical damage the conduit shall be flexible PVC covered galvanized steel.

4.5.13.11.4. All flexible conduits shall be terminated in purpose-built glands.

4.5.13.12. **Cable Junction and Equipment Boxes**

4.5.13.12.1. Boxes for equipment requiring more than 300 mm length of terminals shall be fitted with a door;

4.5.13.12.2. Reference shall be made to the section on SWITCHBOARDS for details on manufacture, equipment, wiring, labelling etc.;

4.5.13.12.3. In wet processing areas boxes shall be made of stainless steel. They shall be mounted at a normal working height with a minimum floor clearance of 300 mm;

4.6. PLUMBING REQUIREMENTS

4.6.1. Plumbing works shall follow the National Plumbing Code of the Philippines.

4.6.2. Sanitary design and construction shall abide by the Code on Sanitation of the Philippines;

4.6.3. **TESTING AND DISINFECTION**: Testing and disinfection of water pipes shall be in accordance with LWUA standards.

5. COMMISSIONING REQUIREMENTS

5.1. GENERAL REQUIREMENTS

5.1.1. The contractor shall supply all necessary manpower, apparatus and instruments necessary for the commissioning and carrying out of proving and performance testing on the plant. All fees or costs associated with testing, commissioning and proving operation of the facility for the specified period shall be borne by the Contractor. The plan for conducting the commissioning and proving tests shall be submitted to the ZCWD for its approval.

5.1.2. Aside from the in-house laboratory, all laboratory analysis of the final effluent conducted monthly must be analyzed by a third-party laboratory duly accredited by the Environmental Management Bureau and submitted to ZCWD. All sampling activities must be conducted in the presence of ZCWD representatives for the whole duration of the commissioning period.

5.1.3. Commissioning shall comprise of a minimum of two (2) stages:

5.1.3.1. Testing and pre-commissioning by the Contractor on site of individual equipment and of integral system operation which has a period of 30 days; and

5.1.3.2. Final commissioning by the Contractor as directed by ZCWD for equipment and integral system operation in compliance with required standards to the satisfaction of ZCWD. This stage shall cover the trial run for a period of 30 days. During the trial run, weekly sampling must be taken and be tested with a DENR accredited laboratory. All weekly samples must pass all the parameters of the required effluent standards within the 30-day period trial run. If during the trial run, a sample did not comply with the required effluent standards, the same shall be repeated. At this instance, the 30-day period shall recommence. This stage of the commissioning shall only be considered to have been complied if all samples have passed the required effluent standards within the given period. All costs incurred for modification to meet the required effluent shall be to the account of the Contractor.

5.1.4. Commissioning of the project shall be for a total period of ninety (90) calendar days. Upon compliance to the conditions for commissioning, ZCWD shall issue a Certificate of Commissioning after which the contractor will proceed to the one (1) year process proving.

5.1.5. Final commissioning shall only be recommended pursuant to the following conditions to the satisfaction of ZCWD:

5.1.5.1. Satisfactory rectification of identified defects and missions;

5.1.5.2. Equipment and system perform satisfactorily as confirmed by the testing and pre-commissioning records; and

5.1.5.3. Operation and maintenance manuals satisfactorily complete.

5.1.6. A pre-requisite to practical completion shall be the completion of final commissioning to the satisfaction of ZCWD.

5.1.7. Prior to acceptance, the winning bidder must be able to expose the end user on the sewage/wastewater system being offered on actual site in any or all of its completed facilities. Expenses for at least five (5) personnel will be to the cost of the contractor.

5.1.8. All drawings shall be submitted in electronic file that may be accessed with CAD format file readable in Autodesk AutoCAD software with a printed copy on size A1 tracing paper.

5.1.9. A fully detailed parts listing including quantities, materials and manufacturer's part numbers (if applicable).

5.1.10. Immediately following successful final works/testing/commissioning, the "As-built" drawings of the STP, including the electrical installations and mechanical facilities should be forwarded to ZCWD incorporating any modifications necessary as a result of the test. It shall forward three (3) white copies, one (1) reproducible copy, and an electronic copy on flash drive, of all documentation and drawings applicable for the installation. It shall also submit three (3) clear copies of test certifications conducted on the various installations.

5.1.11. Each datasheet shall incorporate all relevant data associated with each specific valve which shall include but not be limited to:

- Principal dimensions;
- Any pertinent construction details;
- Materials used for all parts;
- Torque limits;
- Pressure rating;
- Connection detail;

5.1.12. **NAMEPLATES**

A nameplate shall be fitted in a prominent position on each equipment and valves giving the following minimum information:

- Manufacturer's name and address;
- Identification and/serial number;
- Month and year of manufacture;

- Working and Test Pressure;
- The direction of flow in the form of an arrow;
- Speed in rpm for equipment;

5.1.13. Outline of control protocol shall be submitted for electrical components with ratings;

5.1.14. A full set of any special tools required for the operation, maintenance, or repair work on electrical or instrumentation equipment shall be supplied.

5.2. COMMISSIONING WORKS

5.2.1.1. The ZCWD shall create a Project Monitoring Unit (PMU) and shall coordinate with the contractor's authorized representative to oversee the testing and commissioning phase;

5.2.1.2. Every equipment used for the plant shall undergo testing in order to ensure its conformity with the designed load. Should there be any defects, the same shall be rectified by the contractor at their own cost and within reasonable time which shall be decided upon by ZCWD;

5.2.1.3. The Contractor shall guarantee for a period of one (1) year for the failure of any part of the equipment. The Contractor shall replace certain part of the equipment in the event that it has failed to function during the guarantee period. However, if it is found that the failure is due to some other connected parts, the same shall also be rectified or replaced by the contractor to avoid such failure in the future. The guarantee for such replaced parts shall be extended for one (1) year from the date of last replacement;

5.3. OVERALL PERFORMANCE TESTING

5.3.1. The Contractor shall commission all plant and maintain the plant in a satisfactory operating condition for the whole of the commissioning period. After the completion of the installation and successful preliminary testing by the Contractor, the Contractor shall give ZCWD seven (7) days' notice that the installation is ready for normal performance checking, forwarding a record of final preliminary test figures with the notification. On receipt of the notification,

ZCWD PMU will witness repeat tests on the installation together with any additional tests they may be considered necessary to prove that the performance, efficiency and operation of the plant meet the requirements of this specification. The Certification of Practical Completion will only be issued after satisfactory completion of the Testing.

5.3.2. The Contractor shall be responsible for making all the necessary remedial measures within 90 calendar days after the first test period to bring the plant performance efficiency to the specified level at no additional cost to ZCWD; except when the cause of not meeting the specified level of efficiency is when the actual plant loading is more than the specified plant loading duly verified by the Contractor prior to construction. Failure of the Contractor to make the remedial measures shall authorize ZCWD to confiscate the Performance Security or Performance Guarantee bond as the case may be and to retain all monies due to the Contractor without prejudice to ZCWD's right to file a damage suit.

5.3.3. The testing work will include all tests and checks but it shall not be limited to the following:

5.3.3.1. Flushing and cleaning of water lines & piping works;
5.3.3.2. Testing the effectiveness and workability of electrical lines and water & sewer lines;
5.3.3.3. House cleaning of the work area in preparation of hand over to ZCWD;
5.3.3.4. Testing of submersible pumps, blowers and other plant equipment; &
5.3.3.5. Includes hydraulic testing for water tightness/seepage as per relevant code for all water/wastewater retaining structures;

5.4. MECHANICAL

5.4.1. The Contractor shall prepare detailed test plans and commissioning program for review and approval by ZCWD four (4) weeks prior to practical completion.
5.4.2. The plans shall include installation checks, checks of all safeties, operator variable equipment, performance and duties of all pumps and other mechanical equipment.
5.4.3. A complete list of all standard settings and adjustments necessary to variable plant shall be provided by the Contractor;
5.4.4. **Pump Testing and Start-up**

5.4.4.1. The pump installation shall be tested before commissioning commences. All tests shall be performed in accordance with the manufacturer's instructions;

5.4.4.2. Check operation of all valves included with the installation.

5.4.5. **Minimum Tests Required**

5.4.5.1. Pipe work leak test to closed valve conditions

5.4.5.2. Demonstrate the removal of the pump-set using the lifting davit, chain and guide rail(s) if pump is centrifugal

5.4.5.3. Demonstration of running amps at the duty point;

5.4.5.4. Demonstration that the pump performance meets the specified duty;

5.4.5.5. Undertake the electrical testing in accordance with electrical specification;

5.4.6. The Contractor shall be responsible for providing all power requirements and special tools required to undertake the aforementioned. Furthermore, if additional instrumentation (portable in nature) is required to undertake the testing described herein then it shall be the responsibility of the Contractor to provide the same. Should any of the above test results (and others undertaken as detailed within the plant manufacturer's instructions) be not compliant to the required standards then rectification of the same shall be required and re-testing be performed until the standards should have been satisfied with the said works. Any costs incurred for required modification works and re-testing shall be to the account of the Contractor. After testing has been undertaken all ancillary items left on site shall be removed and the site tidied. Only after satisfactory inspection of the working area by the ZCWD shall final hand-over be complete.

5.5. ELECTRICAL

5.5.1. The contractor is completely responsible for the satisfactory installation, testing and commissioning to the relevant standard and to the requirements of ZCWD.

5.5.2. ZCWD reserves the right to inspect at any time, the shop drawings, equipment, materials and installation called for in this Specification and on the drawings during manufacture, installation and commissioning.

5.5.3. **Testing**

5.5.3.1. **General**: Tests are to be pre-planned, scheduled, and carried in a safe and efficient manner. Notification will be given at least three (3) days in

advance to carrying out any tests of the panels and field wiring so that a representative is able to plan witnessing of each test at the following stages:

5.5.3.1.1.1. Equipment and cables support mounted within panel/in the field, but not wired;

5.5.3.1.1.2. Fully wired and ready for test;

5.5.3.2. All test required by Statutory Authorities are to be carried out to proved that the systems operate in accordance with appropriate codes and regulations;

5.5.3.3. Works and field testing shall be witnessed by a company representative or the Engineer and all testing and results shall be recorded. The checklist (record sheets) shall be obtained from the Electrical Engineer;

5.5.3.4. **Field Inspection and Testing**

5.5.3.4.1. All plant provided under this contract shall be available for inspection and testing as required by ZCWD or his inspector, during manufacture. The costs of the tests including the provision of all necessary test equipment at the manufacturer's works shall be deemed included in the Contract Price;

5.5.3.4.2. Prior to starting any test, the Contractor is required to check that the installation, electrical devices and instrumentation are strictly in accordance with the Specification, electrical and instrumentation drawings;

5.5.3.4.3. All other test instrument (pneumatic and electronic calibrators, temperature calibrators etc.) shall have a minimum accuracy of +0.1%.

5.5.3.4.4. Each test instruments shall be calibrated in accordance with manufacturers' standards. The calibration certificates shall not be more than 3-month-old and shall be presented to the Electrical Engineer prior commencing work.

5.5.3.4.5. Following completion of works and before the delivery, testing shall be performed by the contractor to ZCWD's satisfaction.

5.5.3.5. **MCC and Switchgear Test**

5.5.3.5.1. Test shall include but not limited to:

5.5.3.5.1.1. Cubicles shall be inspected to ensure that the quality of finish is to standard. The correct apparatus and labeling have been installed and the wiring has been carried out in a neat and correct manner.

5.5.3.5.1.2. The equipment shall be carefully inspected to ensure that all electrical connections are tight, particular attention should be paid to bus bar connections and all clearances should be adequate.

5.5.3.5.1.3. All wiring shall be checked against the schematic layout and all control switches relay contacts, timers, etc. checked for correct polarities and mode of operation.

5.5.3.5.1.4. Operational tests of control, protection, relays and alarms equipment with all items of auxiliary equipment for mounting remote, temporarily wire-in for the tests.

5.5.3.5.1.5. Where certain control interfaces are not available, simulated signals shall be used to test individual systems.

5.5.3.5.1.6. Checking phase sequence and voltage levels;

5.5.3.5.1.7. Sequential operational tests of all control circuits including interlocks;

5.5.3.5.1.8. Insulation Test (Phase to phase, Phase to neutral and Phase to earth);

5.5.3.5.1.9. Checking the individual operation of all motors without load for rotation, bearing lubrication, noise, vibration and temperature rise

5.5.3.5.1.10. Recording the operating load current of all motors;

5.5.3.5.1.11. Measure and balance full load currents in each phase when the system is fully loaded;

5.5.3.6. **Cable Test**: Every cable shall be tested for insulation (Megger), continuity compliance and earth loop impedance. The results of all tests shall be detailed on a signed test certificate prior to submittal for review. The energization of each circuit shall not be allowed until the test certification has been reviewed by ZCWD;

5.5.3.7. **Transformer Test**

5.5.3.7.1. Transformer test must be done by the ZAMCELCO at the expense of the contractor and secure a positive test result.

5.5.3.8. **Instrument Checkout**

5.5.3.8.1. Each instrument, including transmitter, shall be identified and compared with the process diagrams to verify its function and operation.

5.5.3.8.2. Transmitting instruments containing or provided with protecting walls shall be verified to have compatible components suitable for the service and application intended.

5.5.3.8.3. Analytical instruments shall be verified to the service intended. Solutions and/or source elements shall not be installed until instrumentation is ready for re-wire operation in final calibration.

5.5.3.8.4. Spare parts furnished with instruments shall be checked, identified and stored with identification tags attached. Spare parts shall not be used to complete initial installation and start-up without re-ordering to insure complete spare parts complements.

5.5.3.8.5. Damaged spare parts shall be returned immediately to vendor with corrective action requested.

5.5.3.9. **Instrument Inspection, Cleaning and Testing**

5.5.3.9.1. All instruments must be disconnected from the process piping and vessels during hydrostatic testing of the process lines. Instrument

process piping shall be hydrostatically tested together with process piping and vessels.

5.5.3.9.2. All interconnecting wires from panel to field mounted devices shall be tested by “ringing out”. Wiring pairs shall be disconnected at the transmitter and the panel terminal blocks, joined in pairs at the transmitter, and tested from the panel termination. Individual leads shall be tested using ground return, or common, to verify continuity and identification.

5.5.3.9.3. If any changes in connections are necessary, wires shall be retagged accordingly.

5.5.3.9.4. Signal wire polarities shall be verified by simulation of transmission signals.

5.5.3.9.5. Ground connections and shielding terminations shall be checked against drawings or manufacturer’s instructions. All control cable shielding shall be grounded at one end only, with reference at the receiver station (control panel).

5.5.3.9.6. Equipment (case) grounds shall be in accordance with drawings and manufacturer’s instructions.

5.5.3.9.7. Indicator scales on all transmitters and receivers shall be checked for correct range and legend. Especially calibrated flow meters shall be verified as to scale range and information data sheets supplied.

5.5.3.10. **Calibration**: Electrical instrument calibration shall be performed on an individual instrument or combination of instruments as required completing the measurement or proving the loop functional. Factory tested elements are not to be calibrated unless it is required for critical service and facility is available. Functional checks shall be performed in a manner to ascertain operational capability.

5.5.3.11. **Calibration Data Sheets**: Calibration data sheets shall be prepared and submitted for file reference for all critical measurements.

5.5.3.12. **Instrument for Environmental Protection**

5.5.3.12.1. Environmental protection shall be provided for all instrument equipment against damage upon receipt, storage and during installation;

5.5.3.12.2. Instruments located outdoors, and subject to severe ambient conditions including moisture and corrosion shall be protected by installation in a weatherproof housing or similar protective enclosure or shield.

5.5.3.12.3. The installation of protective housings, or enclosures shall not inhibit the functioning of the instrument or in any way detracted from the ability to perform routing service as required;

5.5.3.13. **Commissioning**

5.5.3.13.1. The contractor shall provide sufficient skilled staff, during the commissioning phase, to carry out necessary adjustments as they are identified. All settings and adjustments to equipment to be recorded;

5.5.3.13.2. All tests must be witnessed by ZCWD or Company Representative and carried out to ZCWD Representative's satisfaction.

5.5.3.14. **Training**

5.5.3.14.1. The contractor shall provide training as per prepared (specified) training program for the maintenance electricians so that they can efficiently maintain and fault find on the equipment. As the plant works shift the training shall be repeated so all personnel will be trained;

5.5.3.14.2. Commissioning shall not be completed until all training has been provided to ZCWD's satisfaction;

5.5.3.14.3. **System Test:** Each Panel Board shall be tested with the power equipment connected, circuit breakers closed and all load and fixtures permanently connected for their intended operation in the presence of ZCWD.

5.5.3.15. **Performance Test and Equipment Setting**

5.5.3.15.1. It shall be the responsibility of the Contractor to test the entire Electrical System for the proper operation. Setting of all protective

relays, pilot devices, and auxiliary system shall conform to the operating requirements of the installation;

5.5.3.15.2. Performance tests shall be undertaken and recorded at the site to validate undertakings given in written warranties and performances levels specified in this Specification.

5.5.3.16. **Electrical Drawings**

5.5.3.16.1. **General**

5.5.3.16.1.1. All drawings shall be created using AutoCAD;

5.5.3.16.1.2. Graphical symbols used on drawings shall comply with the symbols contained in the current version of the appropriate standard. (PEC, NEC or IEC);

5.5.3.16.1.3. Cross-references shall be marked on all schematic diagrams to show where a coil has its contacts and where contacts have their coils. This referencing shall apply to all types of equipment shown on more than one drawing;

5.5.3.16.2. **Drawing Sheets and Scales**

5.5.3.16.2.1. All drawings shall be on sheet with sizes and borders complying with the “Preferred series of sheets, with filling margins”.

5.5.3.16.2.2. All electrical wiring and circuit diagrams as well as electrical layouts shall be in 24" x 36" or A1 size tracing paper;

5.5.3.17. **Post Contract Drawings and Documentations**

5.5.3.17.1. **General**

5.5.3.17.1.1. The drawings shall be supplied in loose-leaf binders with index to simplify location of a particular drawing.

5.5.3.17.1.2. No site work, other than standard equipment or controls, will proceed until such drawings or specifications have been reviewed and marked as satisfactory or released for

construction.

5.5.3.17.1.3. Three reproducible copies of the drawings, specifications or documentation shall be shipped with the equipment or immediately after the plant commissioning and personnel training unless otherwise specified.

5.5.3.17.2. **Document List**

5.5.3.17.2.1. A document list shall be produced to show all documents being supplied under this Contract. This list shall show the document name, document number, paper size, latest revision number and highest sheet number used.

5.5.3.17.3. **Single Line and Block Diagrams**

5.5.3.17.3.1. These are to describe the process control in simple terms using single line diagrams for instrumentation, controls, protection and control sequence;

5.5.3.17.4. **Plant Layout**

5.5.3.17.4.1. Drawings shall show the location of all electrical equipment in relation to the plant.

5.5.3.17.5. **Equipment Layout Drawings**

5.5.3.17.5.1. Cross section and other drawings shall show clearly the location, layout, labeling of the equipment mounted in switchgear, control boxes etc. and the location of cables supporting routing.

5.5.3.17.6. **Schematic Diagram**

5.5.3.17.6.1. Drawings shall show in schematic form all wiring and electrical equipment supplied under this Contract, together with all other circuitry to which this equipment is interconnected. Any relevant reference data supplied by the 'Engineer' shall be incorporated. Drawings shall be in Ladder diagram format.

5.5.3.17.7. **Connection Diagrams/Termination Diagram**

5.5.3.17.7.1. Connection diagrams shall include all control panel and junction box connection diagrams and also interconnection diagrams.

5.5.3.17.8. **Bill of Materials/Parts List**

5.5.3.17.8.1. All apparatus shall be listed in the Bill of Materials showing quantity, description, manufacturer and type, order number, installed location.

5.5.3.17.9. **Cable Routing Diagrams or Cabling Lists**

5.5.3.17.9.1. Cable routing block diagram shall be supplied and shall show all cables involved in the contract together with cable identification number, cable type, length and connection positions. Cable lists may also be used.

5.6. FACILITIES AND EQUIPMENT FOR TURN-OVER

5.6.1. The specifications under this section does not preclude the contractor from providing more than what is specified if it sees that the items provided which are not specified herein are incidental and necessary for the smooth operation of the sewage treatment plant and in meeting the effluent requirements set.

5.6.2. The following facilities, equipment and process modules should be included, but not limited, to:

- Part of Treatment Facility
  - Intake Structure
  - Sludge Acceptance Unit with 15 cu.m./day capacity w/ Shed
  - Screens/Bar Screens (coarse and fine screens with washing/dewatering)
  - Grit Removal System (with washing and classifying and disposal)
  - Oil and Grease Removal System
  - Equalization Tank
  - Biological Treatment System
  - Effluent Disinfection System
  - Excess Sludge Treatment System
  - Final Effluent Outfall structure
- Guard House

- Administration Building (Office, Conference Room, Storage Room (for chemicals) and Laboratory)
- Control Room
- Electromechanical Room
- Force Main/Sewer Pipe connecting the West Pumping Station and the STP
- Storage (for tools and for dried sludge)
- Perimeter Fence
- Perimeter/Plant Lighting
- Parking Space, Driveway and landscaping works
- Equipment Lifting Facilities
- Generator Room
- Storage Tank for Recycled Water (capacity: 100 cubic meters)
- Support System:
  - Potable Water Supply System
  - Drainage System
  - Service/recycle Water Supply System
  - Chemical Dosing System (coagulants flocculating aid, acid/alkali)
  - Odor Control and Ventilation System
  - Acoustic enclosures/Noise Control
  - Effluent Pipe Line System
  - Electrical, Control, Monitoring and Instrumentation System
  - Generator System
  - SCADA (Supervisory Control and Data Acquisition)
  - CCTV/Surveillance Camera
  - Administration Building, Laboratory and its apparatuses
  - Personal Protective Equipment (PPE) and other safety devices in the plant
  - Force main/Sewer pipe connecting the West Pumping Station and the STP

5.6.3. The contractor is not precluded from substituting or omitting facilities, equipment or process modules it finds unnecessary and redundant provided that the substitute or the omitted facility, equipment or process module is necessary to meet the ultimate objective of the facility, equipment or process module substituted or omitted. Furthermore, its quality must not be lower than that standard required for such facility, equipment or process module (i.e. Coarse screens must have an opening of at least 6 mm (0.25 in) or larger and fine screens.

5.6.4. The following are minimum Office equipment for turn-over and shall be included also in the estimates/BOQ:

- 5 units office chairs and tables or its equivalent
- 2 units Desktop computers and printer
- 1 set sofa
- Airconditioning unit/facilities

5.6.5. These office equipment must be of standard quality with due consideration to ergonomics.

5.6.6. The following are the minimum Laboratory Equipment/Tools for turn-over:

- Benchtop pH Meter
- BOD Analyzer, 6 Placer
- BOD Incubator
- Waste Water Set up Spectrophotometer
- Laboratory Fume Cupboard
- Oil Free Vacuum Pump for TSS
- Desiccator
- Refrigerator
- Drying Oven
- Analytical Balance
- Oil and Grease Analyzer
- Laboratory Ware

The detail for Laboratory Equipment which shall be turned over to ZCWD, shall be provided in the BOQ.

5.6.7. It shall also include such laboratory equipment not mentioned herein but are necessary for the complete analysis of the abovementioned parameters. These laboratory equipment's must be compliant with ISO, ASTM, WHO, ISL or other equivalent international standards in the absence of local standards. A certification to such effect must be presented.

5.6.8. There must be a Supply of Reagents good for one whole year operation that will be utilized after the Process Proving Period, including the following at the minimum.

- 1Kit of COD 0-1500 mg/L 02
- 1 Kit of Ammonia Vario HR Tube Test
- 1 Kit of Nitrate Vario Tube Test
- 1 Kit of Nitrite LR Vario Powder Pack
- 1 Kit of Nitrogen Vario Total HR Tube Test

- 1 Kit of Phosphate Vario Total HR Tube Test
- 1 Kit of Lovibond BOD Reagent (Potassium Hydroxide Solution 45%, 50 ml)
- 1 Kit of Nitrification Inhibitor (N-ATH), 50 ml

5.6.9. The reagents to be supplied/ utilized for this project must be available locally.

5.6.10. These should include such reagents as may be necessary to properly conduct wastewater analysis of the abovementioned parameters.

5.7. TRAINING

5.7.1. The supplier shall provide training program for the end-user designed to teach the end-users in the understanding and application of the programmable controller. The training program shall include training manuals and "hands-on" programming experience on a programmable controller of a type similar to that provided by the supplier.

5.7.2. The Contractor shall provide training as per prepared (specified) training program for the operation and maintenance staff so that they can efficiently maintain and fault find on the equipment.

5.7.3. Commissioning shall not be completed until all training has been provided to ZCWD's satisfaction.

5.7.4. Provide training with all the necessary equipment, manuals, videos, notes, and trained and experienced staff.

5.7.5. Training of ZCWD Staff and the Contractor staff during the commissioning process and during all commissioning and operational testing procedure.

5.7.6. **Demonstrations**

5.7.6.1. Prior to final inspection and after all commissioning tests have been completed, the operation of each of the system is to be demonstrated to not less than five (5) persons nominated by ZCWD.

5.7.6.2. These demonstrations shall cover all aspects of use, programming and operation of the plant and equipment and of maintenance procedures. They are to relate closely to the Operation and Maintenance Manuals.

5.7.6.3. Formal training sessions of a minimum total of 40 hours for each of the following training programs for ZCWD staff should be conducted. These training sessions shall be supported by formal session notes, which are complementary to the Operation and Maintenance Manual covering the following:

5.7.6.3.1. Management Skills
5.7.6.3.2. Operations Skills for Wastewater Treatment Plant, Pump Stations and all associated equipment
5.7.6.3.3. Occupational Health and Safety
5.7.6.3.4. Laboratory Skills
5.7.6.3.5. Electrical operations and programming

5.7.6.4. The Contractor is to allow for a period of up to five working days, which may be taken in two separate sections: the initial demonstrations with follow-up during the Defects Liability Period.

5.8. OPERATION AND MAINTENANCE MANUALS AND LIST OF SPARE PARTS

5.8.1. The contractor shall prepare and submit the Operations and Maintenance Manual for each equipment and for the whole STP.

5.8.2. The contractor shall provide the list of recommended spare parts.

5.8.3. All spare parts must be available locally or there must be equivalent replacement.

5.8.4. The contractor shall also include the Material Safety Data Sheet (MSDS) of all chemicals that will be used for the treatment process, including those that will be used for testing and analysis in the laboratory.

5.8.5. **Operation and Maintenance Manuals**

5.8.5.1. The Contractor shall send direct to the ZCWD, three (3) copies of the approved Operations and Maintenance Manuals. These manuals shall be in separate folders and shall provide all information needed for the safe efficient commissioning, operation, adjustment and maintenance of the plant.

5.8.5.2. The Contractor shall collate all the information relating to the enclosure(s) and its associated equipment. Two (2) draft copies of each manual shall be supplied prior to the dispatch of the enclosure(s).

5.8.5.3. Any and all information which are not listed below but are necessary for the complete operation and maintenance of the facility shall be deemed included.

5.8.5.4. ***Operation Manual***

5.8.5.4.1. The Operations manual shall include:

5.8.5.4.1.1. Index and references to enable the user to quickly find the relevant information.

5.8.5.4.1.2. Electrical drawings which include the following:

- Cover
- Index
- Single Line Diagram
- General Arrangement/Plant layout
- Equipment Layout
- AC Distribution Diagram
- DC Distribution Diagram
- Control Wiring Diagram
- Termination diagram
- Cable Schedule
- Parts List

5.8.5.4.2. Equipment manuals for various items necessary for the operator setting up and adjustment of process variables in accordance with the control philosophy.

5.8.5.4.3. A detailed written description of the control philosophy including descriptions of the action to be taken by operators, with respect to operator-controlled devices, together with operator adjustable variables.

5.8.5.4.4. The Operation Manual shall provide the Plant Operator with the information required for successful start-up and Shut-Down Procedures, Operation of Manual Interface, Operation of Local Interface, Plant Considerations, Associated Document References.

5.8.5.5. ***Maintenance Manual***

5.8.5.5.1. The Maintenance manual shall include:

- Index and reference to enable the user to quickly find the relevant information;
- Schedule of drawings, showing title, revision, manufacturer's reference and purchaser's reference;
- Plant and parts list giving manufacturers name, address, catalogue number or re-ordering reference, and serial numbers of individual items;
- Setup, calibration, commissioning instructions for all items of plant, including operating characteristics of all protective devices;
- Commissioning data for all settings and tests performed;
- Fault finding and rectification instructions
- Results of all tests before delivery
- Results of all tests on site

5.8.5.5.2. The Maintenance Manual will provide the Maintenance Technician with the information and references for Preventive, Corrective and Condition-Based Maintenance, Associated Documentation References, Preventive Maintenance Procedures, Condition-Based Maintenance Procedures, Corrective Maintenance Procedures and Fault-Finding Techniques; List of abnormal operating conditions, their cause and remedy; Recommended routine maintenance procedures; Recommended list of spares.

5.8.5.6. ***Plant Operation and Maintenance Manuals***

5.8.5.6.1. The Contractor shall furnish to ZCWD, at least thirty (30) days prior to the commencement of commissioning and testing of the equipment, seven (3) sets of technical manuals for all equipment supplied or installed. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, three ring, loose leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring shall not exceed 63 mm;

5.8.5.6.2. The manuals supplied shall cover the complete works and must be relevant to the actual equipment installed. The operation instruction manual shall be comprehensive and sufficiently detailed to ensure that the equipment can be competently and efficiently

operated by ZCWD staff after commissioning and testing of the equipment have been completed. The maintenance manual shall be in sufficient detail to enable the overhaul and maintenance of all equipment to be effectively carried out by ZCWD maintenance staff;

5.8.5.6.3. All manuals shall be supplied with detailed indices, which will enable any specific item to be quickly and accurately located;

5.8.5.6.4. The operating instruction manual shall be prepared separately from the maintenance instruction manual and compiled such that reference to the maintenance instruction manual is not necessary for the implementation of the operating instruction manual;

5.8.5.6.5. Where manufacturer's standard manuals are supplied for any equipment, they shall be those applicable to the equipment installed and the relevant sections shall be clearly marked. Trouble shooting manuals of the manufacturer's equipment should also be furnished for future maintenance purposes;

5.8.5.6.6. Manuals shall include the following:

- A concise description of the equipment and the proposed method of control and operation;
- A detailed description of each piece of equipment completes with performance specification and mode of operation;
- Procedure to be followed for equipment start-up, operation and shut down;
- Procedures to be followed for installation, testing, maintenance and repair
- Fault-finding procedures for all equipment in the form of charts listing "fault", "possible causes", and "remedy".
- Instructions of dismantling, repair, re-assembly and adjustment of all equipment;
- Lubrication chart for all installed equipment, including lubrication schedules, lubricant SAE grade and type, including frequency of required lubrication;
- Complete list of equipment installed showing the manufacturer's name, manufacturers nearest representative's address, telephone and telex or fax numbers;
- A comprehensive index of manuals supplied by equipment manufacturers, indicating the equipment type, number and manufacturer's name;

- A comprehensive routine maintenance schedule for all the equipment installed;
- Complete details of earthing system installed;
- Sufficient information to enable parts for any piece of equipment to be ordered from the manufacturer;
- Other manuals mentioned in each Section;

5.8.5.6.7. Drawings compromising of:

- General arrangement
- Sectional Arrangement
- Parts list
- Performance curves

5.8.6. All manuals submitted to ZCWD, which do not meet the requirement of this Section, will be returned to the Contractor for improvement and resubmission within fourteen (14) days.

5.8.7. **Tools:** A full set of any special tools required for the operation, maintenance, or repair work on electrical or instrumentation equipment shall be supplied.

5.8.8. **Spares:** A comprehensive set of spares is to be provided to maintain the electrical or instrumentation equipment for a period of not less than 24 months in operation.

5.8.9. **Spare Parts List:** The Contractor shall submit to ZCWD five (5) identical sets of spare parts lists for all equipment supplied or installed. The lists shall be headed by equipment name and numbers indicated in the as-built drawings and shall include the following:

5.8.9.1. Current list price of each spare part. It shall be limited to those spare parts which each manufacturer recommends to be maintained by ZCWD in the inventory, and

5.8.9.2. The name, address, and telephone numbers of the nearest suppliers of the parts listed;

5.8.9.3. The spare parts lists shall be bound in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 63 mm;

5.8.10. **Exemptions**: Where special conditions exist which would make compliance with these Specifications unusually difficult, then details should be submitted in writing to ZCWD, who may grant an exemption. Any such exemption granted shall be obtained in writing from ZCWD by the party seeking the exemption;

5.8.11. **Preferred Equipment**: Any items of equipment offered and not listed under 'Preferred Equipment' must be approved by ZCWD. Any such exemption granted shall be obtained in writing from ZCWD by the party supplying the equipment.

5.8.12. **Location of Equipment:** The location of all electrical equipment shall be such that it will allow both convenient and safe access for service, testing, calibration etc., without the use of temporary staging, ladders, the dismantling of other equipment or the removal of the component itself. No apparatus or terminal block shall be mounted within 250 mm vertically from the internal floor level.

5.8.13. **Minimum Records to be Provided**

- For insulation and continuity testing for all cabling.
- For distribution board and switchboard insulation test.
- For TOL and other equipment settings.
- For Earth Resistance Test.
- For instrument configuration
- Other records and procedures to be followed during testing and commissioning as appropriate for the equipment and/or system;
- Testing and commissioning records shall be kept by the Contractor. Copies of these records shall be forwarded by the Contractor to ZCWD immediately on request. Copies of these records shall be incorporated in the Operations and Maintenance Manual.

6. PROCESS PROVING REQUIREMENTS

6.1. TREATMENT PLANT PERFORMANCE AND EFFLUENT REQUIREMENTS

6.1.1. The winning bidder must design a sewerage treatment plant for a flowrate of 4,000 cubic meters per day of sewage. The STP must be able to treat the present wastewater quality to within or above the acceptable effluent standards set by DENR-EMB for the type of receiving water body (Magay Creek) and which may be reused for beneficial purposes (washing, cleaning, and other general services use).

6.1.2. The winning bidder must conduct their own data gathering needed for the preparation of the design. Sampling and laboratory analysis of wastewater quality to determine design parameters must be made by the winning bidder at any EMB accredited laboratories.

6.1.3. The effluent quality discharged from the STP shall comply with the provisions of DENR Administrative Order No. 2021-19, June 30, 2021 Updated Water Quality Guidelines (WQG) and General Effluent Standards (GES) for Selected Parameters applicable to Class C Freshwater Body.

Parameters	Units	Effluent Limits
Ammonia as NH_3-N	Mg/l	0.6
BOD_5	Mg/l	50
Nitrate as NO_3-N	Mg/l	14
Phosphate	Mg/l	1
Surfactants	Mg/l	15
Oil and Grease	Mg/l	5
Fecal Coliforms	MPN/100 ml	400

Table 7 Significant Effluent Quality Parameters for Sewerage (Operation of Sewer Systems or Sewage Treatment Plant Facilities that Collect, Treat and Dispose of Sewage)

6.1.4. Notwithstanding the above requirements, this project will require the STP to produce better effluent quality such that the **BOD5 should be 30 mg/l, COD should be 60 mg/l, Fecal Coliform of 200 MPNB/100 ml and Total Coliforms shall be 3,000 MPN/100 ml or better.**

6.1.5. The STP must be able to produce treated effluent with quality shall be that which permits water reclamation for beneficial purposes, such as but not limited to, general cleaning and agriculture in accordance with the standards implemented by the Department of Agriculture.

6.1.6. The system must be able to efficiently remove pollutants present in the wastewater to meet the above prescribed effluent quality.

6.1.7. The main treatment process of the STP shall be an aerated biological treatment system capable of removing carbonaceous BOD of up to 98%. It must

be a highly efficient biological treatment unit which may be a stand-alone unit, a combination of two or more biological treatment processes or a hybrid system not limited to aerated biological treatment systems only (such as membrane bioreactor, up flow anaerobic sludge blanket (UASB) or its equivalent).

6.1.8. If the chlorination will be used as the method for disinfection, dechlorination of the effluent before final discharge will be necessary. The effluent requirements/parameters provided under the applicable DENR Administrative Order/s.

6.1.9. It must have a compact design which can be constructed above the ground within the 2,196.00 square meter area of the MRF compound.

6.1.10. The system must be complete in itself in terms of wastewater treatment efficiency but must be simple enough as to require less monitoring in operation. It must be easy to operate and maintain.

6.1.11. The STP which will use a compact aerated biological treatment system or its equivalent shall be designed within the limits of the parameters shown in the table below. Notwithstanding, the Contractor shall assume full responsibility for the appropriateness of all design parameters applied in the project.

6.1.12. Deviation from the minimum design parameters shall not be allowed.

Process Modification	Mean Cell Residence Time, (d)	F/M Ratio	Volumetric loading, (kg BOD_5/m^3, d)	MLSS, (mg/l)	Q_r/Q
Conventional	3-15	0.2-0.4	0.3-0.7	1,000-3,000	0.25-0.75
Complete-mix	3-15	0.2-0.6	0.30-1.6	1,500-4,000	0.25-1.0
High-Rate Modified Aeration	0.2-0.5	1.2-2.0	1.20-2.40	200-1,000	1-1.5
Contact Stabilization	5-10	0.2-0.6	1.0-1.3	(1,000-3,000)[a] (6,000-10,000)[b]	0.5-1.50

Extended Aeration	20-40	0.01-0.1	0.1-0.3	2,000-5,000	0.5-1.50
Oxidation Ditch	15-30	0.04-0.1	0.1-0.3	3,000-5,000	0.75-1.50
Sequencing Batch Reactor (SBR)	10-30	0.04-0.1	0.1-0.3	2,000-5,000[c]	N/A
MBR (Membrane Bioreactor)	5-20	0.1-0.4 (based on COD)	1.2-3.2* COD	5,000-20,000	N/A

Table 8 Design Parameters for Aerated Biological Processes

Legend:

a = contact unit *Q = secondary influent flow*
b = solids stabilization *Q_r = return sludge flow*
c = MLSS varies depending on the portion of the operating cycle
N/A = not applicable
F/M = Food to microorganism ration

Note:
The F/M can be expressed in kg BOD_5 applied/kg MLVSS.d or in lb BOD_5 applied /lb MLVSS.d

6.1.13. Secondary clarifiers shall be designed within the limits of the standard design parameters shown below:

Treatment Processes	Overflow Rate ($m^3/m^2.d$)		Solid Loading ($kg/m^2.h$)		Depth (meter)
	Average	Peak	Average	Peak	
Settling following air activated-sludge (excluding extended aeration)	16.3-32.6	40.7-48.8	4-6	10	3.5-6.0

Settling following oxygen activated-sludge	16.3-32.6	40.7-48.8	5-7	10	3.5-6.0
Settling following extended aeration	8.1-16.3	24.4-32.6	1-5	7	3.5-6.0

Table 9 Design Parameters for Secondary Clarifier

6.1.14. Aeration tanks may be designed within the limits of the standard design parameters shown below and deviation shall be allowed.

Design parameters	Aeration by Diffused Air	Mechanical Aeration
Maximum Side water Depth, m	7.5	7.5
Freeboard, m	0.30-0.60	1.0-1.5
Length to width ratio*	4:1-5:1	Per to the power rating
Width to depth ratio	1:1-22:1	1:1-2.2:1

Table 10 Design Parameters for Aeration Tanks

* - may be reduced to save cost for completely mixed system

6.1.15. The system designed must be flexible enough to allow future expansions where additional process modules may be necessary to accommodate additional loads, or future modification to upgrade performance efficiency. Where the STP will be designed with a capacity of 4,000 cubic meters per day, it must be expandable to 6,000 cmd.

6.1.16. The system must include a disinfection unit capable of eliminating pathogenic microorganisms in the effluent prior to discharge. It must result to the wastewater being treated with a quality compliant with the standards for re-use under Department of Agriculture Administrative Order No. 26.

6.1.17. It must be operated at minimum chemical addition, aeration and maintenance without compromising compliance to effluent limits.

6.1.18. Sludge treatment must be a complete system.

6.1.19. Chemical storage for a 20-day cycle must be available. Bundwalls and wash basins shall be provided in the storage room.

6.1.20. The contractor shall provide for the chemicals that will be used for the treatment of sewage and sludge. They shall provide the same during the testing period, during the one (1) year process proving period and until one (1) year after the facility has been completely turned over.

6.2. PROCESS PERFORMANCE TEST AND GUARANTEE

6.2.1. During the Process Proving Period, aside from the daily analysis of effluent by the in-house laboratory, all laboratory analysis of the final effluent conducted monthly must be analyzed by a third-party laboratory duly accredited by the Environmental Management Bureau and submitted to ZCWD. All sampling activities must be conducted in the presence of ZCWD representatives for the whole duration of the process proving period.

6.2.2. Prior to acceptance of the STP, the Contractor shall, for ninety (90) consecutive days, demonstrate that the completed STP is capable of treating sewage in compliance with the provisions on Treatment Plant Performance Requirements/Efficiencies at the given initial plant loading and at an operation cost not more than ten percent (10%) of the bidder's quoted operation cost. The process proving period of one (1) year shall start upon passing the 90 days commissioning period.

6.2.3. After the commissioning period has been completed and accepted by ZCWD, the 1-year process proving period will commence. During this period, the contractor will operate the STP based on the guaranteed OPEX, which was submitted during the bidding, and should consistently pass the required effluent standard. The contractor therefore will operate the STP only within these periods – the 90-day commissioning period and the 1-year process proving period following commissioning until they have satisfied the requirements.

6.2.4. In case the effluent during monthly sampling period failed to pass the required standard and the actual operating cost is higher by ten percent (10%) than the quoted operation cost, the Contractor shall make some modification on the STP. The process /test shall be repeated until the operating cost shall equal the quoted operation cost or within the allowed variance and the effluent standard has been met from which time the 1-year process proving period shall again be counted. Costs of all modifications shall be to the account of the Contractor.

If after such modification the computed actual annual operation cost during the process proving period (including but not limited to costs of labor, chemicals, electric energy) exceed the quoted operation cost and the given variance, the

difference, extrapolated linearly up to 25 years using the average design plant loading and an inflation rate of five percent (5%) per annum and discounted to present value at a discounting rate of 10%, shall be charged to the Contractor's collectibles and to the Performance Bond if the former is not enough.

6.2.5. The variance in the OPEX costs will serve as the basis for the computation of the NPD. The Non-Performance Damages (NPD) shall be calculated as follows:

NPD = [Actual OPEX – Guaranteed OPEX] x 9.077

These OPEX values represent figures taken during the 1-year proving period. The 9.077 is the computed factor which represents the cost of money over the life of the project – in this case a discount of 10% and over 25 years life of project.

6.3. CONSTRUCTION AND SHOP DRAWINGS

6.3.1. The drawings shall show the complete assembly of the plant with all components, equipment and parts, each with an assigned number corresponding to the plant spare parts list. The layout shall also indicate the relative location with respect to the boundary of the lot allocated for the plant.

6.3.2. The drawings shall also show construction details for each component, piece of equipment, support structures and access facilities.

6.3.3. The construction drawings shall be size A1 and shall show the complete construction and assembly of the plant with all components.

6.4. MINIMUM KEY PERSONNEL FOR THIS PROJECT

The key personnel must meet the required minimum years of experience set below:

Key Personnel	General Experience	Relevant Experience
Sanitary/Environmental Engineer	5 years	3 years
Civil Engineer	5 years	3 years
Mechanical Engineer	5 years	3 years
Electrical Engineer	5 years	3 years
Safety Officer	5 years	3 years
Skilled Workers*	5 years	3 years

* - Skilled Workers refer to Foreman, Mason, Carpenter, Steelman, Welder, Plumber, Electrician.

ANNEXES

Memorandum of Agreement with LGU

Reference Design and Drawings

Survey and Mapping

Utility Locations

Geotechnical Investigation Result

Physical and Chemical Analysis of Sewage

Sample Deed of Undertaking

PAG-ASA Climatological Data

Bill of Quantities (BOQ) Format

Photographs of As-built Plan of the Sewage Pumping Stations

7. MEMORANDUM OF AGREEMENT WITH LGU

REVISED MEMORANDUM OF AGREEMENT
(Use of 2,196 sq. m. lot at Magay Street for the Sewerage Treatment Facility of the ZCWD)

KNOW ALL MEN BY THESE PRESENTS:

This **AGREEMENT** is made and entered into by and between the following Parties:

The **CITY OF ZAMBOANGA**, a municipal corporation organized and existing under and by virtue of the laws of the Republic of the Philippines (Commonwealth Act No. 39, as amended), with principal office and place of business at City Hall, Zamboanga City, represented in this Act by ***Hon. MARIA ISABELLE G. CLIMACO***, in her official capacity as City Mayor and duly authorized to enter into and sign this Agreement by virtue of Sangguniang Panlungsod of Zamboanga Resolution No. 627 dated July 26, 2016, hereinafter referred to as the **"CITY"**;

-- and --

The **ZAMBOANGA CITY WATER DISTRICT**, a government owned and controlled corporation, created and existing by virtue of Presidential Decree No. 198, as amended, with principal office and place of business at Pilar Street, Zamboanga City, represented in this instance by its ***Mr. LEONARDO REY D. VASQUEZ***, in his official capacity as its General Manager, and duly authorized to enter into and sign this Agreement by virtue of ZCWD Board Resolution No. 091 Series 0f 2016 dated July 7, 2016 and hereinafter referred to as the "**ZCWD**".

WITNESSETH THAT:

WHEREAS, the Zamboanga City Water District (ZCWD) proposed the establishment of a Sewerage Treatment Facility (STF) located at the original site of the Material Recovery Facility (MRF) at Magay Street, Barangay Zone IV, City of Zamboanga. The proposed facility covers a total area of ONE THOUSAND EIGHT HUNDRED SQUARE METERS (1,800 sq. m.), more or less;

WHEREAS, in compliance with R.A. 9275, otherwise known as "The Philippine Clear Water Act of 2004", and other appurtenant environmental laws, the CITY is partnering with the ZCWD for the establishment of a Sewerage Treatment Facility (STF) at the aforementioned location;

WHEREAS, the ZCWD is responsible for water services in the City of Zamboanga as authorized under P.D. No. 198 and has the expertise and technical know-how to undertake the development of said sewerage treatment facility and had agreed to undertake such development;

WHEREAS, the proposed area for the STF is outside of the Port Zone Delineation of the Philippine Ports Authority (PPA); and per letter dated January 28, 2014 of Engr. Liberto C. Dela Rosa, Port Manager of PMO-Zamboanga and addressed to the City Legal Officer, as the proposed site is adjacent to the PPA, the latter **interposes no objection** on the development of the said project, with the request that the conduct of the detailed

engineering should be coordinated with PPA's engineering personnel considering that the outfall will pass thru the port's drainage system.

WHEREAS, on 22 April 2014, the Parties entered into a Memorandum of Agreement for the *use of 1,800 square meter lot at Magay Street underneath the MRF for the Sewerage Treatment Facility of the ZCWD*, and docketed under Document No. 115, Page No. 23, Book No. IV, s. 2014 of Notary Public Atty. Novelyn E. Ong. The same was executed pursuant to the authority of the Sangguniang Panlungsod of Zamboanga through Resolution No. 365 dated March 12, 2014 and through Board Resolution No. 019 dated February 21, 2014;

WHEREAS, after the execution of the MOA and much later, a Geotechnical Soil Investigation was conducted at the MRF site. However, the results indicated that the soil therein is potentially liquefiable in the event of strong ground motion, and that this condition is not ideal for the original design and construction of the STF underground, hence the need to construct the same above-ground instead;

WHEREAS, the ZCWD proposed to the CITY that the original MRF facility be transferred and rebuilt at an area within the main public market recently vacated due to conflagration at the cost of ZCWD and that the MRF facility be constructed at a more suitable site, consisting of SIX HUNDRED SIXTY SQUARE METERS (660 sq. m.), more or less;

WHEREAS, instead of constructing below-ground as originally proposed, the STF shall be built above-ground where the original MRF is located covering an area of TWO THOUSAND ONE HUNDRED NINETY SIX SQUARE METERS (2,196 sq. m.), more or less;

NOW, THEREFORE, for and in consideration of the foregoing premises, the PARTIES hereto have come to the following terms:

THE CITY OF ZAMBOANGA

1. The CITY hereby agrees and allows the Zamboanga City Water District (ZCWD) to use and construct an above-ground Sewerage Treatment Facility (STF) at Magay Street, Barangay Zone IV, City of Zamboanga. The facility covers a total area of TWO THOUSAND ONE HUNDRED NINETY SIX SQUARE METERS (2,196 sq. m.), more or less, more particularly described as follows:

S81°40'E	82.73 m. to point 2
S85°33'E	26.89 m. to point 3
S03°08'W	17.22 m. to point 4
N86°16'W	33.68 m. to point 5
S27°07'W	13.99 m. to point 6
N64°42'W	15.06 m. to point 7
N62°47'W	22.12 m. to point 8
N54°51'W	10.26 m. to point 9
N64°09'W	47.44 m. to point 10
N19°50'E	7.14 m. to point 11
S84°43'E	12.90 m. to point 12
S25°27'E	3.29 m. to point 13
S07°55'E	3.11 m. to point 14
S64°59'E	2.58 m. to point of the

Beginning, containing an area of TWO THOUSAND ONE HUNDRED NINETY SIX SQUARE METERS (2,196 sq. m.), more or less.

2. Should the area cease to be used according to the purpose for which this Agreement is intended, the possession and occupation of the subject lot shall automatically revert to the CITY. All improvements and/or constructions introduced and made thereon shall inure to the benefit of the CITY as well.

THE ZAMBOANGA CITY WATER DISTRICT (ZCWD)

1. The ZCWD commits that it shall utilize the TWO THOUSAND ONE HUNDRED NINETY SIX SQUARE METERS (2,196 sq. m.), more or less, lot for the construction and development of the Sewerage Treatment Facility (STF).

2. The ZCWD commits that the City's original MRF facility site be transferred and rebuilt in an area within the main public market recently vacated due to conflagration at the cost of ZCWD and that the MRF facility be constructed at a more suitable site, consisting of SIX HUNDRED SIXTY SQUARE METERS (660 sq. m.), more or less, specifically delineated as:

"A parcel of land situated at the Zamboanga City Public Market, Barangay Zone IV, City of Zamboanga, Island of Mindanao. Bounded on the S.E., S., and S.W., along lines 1-2, 2-3, 3-4, 4-5 and 5-1 respectively by the Z.C Public Market, owned by the City Government of Zamboanga,

beginning at a point marked "1" on plan, thence:

N 86 deg 26' W	40.59 m	to point 2;
N 02 deg 58' W	13.65 m	to point 3;
N 89 deg 36' E	8.41 m	to point 4;
N 83 deg 49' E	32.60 m	to point 5;
S 02 deg 58' W	19.64 m	to point of the

beginning, containing an area of SIX HUNDRED SIXTY SQUARE METERS (660 sq. m.), more or less."

3. The ZCWD hereby commits that it shall be solely and exclusively responsible for the operation and maintenance of the STF.

4. The technical and engineering design of the STF developed by the ZCWD, and the construction of the same, shall be made in coordination with the City, through the Office of the City Environment and Natural Resources Officer (OCENR) and/or the Office of the City Engineer (CEO), as well as other governmental agencies involved in the development of the STF. Specifically, upon the request of the PPA, the conduct of the detailed engineering should be coordinated with the PPA's engineering personnel considering that the outfall will pass thru the port's drainage system.

SEPARABILITY CLAUSE. Should any provision, section or part of this Revised MOA be adjudged or declared illegal or unconstitutional by any court of competent jurisdiction, such judgment shall not affect or impair the

remaining provisions, sections or part which shall continue to be in force and effect.

EFFECTIVITY CLAUSE. This Revised MOA shall take effect upon the signing of the Parties.

IN WITNESS WHEREOF, the PARTIES, thru their duly authorized representatives, have hereunto affixed their signatures this AUG 0 1 2016 day of _____ in the City of Zamboanga, Philippines.

CITY OF ZAMBOANGA

by:

MARIA ISABELLE G. CLIMACO
City Mayor

ZAMBOANGA CITY WATER DISTRICT

by:

LEONARDO REY D. VASQUEZ
General Manager

SIGNED IN THE PRESENCE OF:

_____ and _____

ACKNOWLEDGMENT

Republic of the Philippines)
City of Zamboanga.....) S.S.
x----------x

BEFORE ME, a Notary Public for and in the City of Zamboanga, personally appeared:

1. MARIA ISABELLE G. CLIMACO	PRC ID No. 0694864 issued on January 25, 2001 and valid until September 7, 2016
2. LEONARDO REY D. VASQUEZ	ZCWD I.D. No. 223

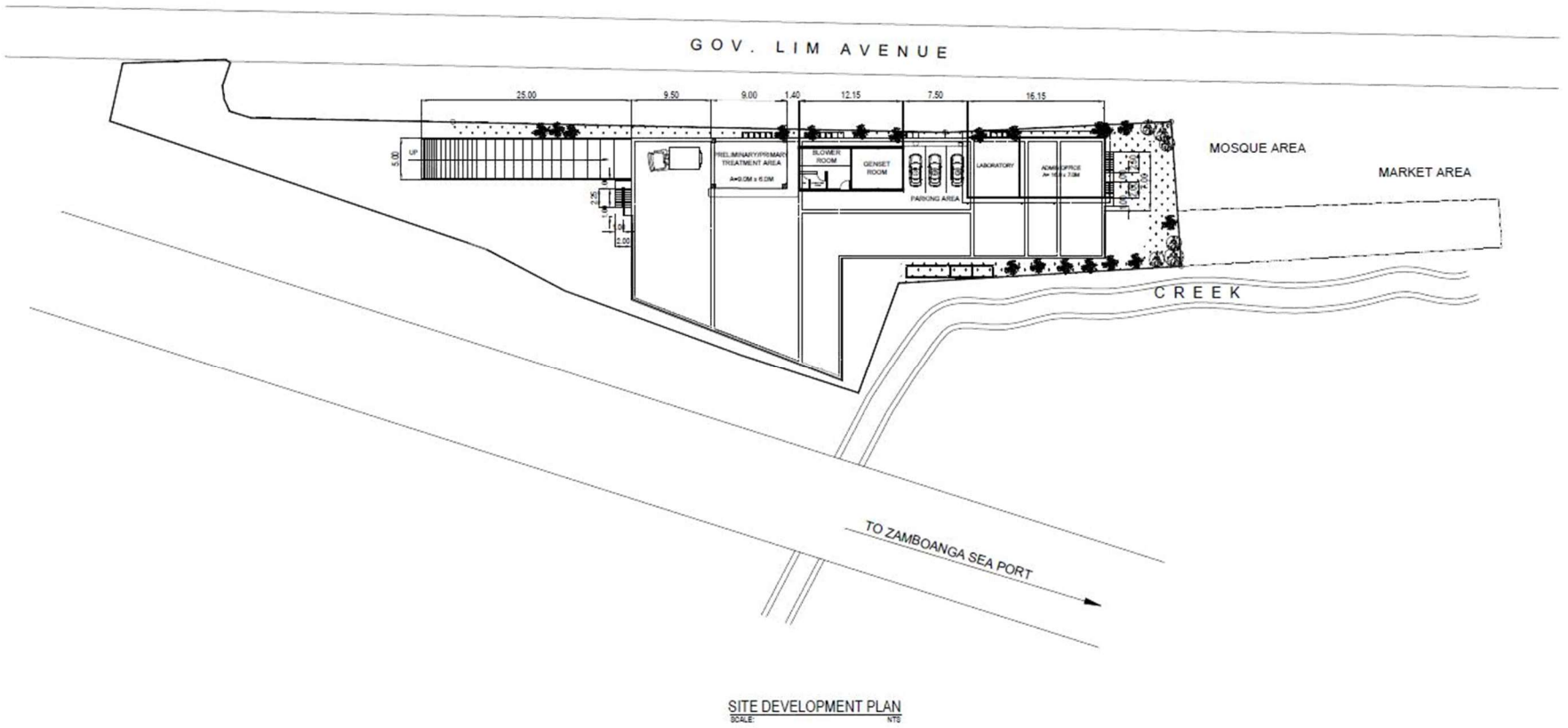
all known to me to be the same persons who executed the Memorandum of Agreement consisting of FOUR (4) PAGES including this page and acknowledged to me that the same is their true and voluntary act and deed as well as that of the juridical entity they represent.

WITNESS MY HAND AND NOTARIAL SEAL this AUG 0 1 2016 day of _____ 2016 in the City of Zamboanga, Philippines.

Doc. No. 195;
Page No. 39;
Book No. VI;
Series of 2016.

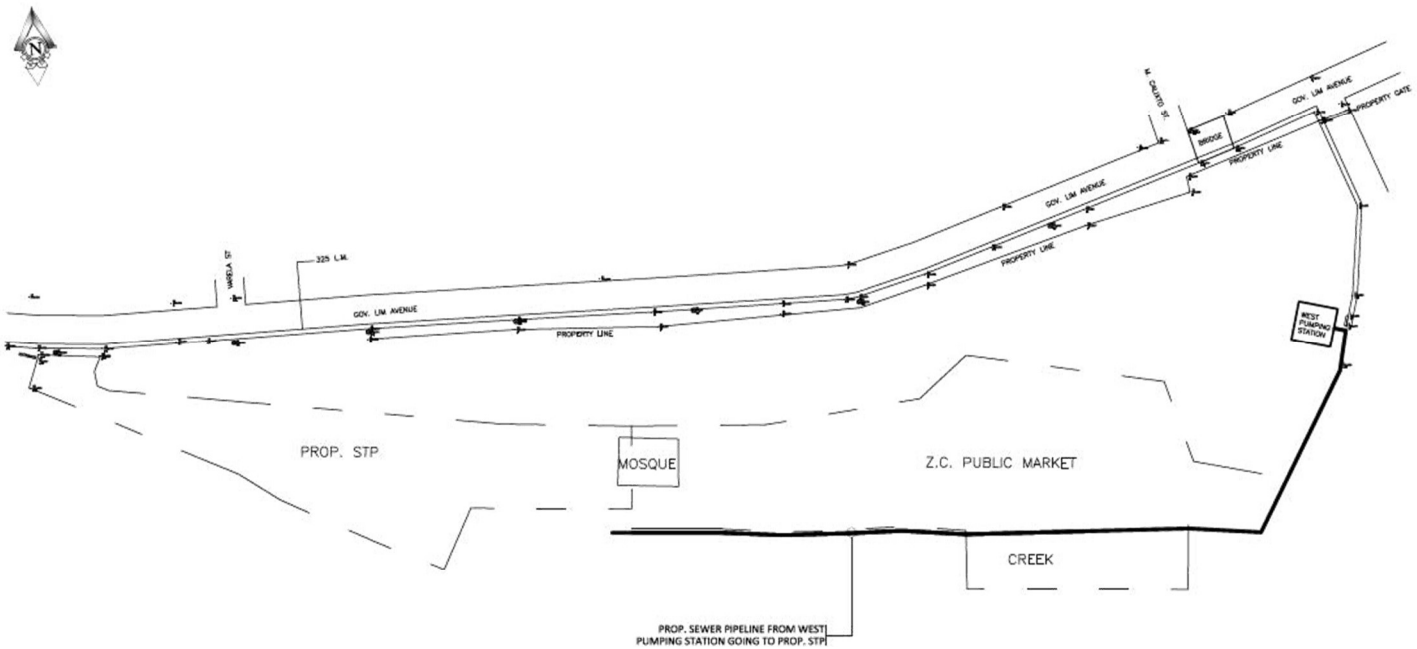
ATTY. NOVELYN M. ONG
Notary Public
Until December 31, 2016
PTR No. 1168068/12-29-2015/ZC
IBP No. 897180/01-4-2016/ZC
Roll No. 53089

8. REFERENCE DESIGN AND DRAWINGS

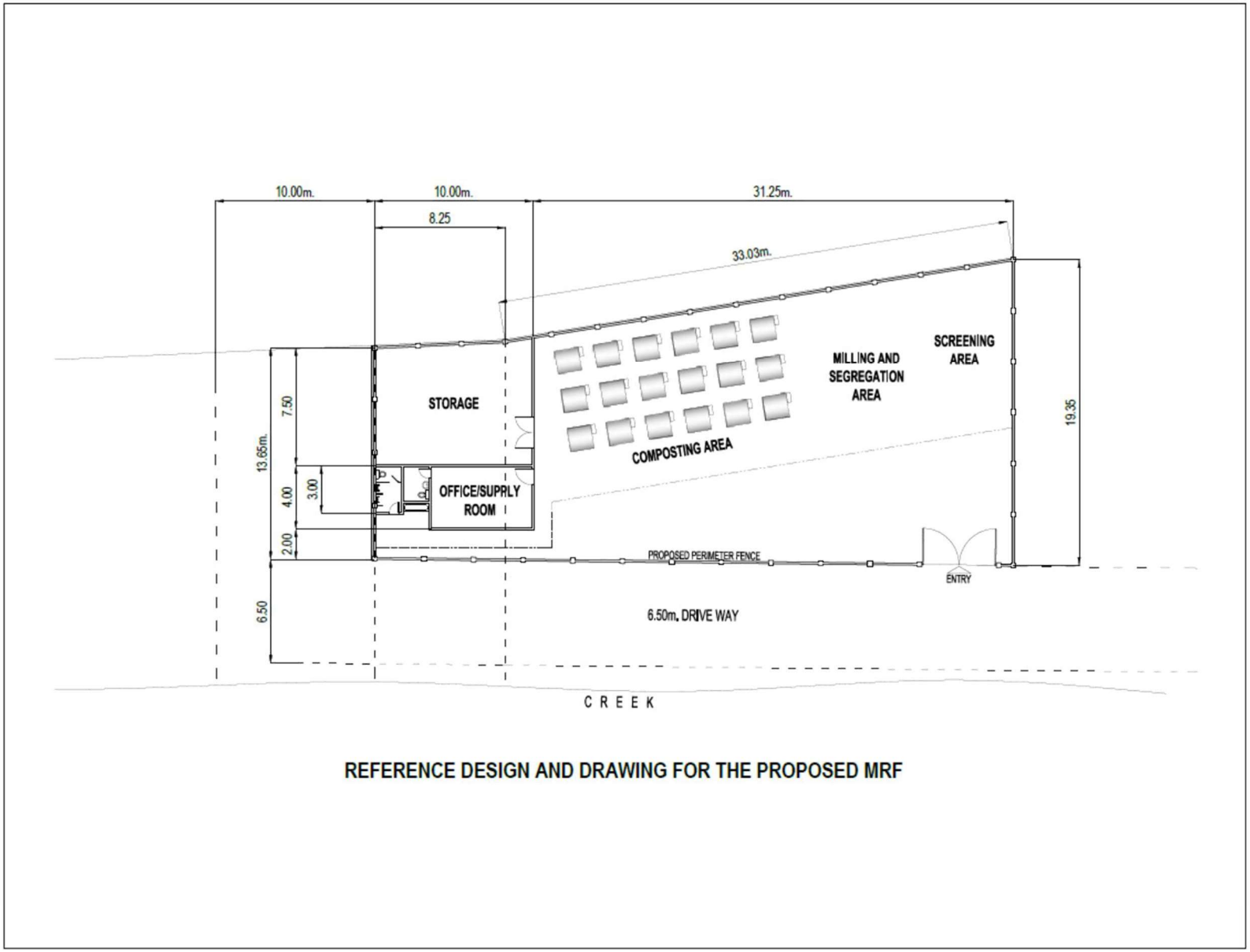


SITE DEVELOPMENT PLAN
SCALE: NTS


PERSPECTIVE
Scale NTS

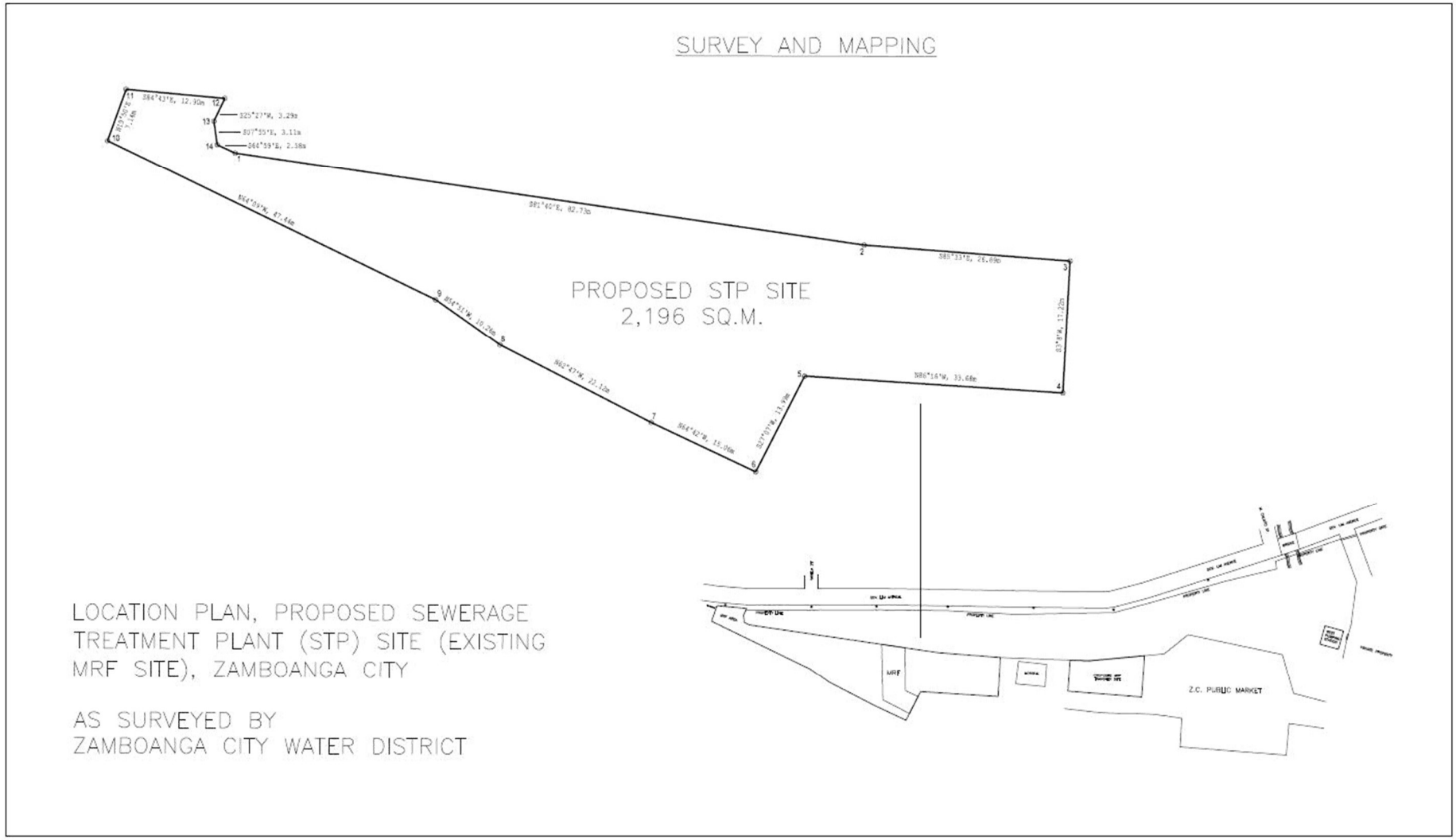


REFERENCE DESIGN AND DRAWING FOR THE PROPOSED SEWER PIPELINE FROM WEST PUMPING STATION GOING TO PROPOSED STP

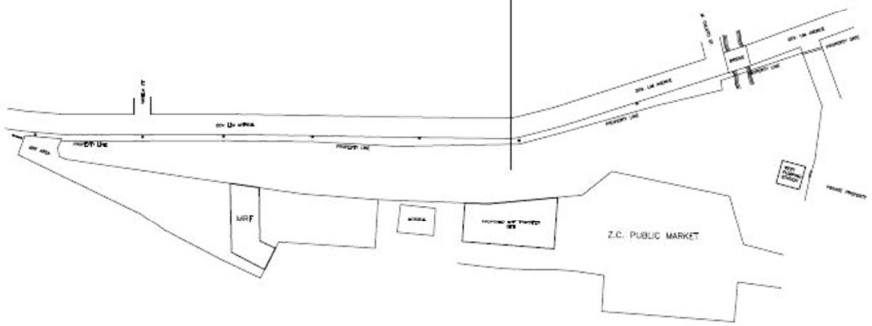


REFERENCE DESIGN AND DRAWING FOR THE PROPOSED MRF

9. SURVEY AND MAPPING



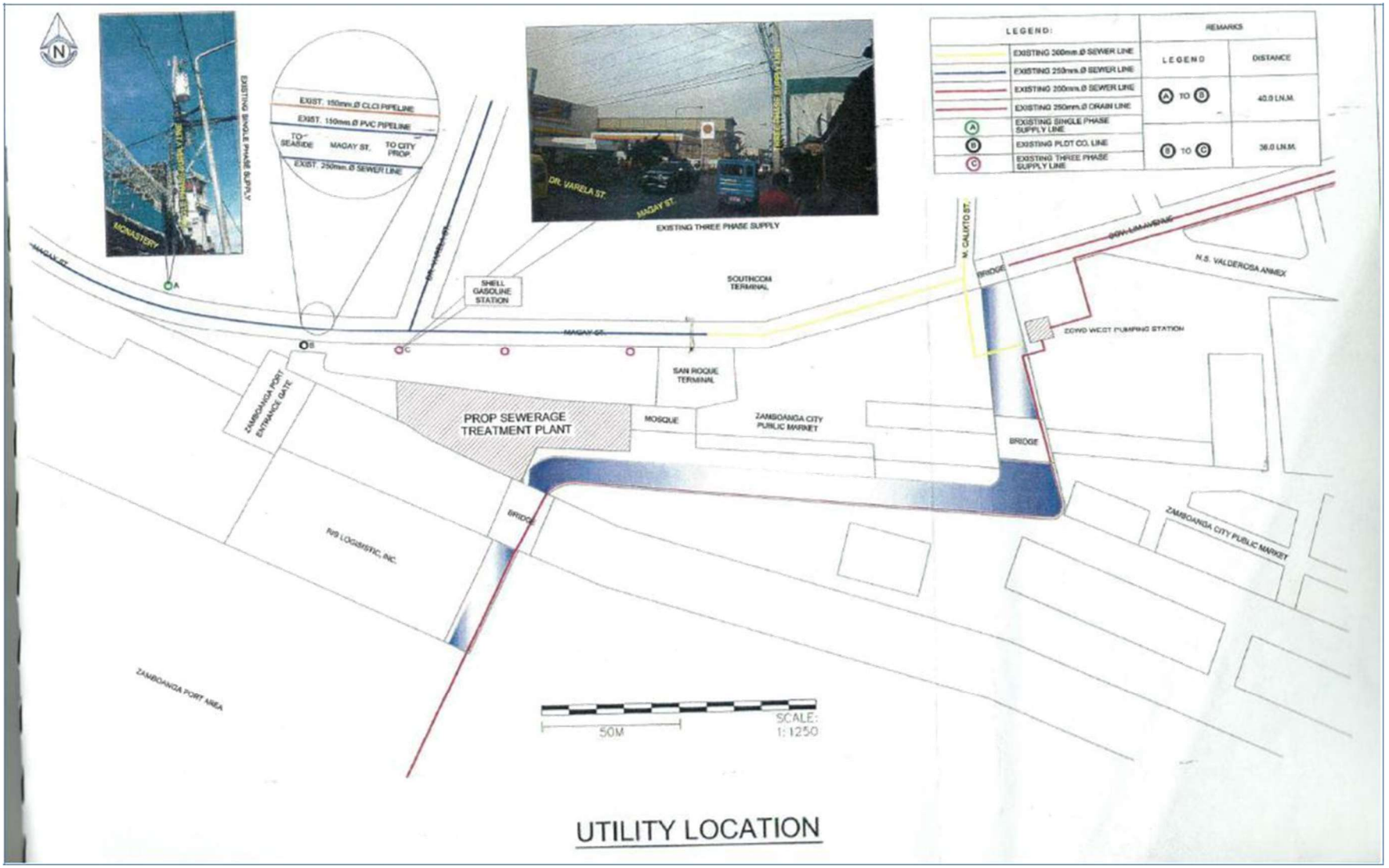
SURVEY AND MAPPING



LOCATION PLAN, PROPOSED TRANSFER
OF MATERIAL RECOVERY FACILITY (MRF),
PUBLIC MARKET, ZAMBOANGA CITY

AS SURVEYED BY
ZAMBOANGA CITY WATER DISTRICT

10. UTILITY LOCATIONS



11. GEOTECHNICAL INVESTIGATION

1. INTRODUCTION

This Final Geotechnical Report is in accordance with the contract Agreement entered into between AECOM International Development, Inc.– herein referred to as the "Client"; and Advanced Geotechnical Engineering Services (AGES) with main office address at 103 Dunhill Street, East Fairview, Quezon City, for the latter to conduct the geotechnical investigation work, in connection with the proposed Sewage Treatment Plant for Zamboanga Water District located at Magay St., Barangay Zone IV, Zamboanga City.

This Final Report contains the borehole location plan, idealized soil profile, final boring logs, laboratory test results, and photographs taken during the actual field work, and the final evaluation and recommendations for foundation design of the proposed project.

2. OBJECTIVE AND SCOPE OF WORK

The main objective of the investigation is to assess the general subsurface condition of the project site, and to provide recommendations relevant to the foundation design of the above-mentioned project.

The Client's authorized Scope of Work calls for the drilling of two (2) boreholes to target depth of thirty (30) meters, the conduct of the necessary laboratory testing on selected soil samples, and the submission of this final geotechnical report.

The specifications, as set forth in the Contract, were adhered to in the conduct of the investigation.

3. THE PROJECT SITE

The proposed site, located at Magay St., Barangay Zone IV, Zamboanga City, is situated inside the compound of Material Recovery Facility near the Philippine Ports Authority (PPA) and main public market. The proposed site is currently surrounded by existing low-rise residential and commercial structures, and is near a creek.

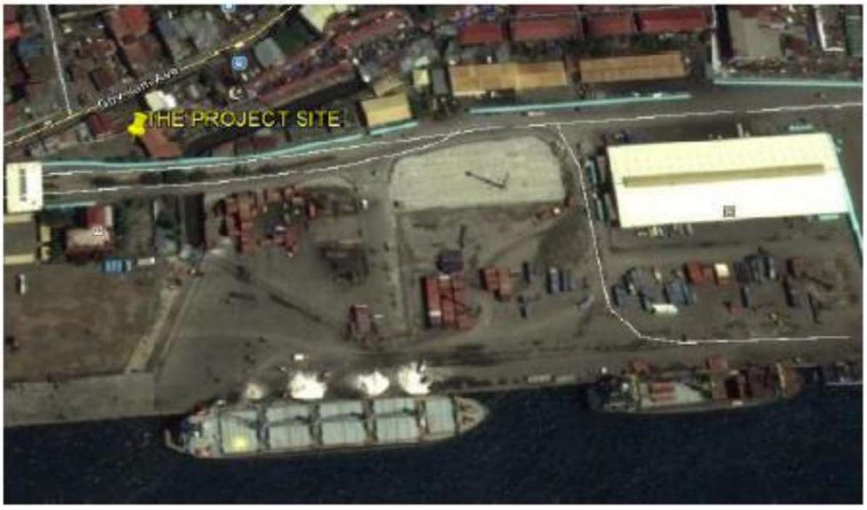


Figure 3-1. Project Site Location from Google Earth

The perspective of the proposed sewage treatment plant provided by the client is shown in Figure 3-2 below.

Figure 3-2. Perspective of the Proposed Sewage Treatment Plant

The proposed sewage treatment plant will be constructed about 6m below the existing ground surface within the compound of the existing Material Recovery Facility (MRF). Some of the low-rise structures within the project site will be demolished to give way for the construction of the proposed sewage treatment plant.

Photographs of the actual borehole location and drilling activity are shown below.

Figure 3-3. Actual Borehole Location & Drilling Activity

4. FIELDWORK

One set of hydraulically powered drilling equipment, complete with crew were mobilized for this project. Actual drilling work was started on September 18, 2015 and was completed on September 21, 2015.

The approximate location of the boreholes is shown in Appendix A entitled "Borehole Location Plan".

The duration of work and the final depth of boreholes are tabulated as follows:

Table 4-1. Summary of drilling activities

Borehole I.D.	Work Started	Work Completed	Final Depth (meter)
BH-1	Sept. 18, 2015	Sept. 19, 2015	30.45
BH-2	Sept. 20, 2015	Sept. 21, 2015	30.45
TOTAL			**60.90**

4.1. DRILLING OF BOREHOLES

The drilling work was conducted using rotary, hydraulically-powered TDC-2 drilling machine.

4.1.1. Wash Boring Procedure

Drilling through ordinary soils was advanced using the Wash Boring Procedure. This is accomplished by first driving short pieces of casings into the ground to start the borehole. The casing is normally cleaned out by means of chopping bit attached to the lower end of the drill rods, with water exiting at high pressure at the side holes of the chopping bit, carrying the cuttings or loosened soil particles out of the borehole through the space between the casings and the drill rods.

NW size casings (76 mm inside diameter) were added to prevent the borehole from caving-in.

4.1.2. Standard Penetration Tests (ASTM D1586)

Standard Penetration Tests were conducted at 1.0 meter intervals for the first 3.0 meters and 1.5 meters thereafter.

Standard Penetration Tests (SPT) was performed using the Automatic Trip Hammer Mechanism with the Standard 50 mm outside-diameter split-spoon sampler, coupled to the end of a string of drill rods, and driven by a 63.5-kg hammer with a free-fall of 75 cm. The trip-hammer mechanism minimizes errors due to human intervention during the testing. The number of blows for the three successive 15-cm penetrations was then recorded.

The sum of the two 15-cm penetrations comprises the N value. These results are incorporated in the final logs in a semi-graphical form.

Disturbed and representative soil samples obtained from the split-spoon samplers were visually classified and then carefully sealed in properly labeled water-tight plastic bags. These were brought to AGES Laboratory in Quezon City for testing.

The soil consistency or in-situ relative density mentioned and shown in the attached final boring logs is based on the following:

Table 4-2. SPT N-value blow count and relative density for granular soil

Relative Density of Sands according to the Results of Standard Penetration Test	
No. of Blows	Relative Density
0 – 4	Very Loose
4 – 10	Loose
10 – 30	Medium Dense
30 – 50	Dense
Over 50	Very Dense

Table 4-3. SPT N-value and consistency for cohesive soil

Consistency of Cohesive Soils according to the Results of Standard Penetration Test	
No. of Blows	Consistency
0 – 2	Very Soft
2 – 4	Soft
4 – 8	Medium Stiff
8 – 15	Stiff
15 – 30	Very Stiff
>30	Hard

Disturbed and representative soil samples obtained from the split-spoon samplers were visually classified and then carefully sealed in properly labeled water-tight plastic bags. These were brought to AGES Laboratory in Quezon City for testing.

5. LABORATORY TESTS

Significant characteristics of the representative soil samples taken out from the fieldwork were further investigated by laboratory tests. These soil characteristics provide data used to classify and quantitatively assess the engineering properties needed in the structure's foundation.

In general, all testing procedures conform to the American Society for Testing Materials (ASTM). The Unified Soil Classification System (USCS) was used in the classification of the samples.

The following tests tabulated below were conducted on disturbed samples:

Table 5-1. Summary of laboratory tests conducted

ASTM DESIGNATION	TITLE/ DESCRIPTION
1. D 2487-85	Classification of Soils for Engineering Purposes
2. D 2216-80	Water (moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
3. D 422	Particle size Analysis of Soils
4. D 4318-84	Liquid Limit, Plastic Limit and Plasticity Index of Soils
5. D 512	Chloride Content Test on Soil
6. D 516	Sulfate Content Test on Soil
7. D 2974	Organic Content on Soil

6. RESULTS AND FINDINGS

The Idealized Soil profile shown in Appendix B was drawn to graphically depict the general subsoil condition at the project site.

Based on the results of the two (2) boreholes, it may be generalized that the project site is underlain by practically uniform soil stratification, described as follows:

Layer A

The uppermost layer of about 12.0 meters thick consists of gray, fine to medium Sand (SM), with traces of non-plastic silt and fine gravel. Consistency of this layer is very loose to loose. SPT blow counts ranged between 3<N<13, with an average of 8.It was observed that pockets/lenses of soft, slightly plastic Clay materials were found in this layer, particularly in BH-1. Decayed wood material was also recovered in BH-1 at 2.0m depth. The lone undisturbed sample recovered at BH-1 (12.0-12.45m depth) cannot be tested for unconfined compression test because of the presence of broken corals and traces of fine gravels.

Layer B

This layer underlies layer A, generally described as medium to high plastic Clay (CH) with appreciable amount of limestone fragments. Thickness of this layer is about 3.0 to 4.5 meters, with recorded SPT blow counts of 5<N<14.

Layer C

This is the last layer encountered in the boreholes, generally classified as creamy white, gravel/sand-sized Limestone fragments with some slight to medium plastic clay.SPT blow counts ranged from a low of 9 in the uppermost stretches of the layer and linearly increased towards the bottom of the borehole (as high as 30). The two boreholes were both terminated in this layer at about 30.45 meter depths.

For better appreciation, a plot showing the recorded uncorrected N-values vs. Depth is shown below.

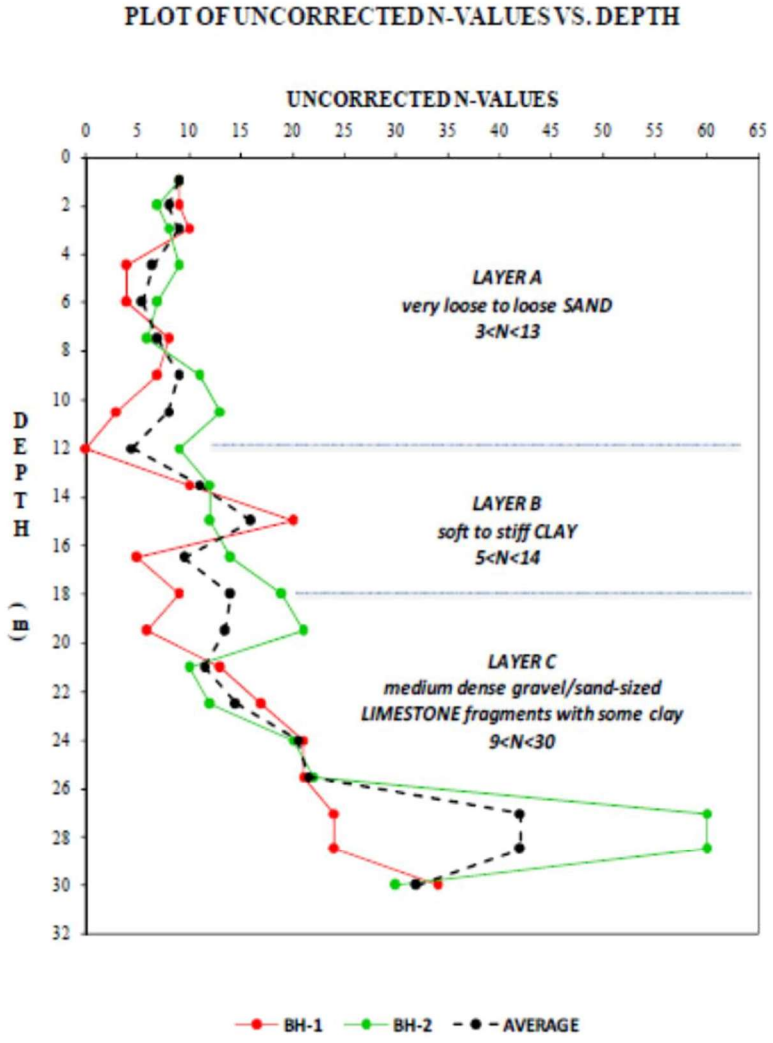


Figure 6-1. Plot of uncorrected N-values vs. depth

6.1. GROUND WATER TABLE MEASUREMENT

The groundwater table was reported in the logs at depth ranging from 0.5m – 1.5m from the existing ground surface. The information is presented below for easy reference:

Table 6-1. Groundwater Table Logs

DATE MEASURED	BH-1	BH-2
9/18/15	1.50m (5PM)	-
9/19/15	0.47m (7AM)	-
	0.47m (5PM)	-
9/20/15	1.5m (7AM)	0.97m (5PM)
9/21/15	-	1.2m (7AM)
	-	1.2m (5PM)

6.2. CHEMICAL TESTS

Representative soil samples were also tested for the determination of the chloride, sulphate and organic content. The results of the following tests are shown below:

Table 6-2. Summary of Chemical Test Results

BH NO.	DEPTH (M)	RESULT OF CHEMICAL TESTS		
		CHLORIDE (mg/kg)	SULPHATE (mg/kg)	ORGANIC CONTENT (%)
BH-1	9.0-9.45	34	3500	-
	16.5-16.95	130	68	-
	19.5-19.95	-	-	3.5
BH-2	2.0-2.45	-	-	3.9
	4.5-4.95	80	1500	-
	24.0-24.45	170	73	-

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. General Findings

Based on the results of the investigation, it is concluded that the project site is underlain by relatively thick loose soil sediments, consisting mainly of an uppermost 12.0m of mostly Sand, and very loose to loose in consistency; followed by the soft to stiff clay that extends to about 18.0m depth. The final layer encountered is described as medium dense gravel/sand-sized Limestone fragments with some clay extending down to the bottom of the borehole at 30.45 meters depth.

The following soil parameters may be assumed based on the results of the soil borings.

AVE. DEPTH (meter)	SOIL DESCRIPTION	MEAN N-VALUE	SATURATED UNIT WEIGHT, γ_s, (kN/m^3)	EFFECTIVE COHESION, C' (kPa)	EFFECTIVE PHI ANGLE, ϕ' (degree)
0 – 12.0	Very loose to loose Sand	8	15.5	0	28
12.0 – 18.0	Soft to stiff Clay	12	16.0	10	30
18.0 – 30.0	Medium dense Limestone fragments with some clay	24	17.0	20	36

Table 7-1. Recommended Soil Parameters

From the above findings, it is apparent that the uppermost 12m thick of soil is compressible and has low bearing capacity, as may be inferred from the low SPT N values (Ave=8). This layer is also potentially liquefiable in the event of strong ground motion (major earthquake).

The results of the liquefaction analysis are presented in the next section.

7.2. Liquefaction

The presence of very loose to loose Sand found in the uppermost 12mdepths would indicate that the project site is susceptible to liquefaction phenomenon. Liquefaction refers to the significant loss of strength and/or stiffness due to cyclic pore pressure generation which is generally exhibited by sands and non-plastic silts.

Liquefaction analysis was conducted using the empirical method of Seed and Idriss (1971), and assuming ground acceleration of 0.25g. Cyclic stress ratio (CSR) and cyclic resistance ratio (CRR) were computed followed by the factor of safety against liquefaction, by dividing CRR by CSR.

The results of the liquefaction study are graphically presented in the next page. It shows the liquefaction potential along the depth of the study (CRR and CSR), where the red shaded areas represent potential liquefiable zones. The factor of safety against liquefaction and the degree of settlement are also plotted with respect to the soil depth. The corresponding soil profile is then shown in the next page.

The settlement was estimated to be about 24cm based on the results of BH-1& BH-2 using the procedure developed by Ishihara and Yosemine (1990).

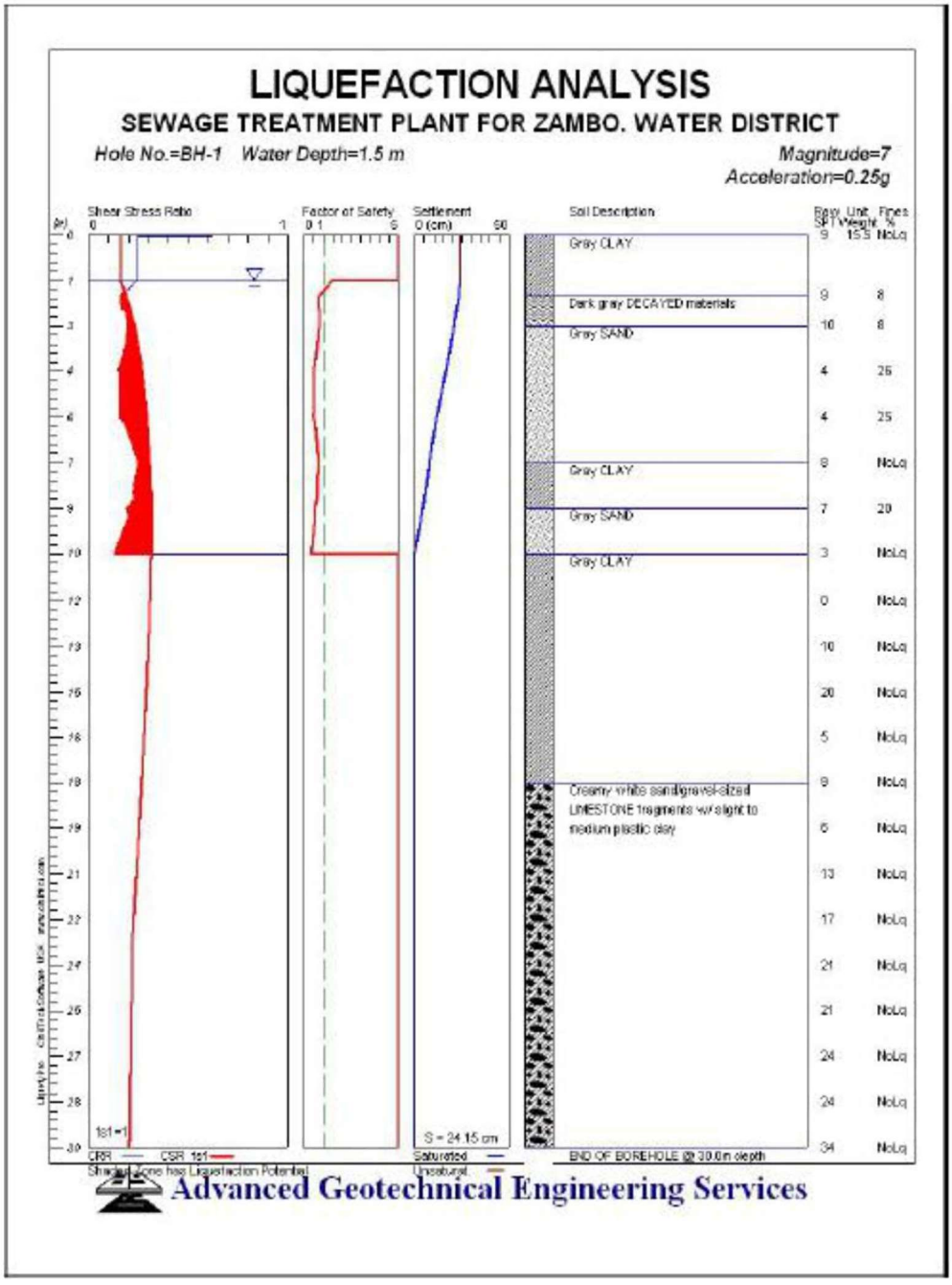


Figure 7-1. Liquefaction Analysis of BH-1

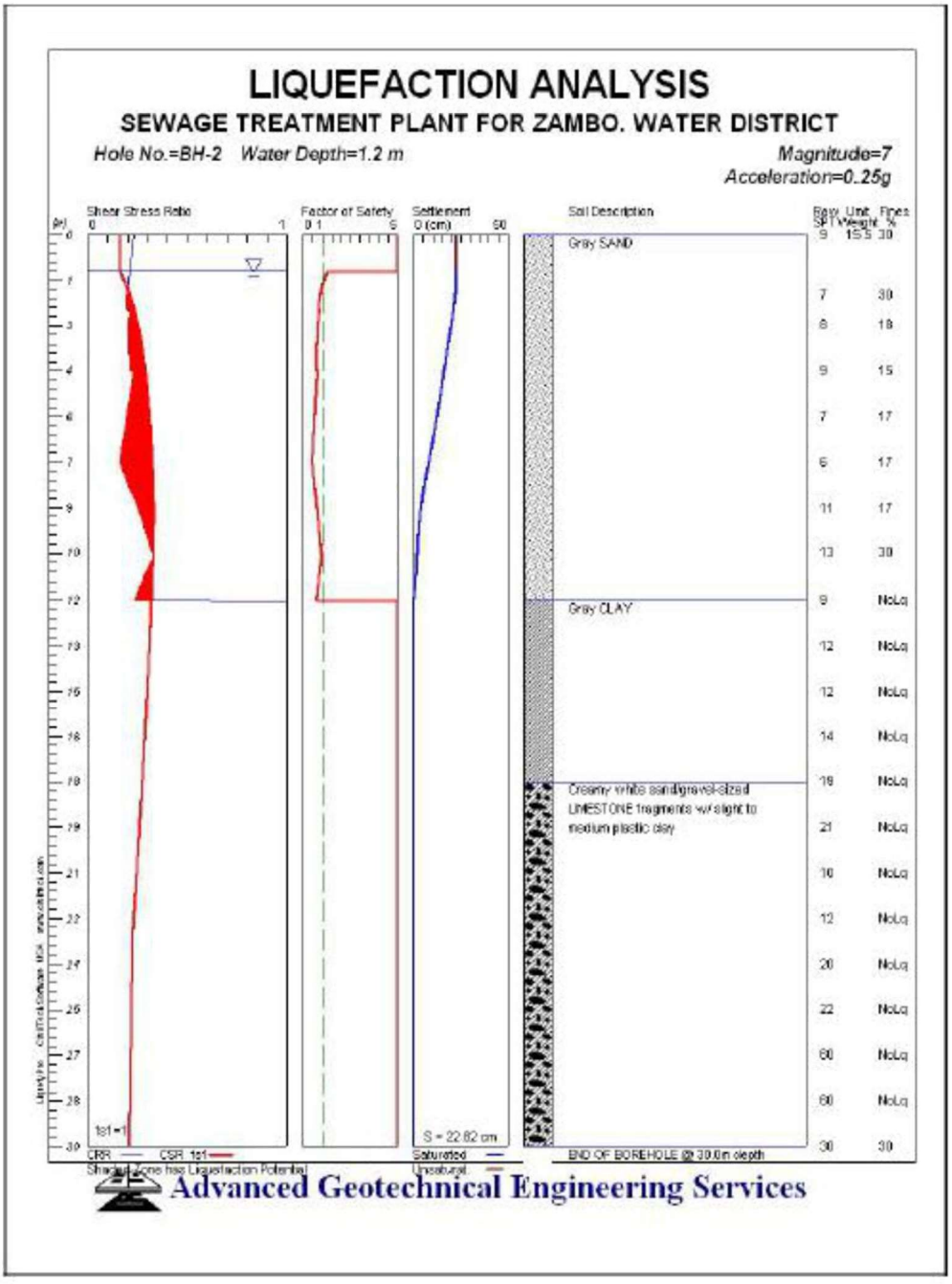


Figure 7-2. Liquefaction Analysis of BH-2

7.3. Lateral Spreading

Lateral spreading is described as the lateral movement of the soil on a gentle sloping ground due to soil liquefaction. Based on the liquefiable potential of the upper soil layer of the project site and nearby shoreline, lateral spreading may occur in an event of a strong earthquake. Documented events are likely on mild slopes of 0.3 to 5%. Horizontal displacement and vertical displacement (settlement and heaving) due to lateral spreading has caused considerable damage to infrastructures and especially underground / utility lines.

In-situ ground solidification technique, such as the deep cement mixing (DCM), is known for mitigation of earthquake-induced lateral spreading. DCM is installed by inserting columns of soil-concrete mixture in the project site. The installation creates a grid of soil-cement columns that produces a stiffer strength to support in-situ soil to reduce lateral spreading. The popularity of this method is indisputable in Japan, followed by the United States and Scandinavia.

7.4. Geotechnical Concerns

The main geotechnical concern of a buried tank below high water table (about a meter from the existing ground) will be the uplift or buoyant force. The uplift force will be exacerbated should liquefaction occur (arising from the excess high pore water pressure) during a strong ground motion (Major earthquake).

A second concern would be the stability of the envisioned vertical cut. Retaining structure is necessary to contain the envisioned 6m vertical cut, and will have to be designed for a) active earth pressure, b) the full hydrostatic forces assuming water level at the ground surface, c) earthquake forces, d) effects of surcharge loads arising from nearby structures or roadways.

Another concern would be the ground subsidence in the surrounding area during excavation works, especially when dewatering (water table is lowered by pumping). Ground subsidence is reasonably expected as the retaining wall moves (or rotates) towards the excavation for the active earth pressure (minimum lateral resistance) to act. Dewatering works in the area will exacerbate ground subsidence unless soil improvement is first provided.

7.5. Foundation Schemes

Based on the above findings, the proposed structure(s) may be supported on deep or piled foundations. In addition to the required compressional load, the piles will have to provide tensile resistance to resist the buoyant forces of the buried tank (i.e., when empty).

Driven piles or bored piles may be considered for this purpose.

Shallow foundation scheme may only be considered for non-essential and low-rise structures, or when soil improvement has been undertaken to arrest possible effects of liquefaction phenomenon and ground subsidence.

Both schemes are discussed in the following sections.

7.5.1. Piled Foundations

Based on the above discussion, the use of single-stick, prestressed, reinforced, precast concrete piles are recommended for the project. The single-stick is underlined for emphasis in anticipation of the required pullout resistance, as jointed piles may have questionable pullout resistance.

Considering the built-up surroundings (1-2 storey residential / commercial buildings), the use of static pile driver is recommended to eliminate noise and air pollutions and unwanted vibrations that may affect the operations of the surrounding residences / businesses / buildings.

Piles will have to bear directly on the medium dense layer (Layer C), with minimum depth of embedment at 24m reckoned from the existing ground surface.

In the event that the use of driven piles might not be plausible, bored piles maybe considered.

The advantage of using bored piles is that it can be drilled and socketed into the more dense material, thus offering higher shaft resistance.

Pile capacity estimates are graphically presented in the next page.

A suitable safety factors, typically 2.5 for compression and 2.75 for tension, may be applied to the calculated ultimate pile capacity to arrive at the allowable pile capacity.

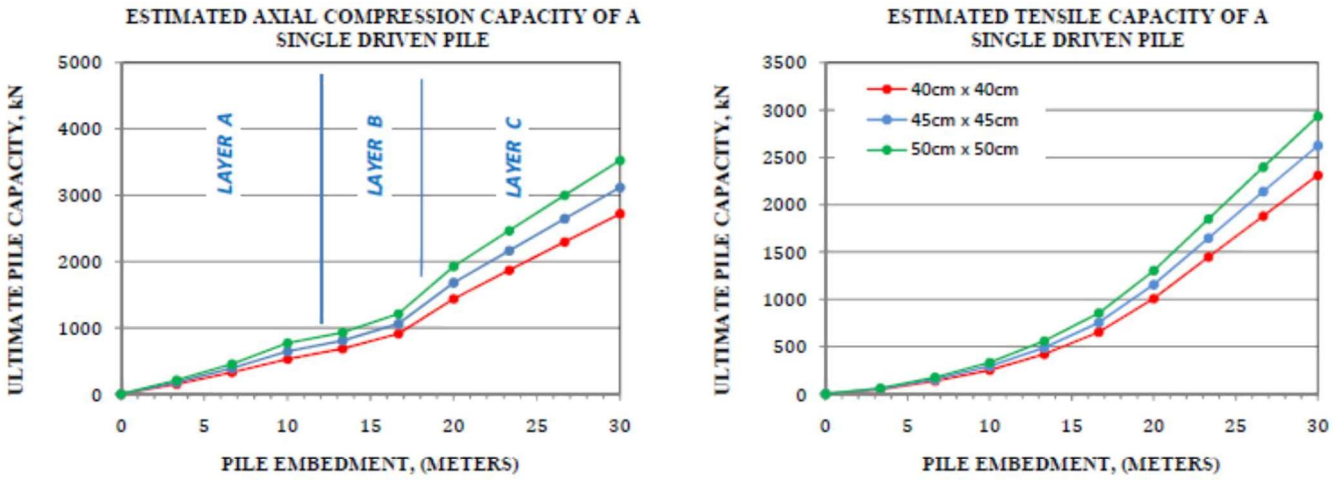


Figure 7-2. Estimated ultimate capacity of single-stick driven piles

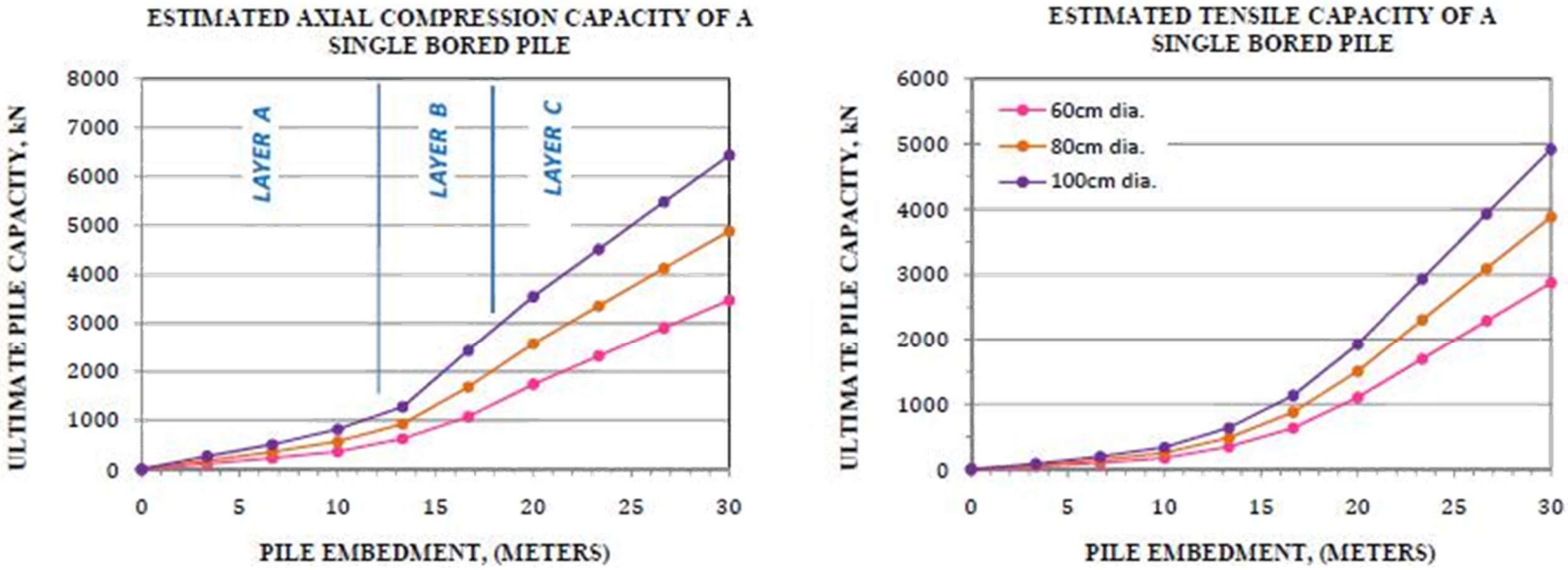


Figure 7-2. Estimated ultimate capacity of a single bored pile

7.5.1.1. Other Pile Design Considerations

Verification of Actual Pile Capacity& Integrity

The tabulated pile capacities are based purely on theoretical computations. The actual capacity of the piles will have to be confirmed / determined by actual pile load tests - either by the Static Test (ASTM D1143) or the Dynamic (ASTM D4945) Testing Procedures. The latter will be the more practical choice as more piles can be tested at a much lesser time and cost.

Foundation Quality Control during Construction

Quality control of piles may be best checked using appropriate testing methods such as Pile Integrity Testing (ASTM D 5882) &Cross-hole Logging Tests (ASTM D 6760) for integrity testing, and High-strain dynamic testing (ASTM D 4945) for capacity verification.

Pile Driving

Pile driving should be done continuously since relatively long stoppages would make re-driving difficult. A wave equation analysis (GRLWEAP) may have to be conducted to verify size of hammers suitable for driving to the prescribed or desired depth, and check driving stresses as well.

Pile Spacing

To minimize stress overlapping, piles should be spaced as far as practicable. A minimum spacing of 2.5 to 3.0D from center to center of piles may be adopted, where D is the diameter of the pile.

Efficiency of Pile Group

Since friction is the major component of the pile capacity, it is recommended that the efficiency of pile groups be calculated using the Converse-Labarre equation calculated as follows:

$$E_g = 1 - \theta \frac{(n-1)m + (m-1)n}{90mn}$$

Where:

n = number of rows

m = number of columns

$\theta = \tan^{-1} \frac{D}{s}$

D = diameter

s = spacing

7.5.2. Shallow Foundations

The use of shallow foundation should be limited to non-essential and light structures, as there is a serious risk associated with liquefaction (described in Section 7.2) and/or ground subsidence.

For the above purpose, footings may be founded on 1.0 – 1.2m below the existing ground level, bypassing any unconsolidated deposits. A conservative net allowable bearing capacity of 50 kPa (1,000 psf) may be assumed in proportioning the footings.

Isolated footings or foundations should be connected with tie-beams to provide structural rigidity and help resist differential settlement especially during strong earthquake.

7.5.3. Coefficient of Lateral Subgrade Modulus, k_h

As a guide, the ranges of k_h that may be used indesigning the piled foundation to resist lateral loads are as follows:

Table 7-2. Coefficient of Lateral Subgrade Modulus, k_h

Layer	General Description	Estimated Lateral Subgrade Modulus (MN/m^3)
A	Very loose to loose Sand (Ave=8)	4 – 6
B	Soft to stiff Clay (Ave=12)	15 - 20
C	Medium dense gravel/sand-sized Limestone fragments with clay (Ave=24)	30 – 40

7.6. Retaining Wall Design

It is apparent that the envisioned 6m depth of excavation will have to proceed with bracing, soil nailing and or tiebacks for temporary support, as the soil is generally weak and is prone to sliding failure.

The design of the wall will have to consider the combined effect of the lateral earth pressure and the surcharge load (if any), the water pressure, and earthquake loads.

In estimating for the lateral earth pressure acting on the retaining wall, an effective friction angle phi of 28 degrees and a saturated unit weight of 15kN/m^3may be assumed. Full hydrostatic height of water will also have to be conservatively assumed, unless appropriate fail-proof drainage system can be assured.

7.7. Ground Subsidence

Ground subsidence in the surrounding area is anticipated due to the presence of high water table and loose sand in the uppermost 12m depth, coupled with the anticipated pumping out of the ground water. It is prudent to provide monitoring of ground and wall movements during construction to evaluate its effect and help minimize the damage to the surrounding structures.

Mitigation would involve soil improvement of the surrounding soils prior to excavation and perhaps provision of longer sheet piles. Seepage forces will have to be considered in the analysis of the retaining wall design

7.8. Seismicity

Based on the seismic provisions of the National Structural Code of the Philippines (NSCP2010, Sixth Edition) seismic zone factor is 0.4 for the project area, and the prevailing soil type (alluvial deposits) falls under S_D. The near-source factors Na & Nv are 1.0.

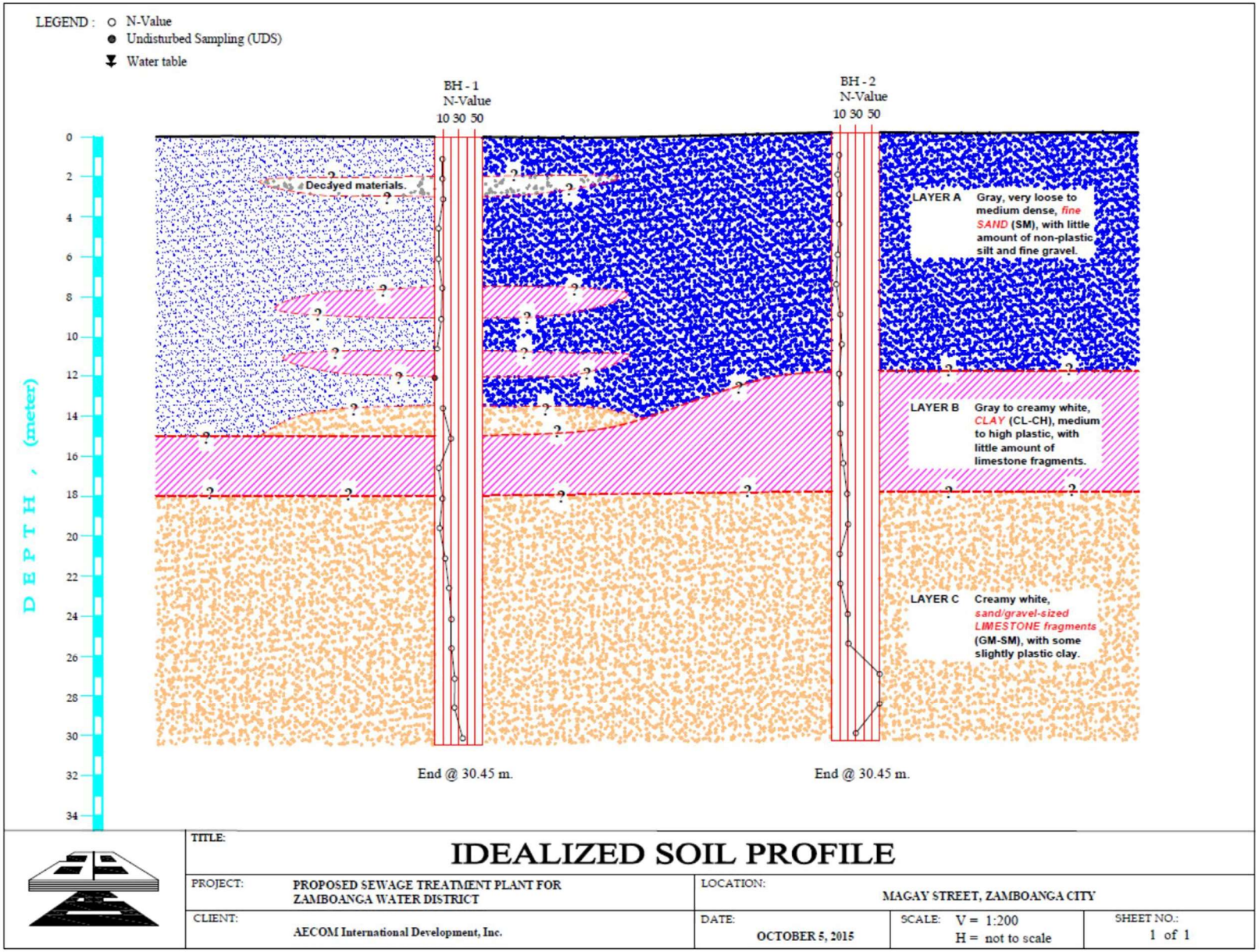
8. LIMITATIONS

This geotechnical report was prepared to aid in the design of this specific project. Its scope is limited to the project and location described herein and represents our understanding of the surface and subsurface conditions at the site, at the time of the investigation.

Should there be appreciable differences found in the soil/rock conditions during the construction phase, or should there be any differences in our understanding of the project requirements, we should be immediately notified so that supplemental recommendations can be provided.

RICHARD C. TAN, MSCE
Principal Geotechnical Engineer
PRC Reg. No. 23248
October 12, 2015
Quezon City, Philippines

TITLE:	**BOREHOLE LOCATION PLAN**			
PROJECT:	PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT	LOCATION:	MAGAY STREET, ZAMBOANGA CITY	
CLIENT:	AECOM International Development, Inc.	DATE: OCTOBER 05, 2015	SCALE: not to scale	SHEET NO.: 1 of 1



TITLE:

IDEALIZED SOIL PROFILE

PROJECT: PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT		LOCATION: MAGAY STREET, ZAMBOANGA CITY	
CLIENT: AECOM International Development, Inc.	DATE: OCTOBER 5, 2015	SCALE: V = 1:200 H = not to scale	SHEET NO.: 1 of 1

BOREHOLE LOG

PROJECT : *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT*

LOCATION : *MAGAY STREET, ZAMBOANGA CITY*

BORING NO.: **BH-1**
FINAL DEPTH: **30.45 m.**
ELEVATION: **No. info.**
GWT: **1.50 m.**
DATE STARTED: **Sept. 18, 2015**
DATE FINISHED: **Sept. 19, 2015**

A G E S

DEPTH (m)	SAMPLE DESCRIPTION	SAMPLE NO.	CONSISTENCY	USCS	REC. RATIO / R. Q. D / N - VALUE (10 30 50)	WATER CONTENT (PL NMC LL; 20 60 100)	P.I.	OTHER TEST RESULTS
1	(1.0-1.45 m) Gray, *silty CLAY*, medium plastic, with some sand and traces of fine gravel. (Rec: 45/45 cm.)	ss-1	Stiff	CL	9		20	
2	(2.0-2.45 m) Dark gray, *DECAYED materials*. (Rec: 45/25 cm.)	ss-2	Loose	ML	9			
3	(3.0-3.45 m) Gray, *fine to medium SAND*, with traces of non-plastic silt and fine gravel. (Rec: 45/25 cm.)	ss-3	Loose	SW-SM	10			
4								
5	(4.5-4.95 m) Dark gray, *fine SAND*, with some non-plastic silt and traces of fine gravel. (Rec: 45/45 cm.)	ss-4	Very loose	SM	4			
6	(6.0-6.45 m) No Recovery (Rec: 45/0 cm.)	ss-5	Very loose	-	4			
7								
8	(7.5-7.95 m) Gray, *silty CLAY*, slightly plastic, with some sand. (Rec: 45/15 cm.)	ss-6	Med. stiff	CL	8		11	
9	(9.0-9.45 m) Gray, *fine SAND*, with little amount of non-plastic. (Rec: 45/45 cm.)	ss-7	Loose	SM	7			

BOREHOLE LOG

PROJECT : *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT*

LOCATION : *MAGAY STREET, ZAMBOANGA CITY*

BORING NO.: **BH-1**
FINAL DEPTH: **30.45 m.**
ELEVATION: **No. info.**
GWT: **1.50 m.**
DATE STARTED: **Sept. 18, 2015**
DATE FINISHED: **Sept. 19, 2015**

A G E S

DEPTH (m)	SAMPLE DESCRIPTION	SAMPLE NO.	CONSISTENCY	USCS	REC. RATIO / R. Q. D / N - VALUE (10 30 50)	WATER CONTENT PL NMC LL (20 60 100)	P.I.	OTHER TEST RESULTS
10								
	(10.5-10.95 m) Gray, *CLAY*, high plastic, with little amount of sand and traces of fine gravel. (Rec: 45/25 cm.)	ss-8	Soft	CH	3		63	
11								
12	(12.0-12.45 m) Gray, *fine SAND*, with some high plastic clay, little amount of broken corals and fine gravel. (Rec: 45/45 cm.)	uds-1		SM	Pressed shelby tube		39	
13								
	(13.5-13.95 m) Creamy white, *gravel-sized LIMESTONE fragments*, with some high plastic clay. (Rec: 45/45 cm.)	ss-9	Med. dense	GM	10		52	
14								
15	(15.0-15.45 m) Brown, *sandy CLAY*, high plastic, with some sand and little amount of fine gravel. (Rec: 45/45 cm.)	ss-10	Very stiff	CH	20		39	
16								
	(16.5-16.95 m) Light brown, *silty CLAY*, medium plastic, with little amount of limestone fragments. (Rec: 45/45 cm.)	ss-11	Med. stiff	CL	5		24	
17								
18	(18.0-18.45 m) Creamy white, *sand-sized LIMESTONE fragments*, with medium plastic clay. (Rec: 45/35 cm.)	ss-12	Loose	SM	9		15	
19								
	(19.5-19.95 m.) Creamy white, *sand/gravel-sized LIMESTONE fragments*, with medium plastic clay.	ss-13	Loose	GM-SM	6		18	

BOREHOLE LOG

PROJECT : *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT*

LOCATION : *MAGAY STREET, ZAMBOANGA CITY*

BORING NO.: BH-1
FINAL DEPTH: 30.45 m.
ELEVATION: No. info.
GWT: 1.50 m.
DATE STARTED: Sept. 18, 2015
DATE FINISHED: Sept. 19, 2015

A G E S

DEPTH (m)	SAMPLE DESCRIPTION	SAMPLE NO.	CONSISTENCY	USCS	REC. RATIO / R. Q. D / N - VALUE (10 30 50)	WATER CONTENT (PL NMC LL; 20 60 100)	P.I.	OTHER TEST RESULTS
20	(Rec: 45/45 cm.)							
21	(21.0-21.45 m.) Creamy white, *sand/gravel-sized* ***LIMESTONE fragments***, with some medium plastic clay. (Rec: 45/40 cm.)	ss-14	Med. dense	GM-SM	13		19	
22								
23	(22.5-22.95 m.) - same materials - (Rec: 45/30 cm.)	ss-15	Med. dense	GM-SM	17		16	
24	(24.0-24.45 m.) Creamy white, *sand-sized* ***LIMESTONE fragments***, with slightly plastic clay. (Rec: 45/40 cm.)	ss-16	Med. dense	SM	21		15	
25								
26	(25.5-25.95 m.) Creamy white, *sand-sized* ***LIMESTONE fragments***, with little amount of slightly plastic clay. (Rec: 45/35 cm.)	ss-17	Med. dense	SM	21		9	
27	(27.0-27.45 m.) Creamy white, *sand-sized* ***LIMESTONE fragments***, with some slightly plastic clay. (Rec: 45/15 cm.)	ss-18	Med. dense	SM	24		8	
28								
29	(28.5-28.95 m.) Creamy white, *sand-sized* ***LIMESTONE fragments***, with little amount of slightly plastic clay. (Rec: 45/10 cm.)	ss-19	Med. dense	SM	24		8	

BOREHOLE LOG

BORING NO.: **BH-1**
FINAL DEPTH: **30.45 m.**
ELEVATION: **No. info.**
GWT: **1.50 m.**
DATE STARTED: **Sept. 18, 2015**
DATE FINISHED: **Sept. 19, 2015**

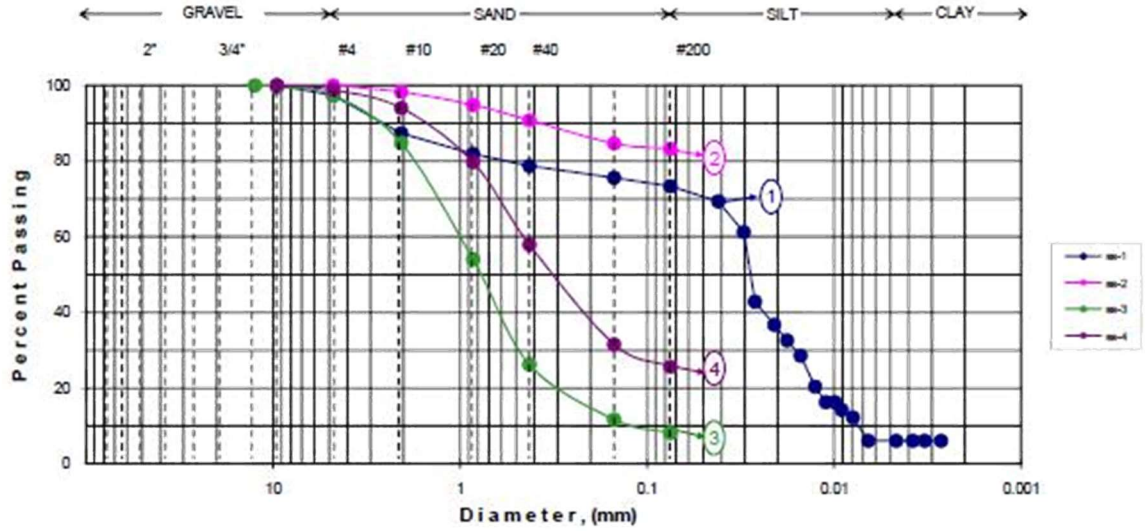
AGES

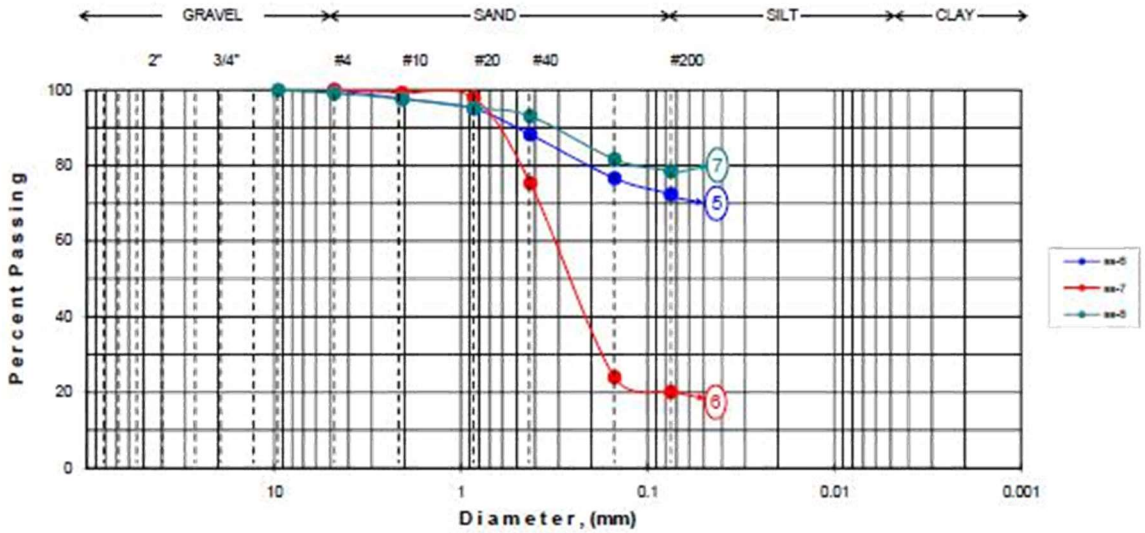
PROJECT : ***PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT***

LOCATION : ***MAGAY STREET, ZAMBOANGA CITY***

DEPTH (m)	SAMPLE DESCRIPTION	SAMPLE NO.	CONSISTENCY	USCS	REC. RATIO / R. Q. D / N - VALUE (10 30 50)	WATER CONTENT (PL NMC LL; 20 60 100)	P.I.	OTHER TEST RESULTS
30	(30.0-30.45 m.) Creamy white, *sand/gravel-sized LIMESTONE fragments*, with little amount of slightly plastic clay. (Rec: 45/40 cm.)	ss-20	Dense	GM-SM	34		12	
31								
	End of Borehole @ 30.45m. Depth							
32								
33								
34								
35								
36								
37								
38								
39								
40								

GRAIN-SIZE DISTRIBUTION CURVES

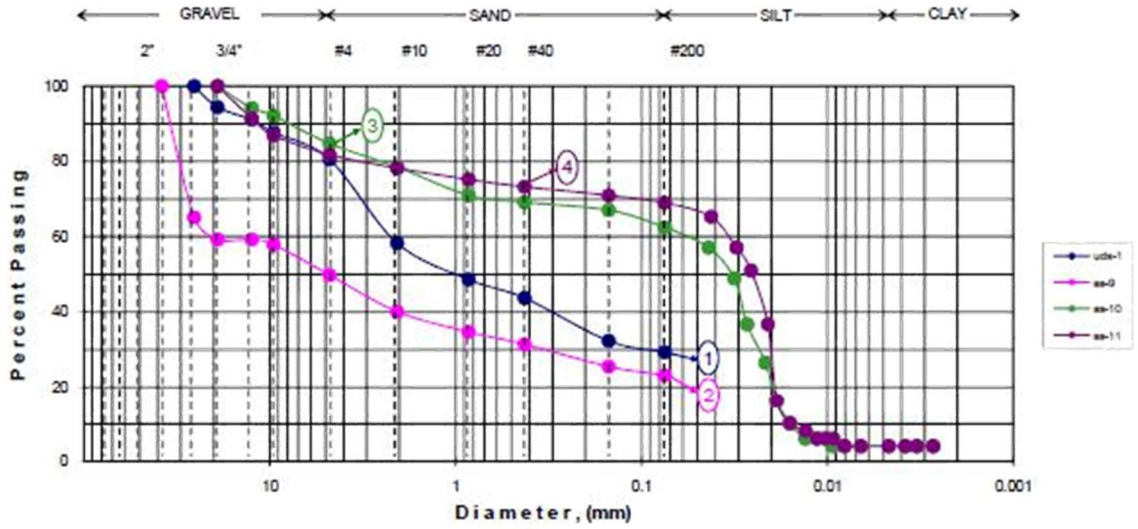


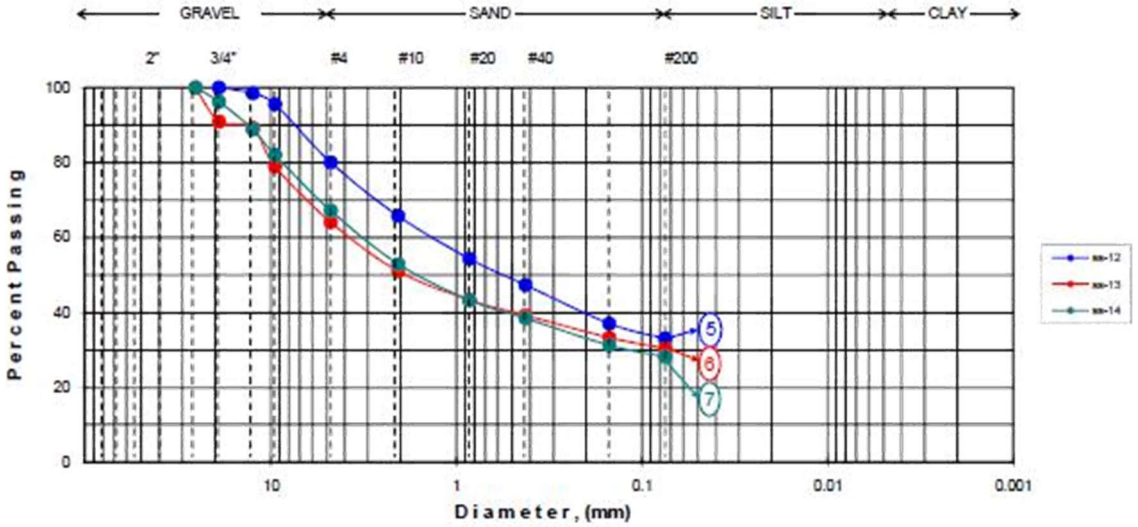


PROJECT SITE: *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT, MAGAY, ZAMBOANGA CITY*

BH NO.	SAMPLE NO.	DEPTH (m)	CURVE NO.	NMC	LL	PL	PI	USCS	DESCRIPTION
BH-1	ss-1	1.00-1.45	1	21.20	38	18	20	CL	Gray, silty CLAY, medium plastic
BH-1	ss-2	2.00-2.45	2	91.91	NP	NP	NP	ML	Dark gray, DECAYED materials
BH-1	ss-3	3.00-3.45	3	18.23	NP	NP	NP	SW-SM	Gray, fine to medium SAND
BH-1	ss-4	4.50-4.95	4	38.60	NP	NP	NP	SM	Dark gray, fine SAND
BH-1	ss-6	7.50-7.95	5	37.80	34	23	11	CL	Gray, silty CLAY, slightly plastic
BH-1	ss-7	9.00-9.45	6	45.99	NP	NP	NP	SM	Gray, fine SAND
BH-1	ss-8	10.50-10.95	7	61.37	98	35	63	CH	Gray, CLAY, high plastic

GRAIN-SIZE DISTRIBUTION CURVES

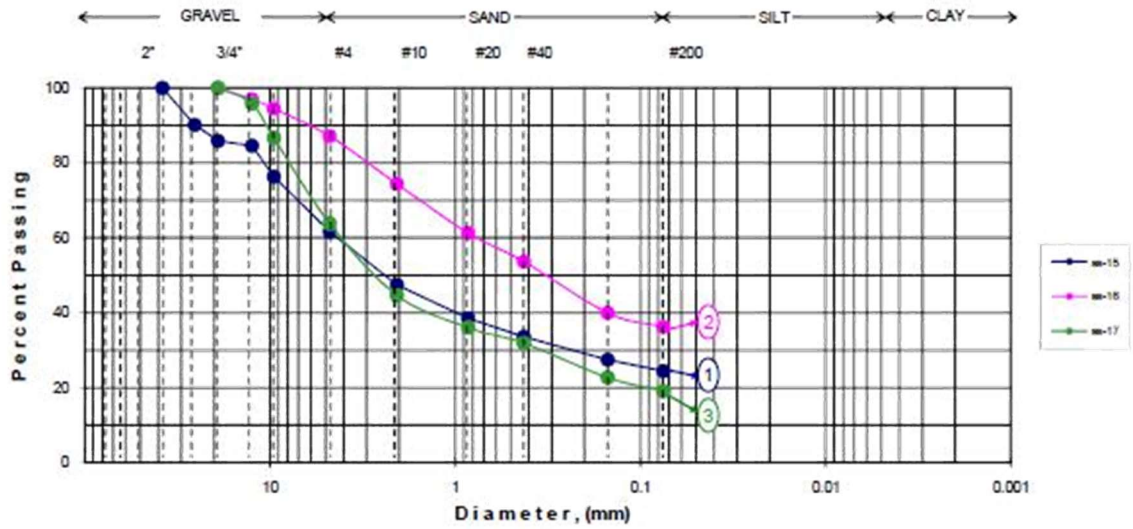


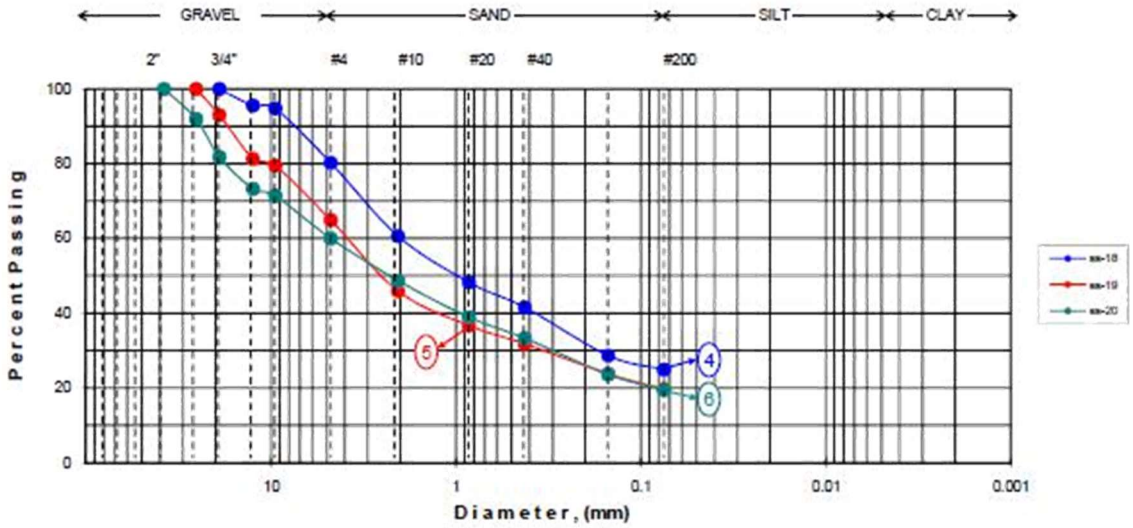


PROJECT SITE: *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT, MAGAY, ZAMBOANGA CITY*

BH NO.	SAMPLE NO.	DEPTH (m)	CURVE NO.	NMC	LL	PL	PI	USCS	DESCRIPTION
BH-1	uds-1	12.00-12.45	1	28.61	64	25	39	SM	Gray, fine SAND, with some high plastic clay, little amount of broken coral and fine gravel
BH-1	ss-9	13.50-13.95	2	24.70	90	38	52	GM	Creamy white, gravel-sized LIMESTONE fragments, with some high plastic clay
BH-1	ss-10	15.00-15.45	3	32.82	72	33	39	CH	Brown, sandy CLAY, high plastic
BH-1	ss-11	16.50-16.95	4	48.00	48	24	24	CL	Light brown, silty CLAY, medium plastic
BH-1	ss-12	18.00-18.45	5	30.83	34	19	15	SM	Creamy white, sand-sized LIMESTONE fragments, with medium plastic clay
BH-1	ss-13	19.50-19.95	6	36.97	38	20	18	GM-SM	Creamy white, sand/gravel-sized LIMESTONE fragments, with medium plastic clay
BH-1	ss-14	21.00-21.45	7	33.49	39	20	19	GM-SM	Creamy white, sand/gravel-sized LIMESTONE fragments, with some medium plastic clay

GRAIN-SIZE DISTRIBUTION CURVES





PROJECT SITE: *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT, MAGAY, ZAMBOANGA CITY*

BH. NO.	SAMPLE NO.	DEPTH (m)	CURVE NO.	NMC	LL	PL	PI	USCS	DESCRIPTION
BH-1	ss-15	22.50-22.95	1	26.47	36	20	16	GM-SM	Creamy white, sand/gravel-sized LIMESTONE fragments, with some medium plastic clay
BH-1	ss-16	24.00-24.45	2	27.38	34	19	15	SM	Creamy white, sand-sized LIMESTONE fragments, with slightly plastic clay
BH-1	ss-17	25.50-25.95	3	20.19	30	21	9	SM	Creamy white, sand-sized LIMESTONE fragments, with little amount of slightly plastic clay
BH-1	ss-18	27.00-27.45	4	20.70	28	20	8	SM	Creamy white, sand-sized LIMESTONE fragments, with some slightly plastic clay
BH-1	ss-19	28.50-28.95	5	20.56	27	19	8	SM	Creamy white, sand-sized LIMESTONE fragments, with little amount of slightly plastic clay
BH-1	ss-20	30.00-30.45	6	20.79	29	17	12	GM-SM	Creamy white, sand/gravel-sized LIMESTONE fragments, with little amount of slightly plastic clay

BOREHOLE LOG

PROJECT : *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT*

LOCATION : *MAGAY STREET, ZAMBOANGA CITY*

BORING NO.: BH-2
FINAL DEPTH: 30.45 m.
ELEVATION: No. info.
GWT: 1.20 m.
DATE STARTED: Sept. 20, 2015
DATE FINISHED: Sept. 21, 2015

A G E S

DEPTH (m)	SAMPLE DESCRIPTION	SAMPLE NO.	CONSISTENCY	USCS	REC. RATIO / R. Q. D / N - VALUE (10 30 50)	WATER CONTENT PL NMC LL (20 60 100)	P.I.	OTHER TEST RESULTS
1	(1.0-1.45 m) Gray, *fine SAND*, with some slightly plastic clay and some fine gravel. (Rec: 45/35 cm.)	ss-1	Loose	SM	9		8	
2	(2.0-2.45 m) Gray, *SAND and GRAVEL mixture*, some slightly plastic clay. (Rec: 45/45 cm.)	ss-2	Loose	GM-SM	7		9	
3	(3.0-3.45 m) Gray, *fine SAND*, with little amount non-plastic silt. (Rec: 45/25 cm.)	ss-3	Loose	SM	8			
4								
5	(4.5-4.95 m) Gray, *fine SAND*, with little amount of non-plastic silt and traces of fine gravel. (Rec: 45/35 cm.)	ss-4	Loose	SM	9			
6	(6.0-6.45 m) Gray, *fine SAND*, with little amount non-plastic silt. (Rec: 45/15 cm.)	ss-5	Loose	SM	7			
7								
8	(7.5-7.95 m) - same materials - (Rec: 45/20 cm.)	ss-6	Loose	SM	6			
9	(9.0-9.45 m) Gray, *fine SAND*, with some corals and little amount of non-plastic. (Rec: 45/25 cm.)	ss-7	Med. dense	SM	11			

BOREHOLE LOG

PROJECT : *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT*

LOCATION : *MAGAY STREET, ZAMBOANGA CITY*

BORING NO.: BH-2
FINAL DEPTH: 30.45 m.
ELEVATION: No. info.
GWT: 1.20 m.
DATE STARTED: Sept. 20, 2015
DATE FINISHED: Sept. 21, 2015

A G E S

DEPTH (m)	SAMPLE DESCRIPTION	SAMPLE NO.	CONSISTENCY	USCS	REC. RATIO / R. Q. D / N - VALUE (10 30 50)	WATER CONTENT PL NMC LL (20 60 100)	P.I.	OTHER TEST RESULTS
10								
	(10.5-10.95 m) Gray, *fine SAND*, with some corals and little amount of non-plastic silt. (Rec: 45/15 cm.)	ss-8	Med. dense	SP-SM	13			
11								
12	(12.0-12.45 m) Gray, *CLAY*, high plastic, with limestone fragments. (Rec: 45/15 cm.)	ss-9	Stiff	CH	9		32	
13								
	(13.5-13.95 m) Gray, *sand-sized LIMESTONE fragments and CLAY mixture*, medium plastic. (Rec: 45/35 cm.)	ss-10	Stiff	SC-CL	12		29	
14								
15	(15.0-15.45 m) Creamy white, *CLAY*, high plastic, with little amount of limestone fragments. (Rec: 45/30 cm.)	ss-11	Stiff	CH	12		54	
16								
	(16.5-16.95 m) - same materials - (Rec: 45/25 cm.)	ss-12	Stiff	CH	14		54	
17								
18	(18.0-18.45 m) Creamy white, *sand-sized LIMESTONE fragments*, with some medium plastic clay. (Rec: 45/20 cm.)	ss-13	Med. dense	SM	19		23	
19								
	(19.5-19.95 m.) Creamy white, *sand-sized LIMESTONE fragments*, with some medium plastic clay.	ss-14	Med. dense	SM	21		14	

BOREHOLE LOG

PROJECT : *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT*

LOCATION : *MAGAY STREET, ZAMBOANGA CITY*

BORING NO.: BH-2
FINAL DEPTH: 30.45 m.
ELEVATION: No. info.
GWT: 1.20 m.
DATE STARTED: Sept. 20, 2015
DATE FINISHED: Sept. 21, 2015

A G E S

DEPTH (m)	SAMPLE DESCRIPTION	SAMPLE NO.	CONSISTENCY	USCS	REC. RATIO / R. Q. D / N - VALUE (10 30 50)	WATER CONTENT (PL NMC LL; 20 60 100)	P.I.	OTHER TEST RESULTS
20	(Rec: 45/25 cm.)							
21	(21.0-21.45 m.) Creamy white, *gravel-sized* ***LIMESTONE*** *fragments*, with some slightly plastic clay. (Rec: 45/25 cm.)	ss-15	Loose	GM	10			
22								
23	(22.5-22.95 m.) Creamy white, *sand/gravel-sized* ***LIMESTONE*** *fragments*, with some slightly plastic clay. (Rec: 45/25 cm.)	ss-16	Med. dense	GM-SM	12		8	
24								
25	(24.0-24.45 m.) Creamy white, *sand-sized* ***LIMESTONE*** *fragments*, with some slightly plastic clay. (Rec: 45/25 cm.)	ss-17	Med. dense	SM	20			
26	(25.5-25.95 m.) Creamy white, *sand/gravel-sized* ***LIMESTONE*** *fragments*, with some slightly plastic clay. (Rec: 45/15 cm.)	ss-18	Med. dense	GM-SM	22			
27	(27.0-27.25 m.) Creamy white, *sand-sized* ***LIMESTONE*** *fragments*, with little amount of slightly plastic clay. (Rec: 25/10 cm.)	ss-19	Very dense	SP-SM	50/5 cm.			
28								
29	(28.5-28.75 m.) Creamy white, *sand-sized* ***LIMESTONE*** *fragments*, with slightly plastic clay. (Rec: 25/25 cm.)	ss-20	Very dense	SM	50/10 cm.		9	

BOREHOLE LOG

PROJECT : *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT*

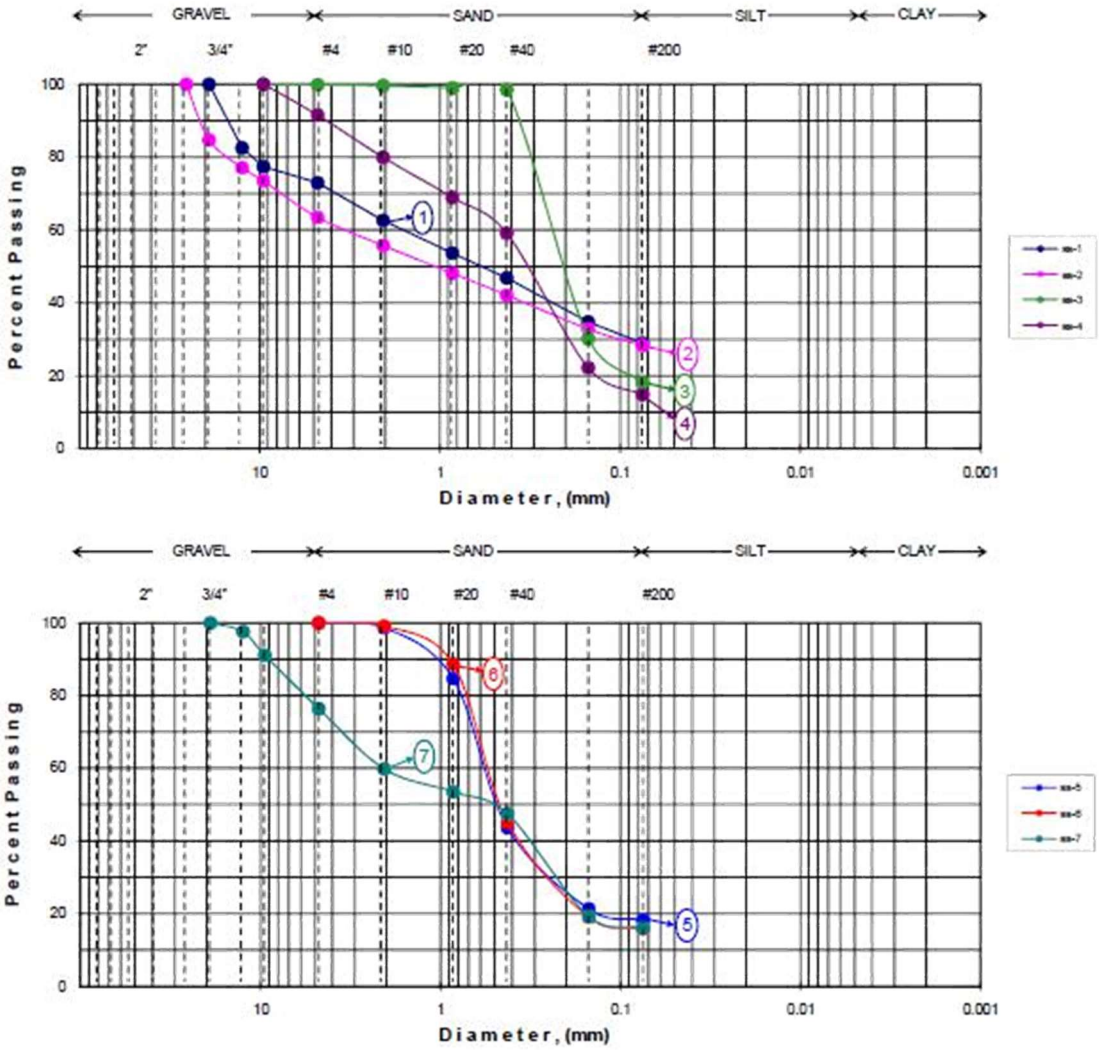
LOCATION : *MAGAY STREET, ZAMBOANGA CITY*

BORING NO.: BH-2
FINAL DEPTH: 30.45 m.
ELEVATION: No. info.
GWT: 1.20 m.
DATE STARTED: Sept. 20, 2015
DATE FINISHED: Sept. 21, 2015

AGES

DEPTH (m)	SAMPLE DESCRIPTION	SAMPLE NO.	CONSISTENCY	USCS	REC. RATIO / R. Q. D / N - VALUE (10 30 50)	WATER CONTENT (PL NMC LL; 20 60 100)	P.I.	OTHER TEST RESULTS
30	(30.0-30.45 m.) Light brown, *fine to medium SAND*, with some fine gravel and little amount of non-plastic silt. (Rec: 45/20 cm.)	ss-21	Dense	SM	30			
31								
32	*End of Borehole @ 30.45m. Depth*							
33								
34								
35								
36								
37								
38								
39								
40								

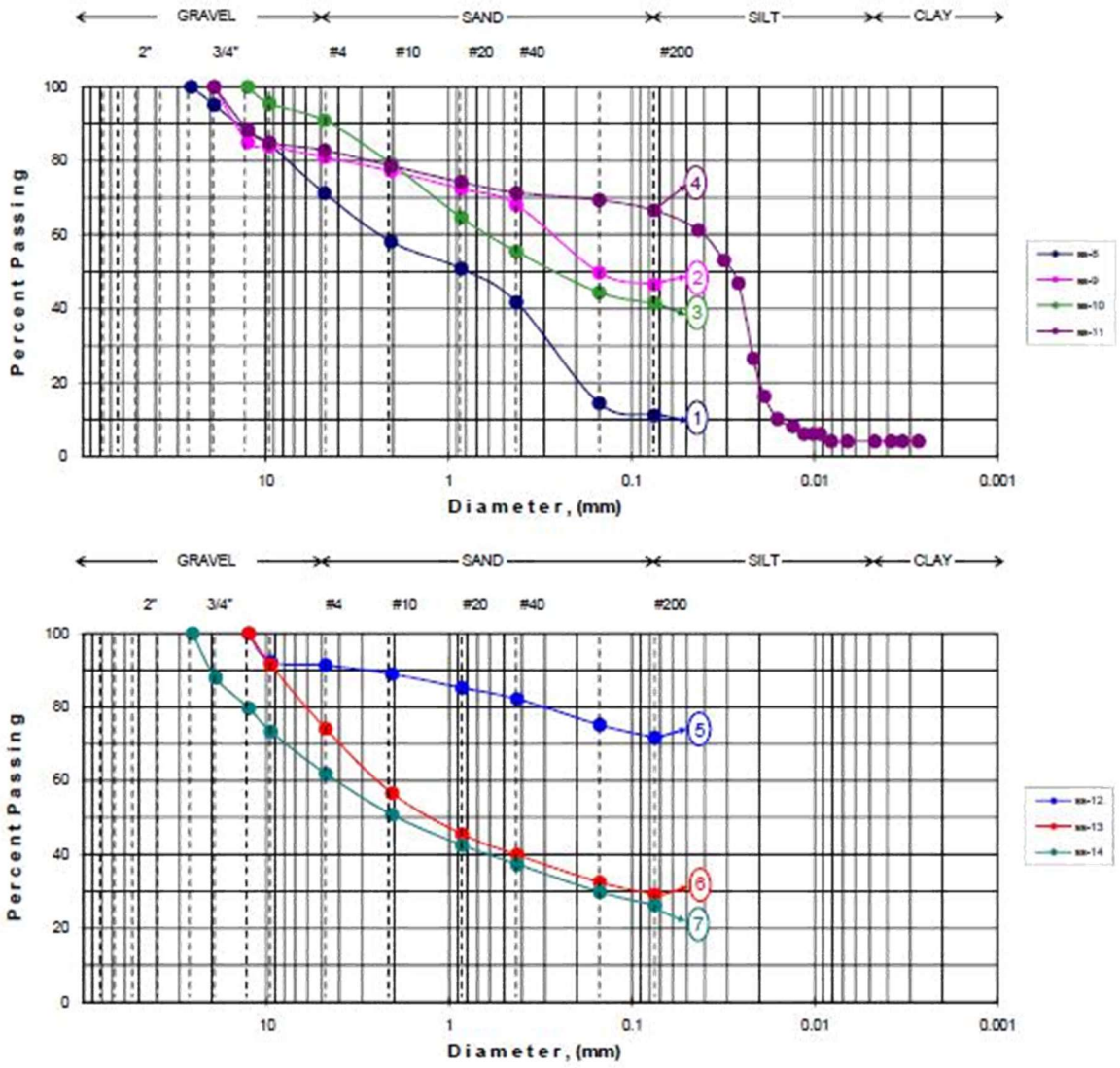
GRAIN-SIZE DISTRIBUTION CURVES



PROJECT SITE: *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT, MAGAY STREET, ZAMBOANGA CITY*

BH. NO.	SAMPLE NO.	DEPTH (m)	CURVE NO.	NMC	LL	PL	PI	USCS	DESCRIPTION
BH-2	ss-1	1.00-1.45	1	20.18	27	19	8	SM	Gray, fine SAND, with some slightly plastic clay
BH-2	ss-2	2.00-2.45	2	15.50	28	19	9	GM-SM	Gray, SAND and GRAVEL mixture, some slightly plastic cla
BH-2	ss-3	3.00-3.45	3	30.39	NP	NP	NP	SM	Gray, fine SAND
BH-2	ss-4	4.50-4.95	4	26.36	NP	NP	NP	SM	Gray, fine SAND
BH-2	ss-5	6.00-6.45	5	24.74	NP	NP	NP	SM	Gray, fine SAND
BH-2	ss-6	7.50-7.95	6	24.66	NP	NP	NP	SM	Gray, fine SAND
BH-2	ss-7	9.00-9.45	7	21.95	NP	NP	NP	SM	Gray, fine SAND

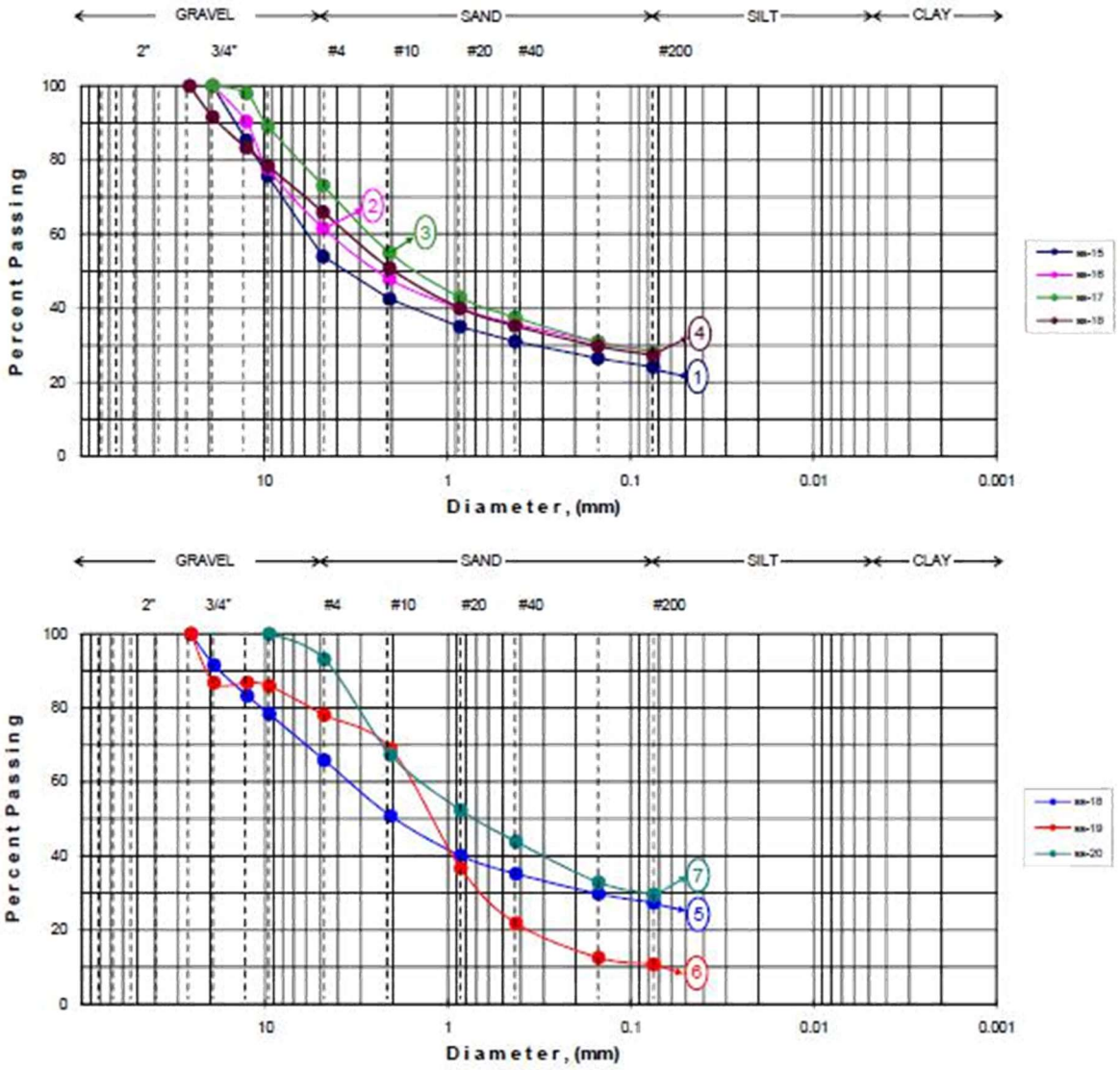
GRAIN-SIZE DISTRIBUTION CURVES



PROJECT SITE: *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT, MAGAY STREET, ZAMBOANGA CITY*

BH NO.	SAMPLE NO.	DEPTH (m)	CURVE NO.	NMC	LL	PL	PI	USCS	DESCRIPTION
BH-2	ss-8	10.50-10.95	1	28.09	NP	NP	NP	SP-SM	Gray, fine SAND
BH-2	ss-9	12.00-12.45	2	38.26	57	25	32	CH	Gray, CLAY, high plastic, with limestone fragments
BH-2	ss-10	13.50-13.95	3	30.08	49	20	29	SC-CL	Gray, sand-sized LIMESTONE fragments and CLAY mixture, medium plastic
BH-2	ss-11	15.00-15.45	4	35.95	79	25	54	CH	Creamy white, CLAY, high plastic
BH-2	ss-12	16.50-16.95	5	38.64	77	23	54	CH	Creamy white, CLAY, high plastic
BH-2	ss-13	18.00-18.45	6	27.35	43	20	23	SM	Creamy white, sand-sized LIMESTONE fragments, with some medium plastic clay
BH-2	ss-14	19.50-19.95	7	22.51	34	20	14	SM	Creamy white, sand-sized LIMESTONE fragments, with some medium plastic clay

GRAIN-SIZE DISTRIBUTION CURVES



PROJECT SITE: *PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT, MAGAY, ZAMBOANGA CITY*

BH NO.	SAMPLE NO.	DEPTH (m)	CURVE NO.	NMC	LL	PL	PI	USCS	DESCRIPTION
BH-2	ss-15	21.00-21.45	1	21.91	Insuffcient sample			GM	Creamy white, gravel-sized LIMESTONE fragments, with some slightly plastic clay
BH-2	ss-16	22.50-22.95	2	24.56	28	20	8	GM-SM	Creamy white, sand/gravel-sized LIMESTONE fragments, with slightly plastic clay
BH-2	ss-17	24.00-24.45	3	23.31	Insuffcient sample			SM	Creamy white, sand-sized LIMESTONE fragments, with some of slightly plastic clay
BH-2	ss-18	25.50-25.95	4	23.38	Insuffcient sample			GM-SM	Creamy white, sand/gravel-sized LIMESTONE fragments, with some slightly plastic clay
BH-2	ss-19	27.00-27.25	5	17.93	Insuffcient sample			SP-SM	Creamy white, sand-sized LIMESTONE fragments, with little amount of slightly plastic clay
BH-2	ss-20	28.50-28.75	6	10.55	29	20	9	SM	Creamy white, sand-sized LIMESTONE fragments, with slightly plastic clay
BH-2	ss-21	30.00-30.45	7	13.85	NP	NP	NP	SM	Light brown, fine to medium SAND

GEOANALYTICS, INC.
CIVIL ENGINEERING LABORATORY
PGA TECHNICAL CENTER BLDG.
No. 85 Kamuning Road Quezon City
Tel. Nos.: 929-3352, 929-3354, 929-3355, 929-1786, 411-3180
Telefax: 929-3353
E-mail: pgamain.laboratory@gmail.com - website: www.pgatech.com.ph

PROJECT	: The Proposed Sewage Treatment Plant for Zamboanga Water District
LOCATION	: Magay, Zamboanga City
CUSTOMER	: AGES
ADDRESS	: AGES, 103 Dunhill St. Fairview Quezon City
JOB NO.	: 15-08823
SAMPLE	: Soil
DESIRED TEST	: Moisture content,Ash & Organic matter of peat & other organic soils
REFERENCE	: ASTM D-2974-00 (2006 Edition)

TEST REPORT

Borehole No.	Sample No.	Depth (m)	Moisture Content (%)	Ash Content (%)	Organic Matter (%)
1	SS-13	19.50-19.95	33.6	96.5	3.5
2	SS-2	2.00-2.45	19.4	96.1	3.9

This laboratory is responsible for test only.

Note :
1) Date Tested : October 14, 2015
2) Date Released : OCT 17 2015
3) Tested by : Verna G. Barcilla
4) Furnace Temperature used for ash content determination was 440°C

Checked by:
Maricar K. Linga

Approved by :
J.E. Villaviray
Laboratory Manager

Philippine Institute
of Pure and Applied
Chemistry

PIPAC

Ateneo de Manila University Campus
Loyola Heights, Quezon City
E-mail: pipac@admu.edu.ph
Website: http://www.pipac.com.ph
Tel.: (632) 426-6072
Fax: (632) 426-6073

ADVANCED GEOTECHNICAL ENGINEERING
SERVICES, INC. (AGES)
103 Dunhill Street
Fairview, Quezon City

20 October 2015
2015-2432-01

REPORT OF ANALYSIS

SAMPLE(S) : Soil (SPT)
Project Title: The Proposed Sewage Treatment Plant for Zamboanga Water District, Magay, Zamboanga City

1.	BH-1 SS-7, (Depth: 9.00 -9.45m)
2.	BH-1 SS-11, (Depth: 16.50 -16.95m)
3.	BH-2 SS-4, (Depth: 4.50 -4.95m)
4.	BH-2 SS-17, (Depth: 24.00 -24.45m)

DATE SAMPLE(S) RECEIVED : 08 October 2015

DATE ANALYSIS STARTED : 13 October 2015

DATE ANALYSIS FINISHED : 20 October 2015

ANALYZED FOR : 1. Sulfate
2. Chloride

RESULT(S):

	Samples	Sulfate, mg/kg	Chloride, mg/kg
1.	**BH-1 SS-7, (Depth: 9.00 -9.45m)**	**3,500**	**34**
2.	**BH-1 SS-11, (Depth: 16.50 -16.95m)**	**68**	**130**
3.	**BH-2 SS-4, (Depth: 4.50 -4.95m)**	**1,500**	**80**
4.	**BH-2 SS-17, (Depth: 24.00 -24.45m)**	**73**	**170**
Analytical Method(s)		**Water Extraction/Ion Chromatography**	

THELMA JANE F. PARREÑAS
Laboratory Manager
Chem. Reg. No.: 0005144

DR. MODESTO T. CHUA
Institute Director
Chem. Reg. No.: 0004325

/mnb, SA #54224

PROPOSED SEWAGE TREATMENT PLANT FOR ZAMBOANGA WATER DISTRICT, MAGAY, ZAMBOANGA CITY

12. SEWAGE ANALYSIS

RSTL FORM 011
Revision 0
Effectivity Date:
March 01, 2018

Republic of the Philippines
DEPARTMENT OF SCIENCE AND TECHNOLOGY IX
Regional Standards and Testing Laboratories
Pettit Barracks, Zamboanga City
Tel. No.: 991-1024 / Fax No.: 992-1114 / E-mail: dost9ordsecretariat@gmail.com

TEST REPORT

Request Reference Number	:	R9-112019-CHE-0840
Date Submitted	:	November 20, 2019
Date Analyzed	:	November 20 – 25, 2019
Sample Submitted	:	Wastewater
Sample Descriptions	:	West Pumping Station Date & Time of Sampling: 11/20/2019 @ 08:00 AM Approx. 3 L sample, slightly turbid, in PET bottle and 800 mL (2 samples) in wide mouth glass jar.
Submitted by	:	**Zamboanga City Water District**
Address	:	Pasonanca, Zamboanga City

CHEMICAL / PHYSICAL TEST RESULT/S:

PARAMETER	TEST METHOD	RESULT
pH	Electrometric Method, SMEWW 4500-H+ B., 22nd ed., 2012	6.80 @ 25 °C
Biochemical Oxygen Demand, mg/L	Incubation (Dilution Technique) Method, SMEWW 5210 B., 22nd ed., 2012	114
Phosphate, mg/L	Vanadomolybdophosphoric Acid Colorimetric Method, SMEWW 4500-P C., 22nd ed., 2012	0.685*
Nitrate, mg/L	Cadmium Reduction Method, Hach Method 8192	21.0*
Ammonia Nitrogen, mg/L	Salicylate Colorimetric Method, Hach Method 8155	7.75
Oil and Grease, mg/L	Liquid-Liquid, Partition-Gravimetric Method, SMEWW 5520 B., 22nd ed., 2012	6.50
***** Nothing Follows *****		

REMARKS:

- This report is based on the samples received by this office and should not be used for advertising purposes or sales promotion nor as basis for tariff or customs classification of imported commodity.
- This report shall not be reproduced except in full, without the written approval of the laboratory.

Analyzed By:

NOEL T. ARQUIZA, RCT
PRC Reg. No.: 0001440
Laboratory Analyst

JANICE T. ONG, RCh
PRC Reg. No.: 0010271
Laboratory Analyst

Certified By:

SHADAM E. SUGANOB, RCh
PRC Reg. No.: 0011422
Laboratory Analyst

Noted By:

ROSEMARIE S. SALAZAR
Laboratory Head

Approved for Release:

MARTIN A. WEE
Regional Director

Report Number : 11262019-CHE-1779
Date Released : 26 NOV 2019

Page 1 of 1

13. SAMPLE DEED OF UNDERTAKING

UNDERTAKING TO INDEMNIFY

KNOW ALL MEN BY THESE PRESENTS:

This Undertaking to Indemnify (the "Undertaking") is being executed this ___ day of _____ 20__, in _____ City by _____, a corporation duly established under Philippine Laws, with principal office address at _____, represented herein by its (position), (name), hereinafter referred to as the "**Bidder**" in favour of **AECOM INTERNATIONAL DEVELOPMENT, INC.**, a foreign corporation duly organized and existing under the laws of the U.S.A., with principal office address at Wilson Boulevard, Suite 700, Arlington, VA 2220l, U.S.A., hereinafter referred to as "**AECOM**".

WITNESSETH:

WHEREAS, AECOM is providing technical assistance to the Zamboanga City Water District ("**ZCWD**") in connection with the bidding being conducted by ZCWD for the construction of an underground sewage septage treatment plant in _____ (the "**Construction Project**");

WHEREAS, AECOM, as technical consultant of ZCWD, developed a schematic design of the treatment plant (the "**Schematic Design**") that will serve as a reference design for the Bidder in relation to the Construction Project;

WHEREAS, the Schematic Design is being provided by AECOM for reference purposes only and the Bidder acknowledges and understands that it should develop its own design for the Construction Project;

NOW, THEREFORE, for and in consideration of the foregoing premises, the Bidder acknowledges that the Schematic Design is being provided strictly for reference purposes only and, in this connection, undertakes to hold free and harmless and indemnify ZCWD, AECOM, and its respective directors, officers, agents, employees and authorized representatives, against any and all losses, liabilities, responsibilities, damages, costs and/or expenses, including attorney's fees, arising out of or relating to any claim, demand, suit, judgment or any other cause of action brought by any party in connection with the Schematic Design, such as, but not limited to, damages to persons or properties arising from, or out of, any occurrence relating to the use of the Schematic Design.

The Bidder further waives all causes of action it may have, arising from the use of the Schematic Design, and undertakes that it shall not institute, commence any step, action or proceeding (whether legal, arbitral, administrative, criminal, civil, regulatory or otherwise), nor participate in any such step, action or proceeding in connection with, or relating to, the Schematic Design, against ZCWD, AECOM, and its respective directors, officers, agents, employees and authorized representatives, whether past, present or future, and shall take such steps as may be necessary to ensure that no such steps, actions, proceedings are instituted or commenced, but rather immediately dismissed.

This Undertaking by the Bidder will survive any adjudication and/or voluntary settlement of any underlying third party claim.

IN WITNESS WHEREOF, we have hereunto set our hands this _____day of _____ 20__, at _____, Philippines.

(BIDDER)

By:

_____
[NAME]
[Position]

Signed in the Presence of:

_____ _____

ACKNOWLEDGMENT

REPUBLIC OF THE PHILIPPINES)
_____CITY) S.S.

BEFORE ME, a Notary Public in and for _____City, this ___ day of _____ 20__, appeared the following person who exhibited to me his/her government-issued identification document/s, as follows:

	Government Issued I.D.	Date/Place Issued
[Name]	_____	_____
	_____	_____

known to me to be the same person who executed the foregoing instrument, and acknowledged to me that the same is his/her free act and voluntary deed as well as that of the corporation he/she represents.

This document, which pertains to an **Undertaking to Indemnify,** consisting of two (2) pages, including the page on which this Acknowledgment is written, has been signed by the party herein and his/her witnesses on each and every page thereof, and sealed with my notarial seal.

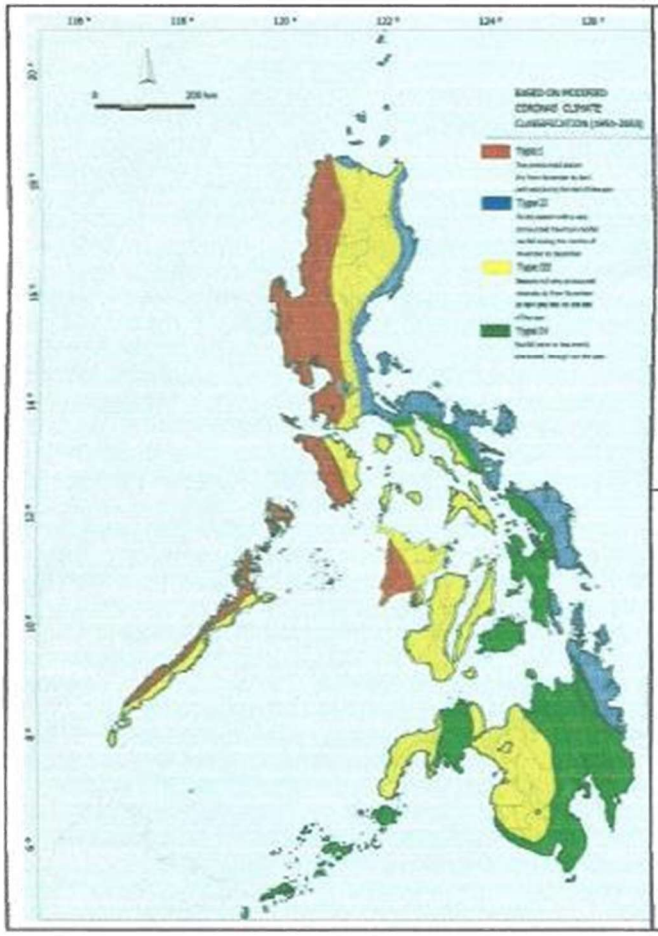
WITNESS MY HAND AND SEAL, on the date and at the place first above written.

Doc No. ____;
Page No. ____;
Book No. ____;
Series of 20__.

14. PAG-ASA CLIMATOLOGICAL DATA

REPUBLIC OF THE PHILIPPINES
Department of Science and Technology
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
Science Garden, Agham Road, Diliman, Quezon City 1100

The Philippine Climate



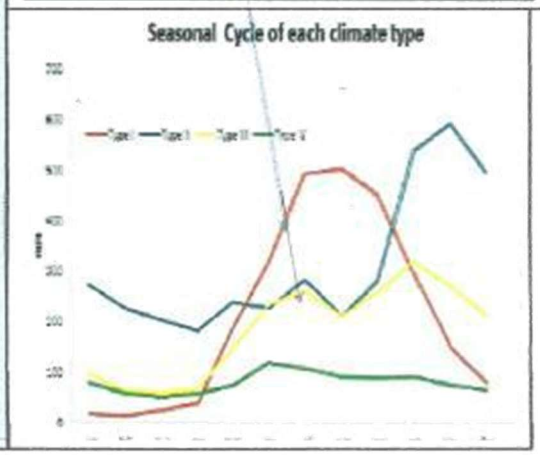
Climate Classification:

Type I
Two pronounced season dry from November to April and wet for the rest of the year. maximum rain period coincides with the peak of the southwest monsoon (July to September).

Type II
No dry season with a very pronounced maximum rainfall from November to April and wet for the rest of the year.

Type III
Season not very pronounced relatively dry November to April and wet for the rest of the year

Type IV
Rainfall more or less evenly distributed through out the year



Seasons

Month	December-February	March-May	June-August	September-November
Rainfall	DRY		RAINY	
Temperature	COOL	HOT		
Season	Cool Dry	Hot Dry	Rainy	

"tracking the sky… helping the country"

REPUBLIC OF THE PHILIPPINES
Department of Science and Technology
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
Science Garden, Agham Road, Diliman, Quezon City 1100

RAINFALL (in Millimeter, mm)

STATION: ZAMBOANGA CITY, ZAMBOANGA DEL SUR **LATITUDE :** 06°54'18"N
YEAR: 2014 **LONGITUDE:** 122°04'30"E

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	5.2	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	75.6	Trace	Trace
2	Trace	0.0	0.0	0.0	0.0	0.0	20.3	Trace	0.0	28.2	0.0	0.0
3	Trace	0.0	0.0	0.0	0.0	0.0	5.0	0.0	20.6	1.6	0.3	0.0
4	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	22.2	6.8	0.2	1.0
5	0.0	Trace	0.0	5.8	0.0	0.0	Trace	0.0	13.2	11.3	3.6	0.0
6	8.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	4.0	64.8	10.6	0.0
7	2.4	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.5	10.8	5.9	0.0
8	1.0	4.4	0.0	3.8	Trace	0.0	2.4	Trace	36.8	46.2	7.7	0.0
9	0.5	0.8	0.0	0.0	2.4	2.4	0.0	Trace	0.0	20.0	7.6	0.0
10	3.0	1.0	Trace	0.0	0.0	0.0	Trace	Trace	0.0	15.5	8.1	0.0
11	3.5	1.0	0.0	0.2	Trace	0.0	1.6	0.0	0.0	0.0	6.4	0.0
12	6.6	7.4	Trace	1.4	3.8	Trace	0.0	0.0	0.0	0.0	7.0	0.0
13	7.7	4.6	4.2	1.2	5.7	1.2	0.0	0.4	25.0	0.0	7.6	0.0
14	0.4	0.0	96.0	0.0	0.0	0.2	4.6	0.0	0.0	0.0	0.0	0.0
15	Trace	1.2	0.0	0.0	0.6	19.2	9.6	Trace	0.0	0.0	Trace	0.2
16	0.0	1.0	0.0	0.0	0.0	8.2	0.0	61.4	0.0	0.0	Trace	0.0
17	Trace	0.0	1.0	0.0	Trace	8.4	0.0	1.8	1.8	0.0	0.0	5.4
18	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	Trace	Trace	0.0	11.4
19	Trace	0.0	0.0	1.0	0.2	0.0	1.0	0.0	0.0	0.0	0.2	6.6
20	0.0	0.0	0.0	0.0	0.0	Trace	7.2	1.0	0.0	0.0	Trace	12.8
21	0.0	0.0	Trace	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.4
22	0.0	0.0	0.2	0.2	0.5	0.2	0.0	0.0	1.5	0.0	0.0	0.0
23	0.0	0.0	4.8	0.3	1.2	0.0	0.0	0.0	9.8	0.4	0.0	1.4
24	0.0	0.0	4.4	0.0	4.1	0.0	0.0	Trace	0.0	Trace	0.0	0.0
25	0.0	0.0	9.8	Trace	0.8	0.1	0.6	2.8	0.0	0.0	Trace	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	2.0	Trace	5.2	0.2	2.2	0.0
27	0.0	0.0	0.0	0.0	39.4	0.2	4.3	0..0	22.4	O.2	Trace	0.0
28	0.0	0.0	0.2	0.1	0.0	0.0	19.3	3.2	0.4	0.0	0.0	1.0
29	0.0		0.0	Trace	0.0	2.7	30.0	26.3	0.4	Trace	3.6	1.3
30	0.0		0.0	0.0	0.6	0.3	0.0	0.0	2.6	24.2	0.0	4.0
31	0.0		Trace		1.6		0.0	2.0		0.0		21.2
TOTAL	38.3	21.6	122.4	14.6	60.9	43.1	109.4	110.3	166.4	305.6	71.0	66.7
AVERAGE	2.8	1.5	8.7	1.5	4.2	3.0	7.3	9.2	11.1	21.8	5.7	4.3
HIGHEST	8.0	7.4	96.0	14.6	39.4	19.2	30.0	61.4	36.8	75.6	10.6	21.2

LEGEND: Trace – Rainfall amount less than 0.1 mm

Certified correct:

MARIBEL "Hasanah" G. ENRIQUEZ
Chief Meteorological Officer
PAGASA Zamboanga Synoptic Station

"tracking the sky... helping the country"

REPUBLIC OF THE PHILIPPINES
Department of Science and Technology
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
Science Garden, Agham Road, Diliman, Quezon City 1100

CLIMATOLOGICAL EXTREMES

STATION: ZAMBOANGA CITY
YEAR: AS OF 2010

MONTH	TEMPERATURE (°C)				GREATEST DAILY RAINFALL (MM)		HIGHEST WIND (MPS)		
	HIGH	DATE	LOW	DATE	AMOUNT	DATE	SPD	DIR	DATE
JAN	35.5	01-23-2002	15.8	01-22-1965	128.0	01-23-1916	22	NE	01-30-1982
FEB	35.5	02-28-2010	15.6	02-27-1905	156.5	02-26-1928	16	SSE	02-01-1988
MAR	36.0	03-26-2002	17.5	03-10-1911	79.6	03-21-2010	17	NNE	03-05-1972
APR	36.9	04-22-1987	16.7	04-07-1967	106.0	04-30-2004	14	W	04-22-1990
MAY	36.1	05-24-1987	20.7	05-11-1954	88.9	05-13-1990	20	NE	05-09-1978
JUNE	36.0	06-05-2010	20.4	06-02-1904	123.5	06-20-2008	21	W	06-23-1984
JULY	35.2	07-07-1988	20.0	07-18-1958	140.4	07-09-1940	20	WSW	07-21-1989
AUG	35.7	08-31-1992	19.0	08-12-1917	136.6	08-29-1952	23	ENE	08-17-1988
SEP	35.8	09-02-2004	19.9	09-07-1911	193.2	09-29-1990	22	W	09-13-1986
OCT	36.0	10-01-1999	18.4	10-05-1955	199.1	10-09-2001	23	WSW	10-06-1984
NOV	35.5	11-11-1988	18.5	11-11-1910	163.3	11-27-1955	22	W	11-07-1988
DEC	35.2	12-13-2004	16.7	12-28-1950	161.0	12-02-1910	18	NE	12-22-1992
ANNUAL	36.9	04-22-1987	15.6	02-27-1905	199.1	10-09-2001	23	ENE	08-17-1988
Period of Record	1903 - 2010				1902 - 2010		1950 - 2010		

Certified Correct:

MARIBEL "Hasanah" G. ENRIQUEZ
Chief Meteorological Officer
PAGASA Zamboanga Synoptic Station
Zamboanga City

"tracking the sky… helping the country"

15. BOARD RESOLUTION NO. 190 S. 2017

Republic of the Philippines

ZAMBOANGA CITY WATER DISTRICT

BOARD OF DIRECTORS

Pilar Street, Zamboanga City

Tel Nos. (062) 991 1556 loc. 8116; Telefax 991 1634

A RESOLUTION APPROVING THE PERFORMANCE SPECIFICATIONS AND PARAMETERS FOR THE DESIGN, BUILD, TESTING AND COMMISSIONING OF THE 4000 CUBIC METER PER DAY SEWERAGE TREATMENT PLANT

Board Resolution No. 190
Series of 2017

WHEREAS, Engr. Anne Aubrey R. De Guzman-Bugtong, Environmental Specialist, through the recommendation of AGM Amulfo A. Alfonso, presented to the Board the Performance Specifications and Parameters for the Design, Build, Testing and Commissioning of the 4000 cubic meter per day Sewerage Treatment Plant (STP) located at the Materials Recovery Facility (MRF) Compound, Gov. Lim Avenue, Zamboanga City, for their approval;

WHEREAS, after a thorough review and discussion on the matter, the Board finds it in order;

NOW THEREFORE, on motion by Director Abram M. Eustaquio, duly seconded by Director Efren F. Arañez, it was **RESOLVED**, as it is hereby **RESOLVED**, to APPROVE the Performance Specifications and Parameters for the Design, Build, Testing and Commissioning of the 4000 cubic meter per day STP.

The motion was unanimously approved.

18 December 2017, Zamboanga City Philippines.

ESTHER G. ORENDAIN
Secretary

ATTESTED BY:

JOSE VICENTE F. ATILANO III
Chairman

MILAGROS L. FERNANDEZ, M.D.
Vice-Chairperson

ENGR. EFREN F. ARAÑEZ
Director

ABRAM M. EUSTAQUIO
Director

16. BILL OF QUANTITIES (BOQ) FORMAT

Republic of the Philippines
ZAMBOANGA CITY WATER DISTRICT
Pilar Street, Zamboanga City

BILL OF QUANTITIES

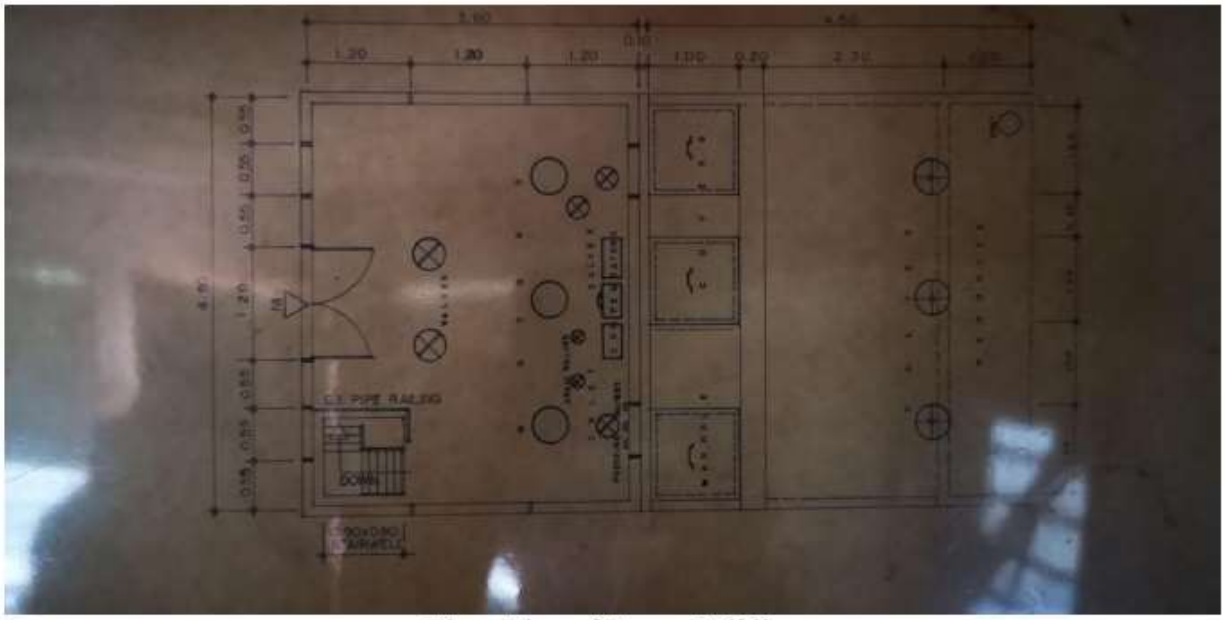
Project Title:
Total Project Cost:
Project Duration: One Thousand Two Hundred Seventy Seven (1277) Calendar Days

WORK ITEM / DESCRIPTIONS		QUANTITY	UNIT	UNIT COST (w/ OCM, Profit & VAT)	TOTAL AMOUNT
I. GENERAL REQUIREMENTS					
II. PLANNING AND ENGINEERING DESIGN PHASE					
II. CONSTRUCTION PHASE					
A.	EARTHWORKS				
B.	CIVIL WORKS				
C.	ELECTRICAL WORKS				
D.	SSTP PROCESS				
E.	OTHERS				
III. TURNOVER					
A.	TESTING AND COMMISSIONING				
B.	PROVING TREATMENT PERFORMANCE				
C.	TURNOVER OF LABORATORY TOOLS & EQUIPMENT AND OFFICE EQUIPMENT				
D.	OTHERS				
				Total Project Cost	

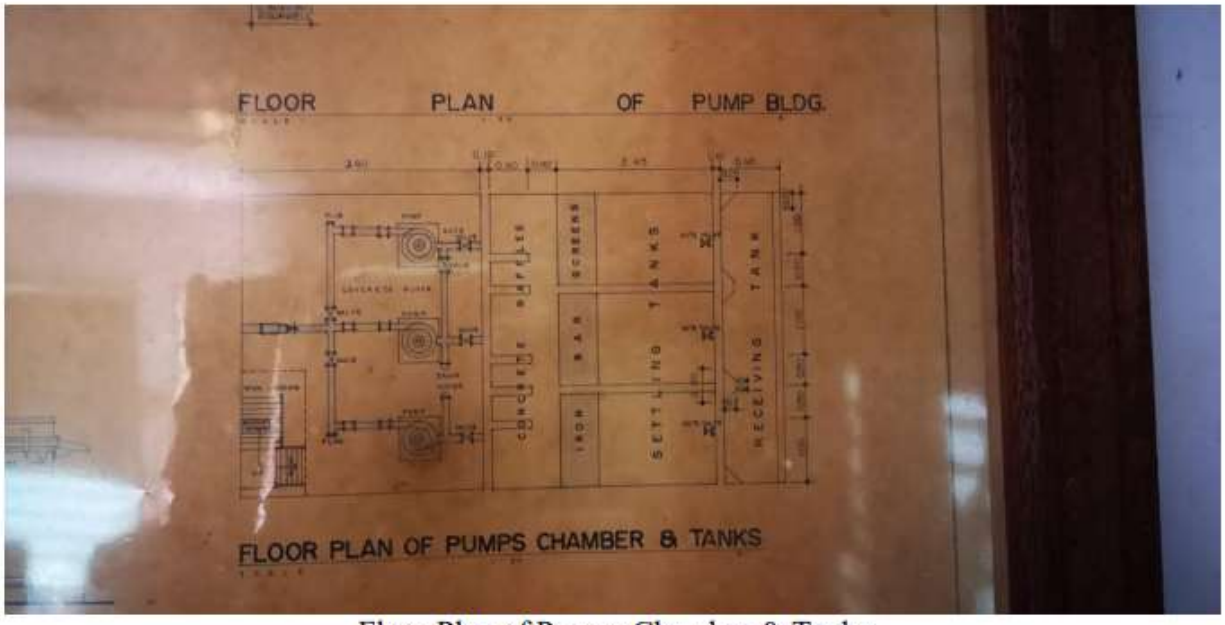
Prepared & Submitted by:

_____
Contractor's Authorized Representative

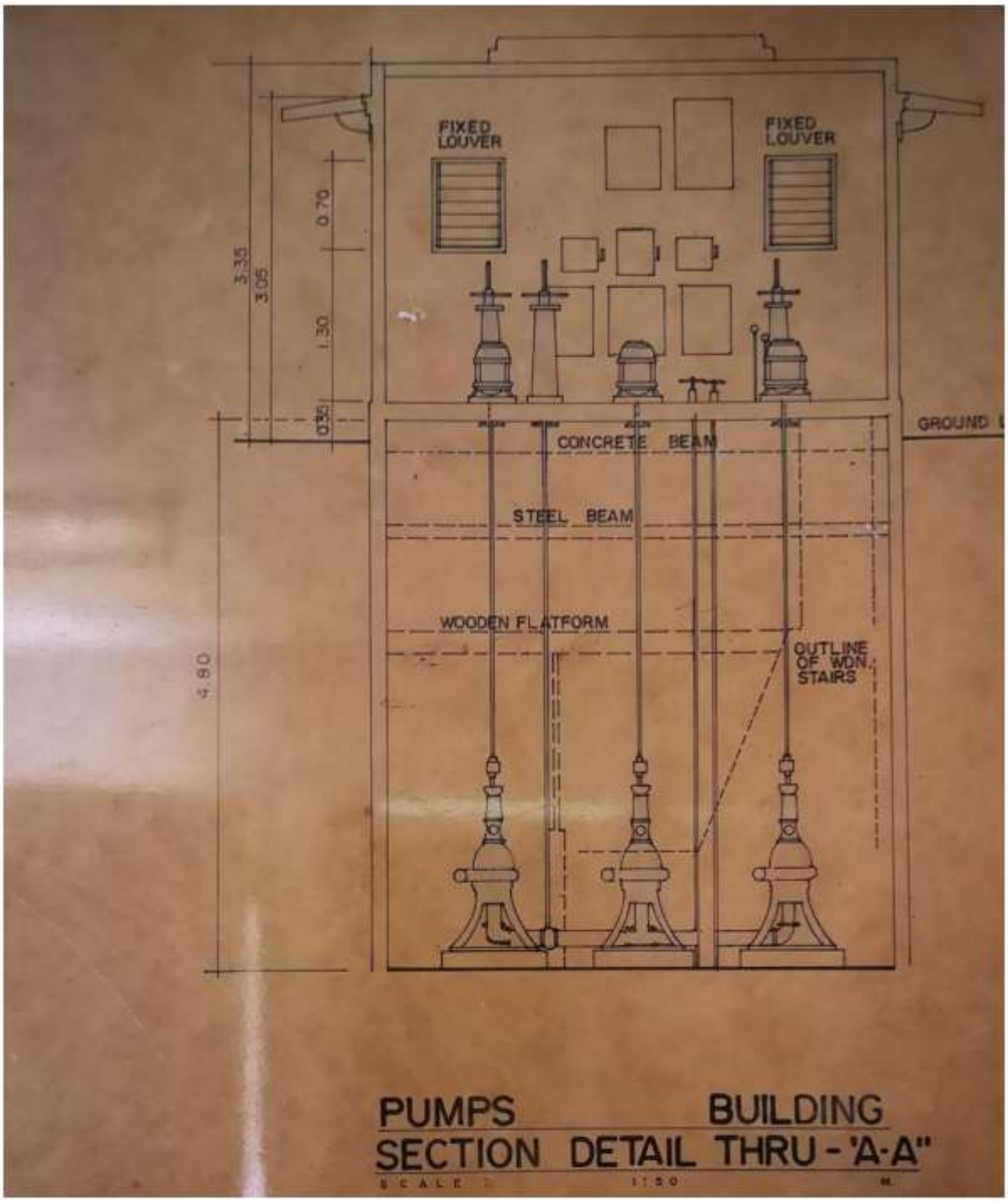
17. PHOTOGRAPHS OF AS-BUILT PLAN OF THE SEWAGE PUMPING STATIONS



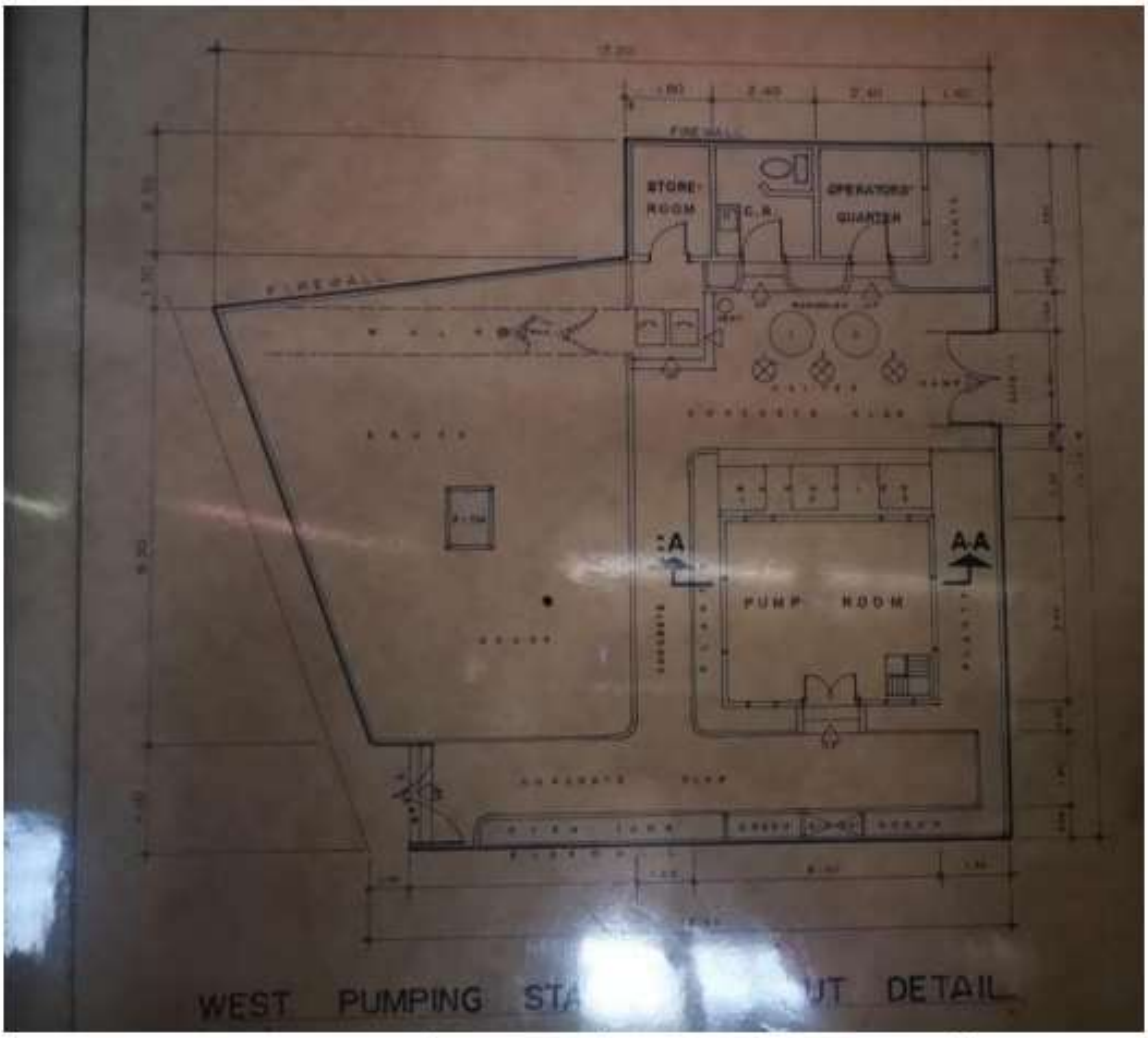
Floor Plan of Pump Building



Floor Plan of Pumps Chamber & Tanks



Pumps Building



West Pumping Station Layout Detail

Prepared by:

Digitally signed by De Guzman-Bugtong Anne Aubrey Ramirez
Date: 2023.01.31 11:18:11 +08'00'

ANNE AUBREY R. DE GUZMAN-BUGTONG
Environmental Specialist A
(Environmental/Sanitary)

JEREMIAH R. CRUZ
Engineer B (J.O.)

MARK BENEDICT C. REYES
Principal Engineer C (Mechanical)

Digitally signed by Bautista Edito Mabolo
Date: 2022.12.05 08:49:27 +08'00'

EDITO M. BAUTISTA, JR.
Principal Engineer C (Civil/Structural)
OIC, Design Division

CHECKED BY:

VALERIE GAY Y. GUTIERREZ
DMA - Environment and Water Resources Department

RECOMMENDING APPROVAL:

Digitally signed by Acosta-De Fiesta Marli Patagoc
Date: 2023.02.01 08:34:29 +08'00'

MARLI P. ACOSTA-DE FIESTA
Department Manager A, ECD
OIC, Technical Services Group

APPROVED FOR PROJECT IMPLEMENTATION:

Carbon Michael Angelo Modina
2023.02.02 13:52:43 +08'00'

MICHAEL ANGELO M. CARBON
Acting General Manager