

Part 1 General

1.1 GENERAL

- .1 This section of the specification forms part of the Contact Documents and shall be read in conjunction with them.
- .2 This section specifies the requirement for measurement and payment of the Work to be performed under the various specifications and as outlined on the Unit Price List for each scope of work.
- .3 In case of conflict between various sections of the specifications this section takes precedence over the specifications.
- .4 Unless otherwise specified, unit rates and lump sum price bid shall include for all labour, materials, tools, equipment, operating and maintenance costs, temporary works, and for supervision, overhead and profit. It is further understood and agreed that the cost for each item includes all sales taxes, permits and fees, and any or all municipal, provincial or federal charges in connection with the work and that costs of a general nature that do not pertain to any one item or for which no particular reference is made in the descriptions are distributed among all items that are bid.

Part 2 Products

2.1 MOBILIZATION / DEMOBILIZATION

- .1 50% of the unit price tendered will be paid for mobilization upon confirmation by the Engineer that the Contractor has delivered the necessary plant, equipment, labour, and material to complete the work as outlined in the contract documents.
- .2 30% of the unit price tendered will be retained for demobilization, which will be paid upon successful commissioning of the new installation, and cleanup of the site.
- .3 10% of the unit price tendered for this item will be paid upon completion of the erection of the project sign as described in these documents.
- .4 10% of the unit price for this item will be paid once site cleanup and restoration has been accepted.
- .5 Temporary facilities shall include any costs, moving equipment during the course of construction, materials, offices and other items, and any expenses associated with the project, including security fencing, barricades, channelizer barrels, survey, quality control testing, access road, Contractor's Security Escort, etc. Payment shall be on a lump sum basis as a percentage of the work complete, as agreed upon between the Contractor and Engineer.

2.2 SUPPLY AND DELIVERY

- .1 The unit price tendered shall include all labour, equipment and materials for the fabrication and/or procurement of the materials specified, and the delivery of the materials to Hall Beach. Payment will be based on the units and estimated quantities as listed in the Form of Tender.

2.3 CONSTRUCTION PHASE

- .1 Installation of Silt Fence – The unit price tendered shall include all equipment, labour and materials required for the installation of silt fence, including trench and wood stake. Measurement for payment shall be by the measured linear metre of silt fence installed.
- .2 Supply, deliver and place for the stripping of the new cell of any exist. sludge, garbage, organics, peat or any other sort areas and backfill with granular material The unit price tendered shall include all equipment, labour and materials required for the complete installation and compaction of material and transportation and disposal off-site of excavated materials as per Section 310517 Aggregate Materials and Section 334723 Sanitary Sewage Lagoons. Measurement for payment shall be in cu. m. of compacted material installed.
- .3 Supply, deliver and Installation of Granular Material for New Berm. The unit price tendered shall include all equipment, labour and materials required for the complete installation and compaction of materials for the new berm as per Section 310517 Aggregate Materials and Section 334723 Sanitary Sewage Lagoons. Measurement for payment shall be in cu.m. of compacted material installed.
- .4 Installation of Berm Liner. The unit price tendered shall include all equipment, labour, sand bedding, sand cover and anchor trench and materials required for the complete installation of the liner. Measurement and payment will be made in square metres based on the measured surface of berm liner in place. No additional payment will be made for overlap at joints.
- .5 Supply, deliver and Installation of 150mm Granular A material for topping of road and truck Discharge Point. The unit price tendered shall include all equipment, labour and materials required for the complete installation and compaction of Granular as per Section 310507 Aggregate Materials. Measurement for payment shall be based on sq.m. of compacted material installed.
- .6 Supply, deliver and Installation of 200mm Granular B material for topping of road and truck Discharge Point. The unit price tendered shall include all equipment, labour and materials required for the complete installation and compaction of Granular as per Section 310507 Aggregate Materials. Measurement for payment shall be based on sq.m. of compacted material installed.
- .7 Supply, deliver and Installation of 300mm Granular C material for topping of road. The unit price tendered shall include all equipment, labour and materials required for the complete installation and compaction of Granular as per Section 310507 Aggregate Materials. Measurement for payment shall be based on sq.m. of compacted material installed.

- .8 Supply, deliver and Install of Spillway Structures. The unit price tendered shall include all equipment, labour and materials required for the complete installation of spillway structure, as per Section 313610 Gabions and Gabion Mats, Section 313221 Geotextiles and Section 310517 Aggregates Materials. Measurement for payment shall be as per unit installed.
- .9 New swale Construction with Off-Site Disposal: The unit price tendered shall include all equipment, labour and materials necessary for the excavation of the ditch to the alignment and grades shown on the drawing. The unit price shall also include all equipment, labour and materials necessary for the transportation and disposal off-site of excavated material. Measurement for payment shall be based on the linear metre as measured in the field.
- .10 Installation of Truck Discharge Structures. The unit price tendered shall include all equipment, labour and materials required for the complete installation of truck discharge structures, including erosion protection and bollards. Measurement for payment shall be as per unit installed.
- .11 Installation of Inlet Structure Piping. The unit price tendered shall include all equipment, labour and materials required for the installation of inlet structures, including 200 dia. HDPE Series 100 pipe, concrete block, wood cribbage, reducer, bends 150 dia. HDPE Series 100 pipe, flange, 150 mm dia. hose, 1 m long hose shank, couplings and male end adaptor and gabion mat. Measurement for payment shall be as per unit installed.
- .12 Installation of outlet Structure Piping. The unit price tendered shall include all equipment, labour and materials required for the installation of inlet structures, including 300dia. HDPE Series 150 pipe, wood support, wood cribbage, reducer, bends 150 dia. HDPE Series 100 pipe, flange, 150 mm dia. hose, 1 m long hose shank, couplings and male end adaptor. Measurement for payment shall be as per unit installed.
- .13 Removal of existing truck discharge and off-site disposal. The unit price tendered shall include all equipment, labor and materials required for the removal of the truck discharge chute, bollards, rocks, unsuitable granular material, and transportation and disposal off-site. Measurement for payment shall be in lump sum of material moved.
- .14 Supply, deliver and Install Boulder Barriers. The unit price tendered shall include all equipment, labour and materials required for the installation of boulder barriers. Measurement for payment shall be per unit installed.
- .15 Installation of Signage: The unit price tendered shall include all equipment, labour and materials necessary for the installation of signs. Measurement for payment shall be per unit installed.
- .16 Installation of Pump. The unit price tendered shall include all equipment, labour and materials required for the installation of pump, including pressure gauge, ball valve, male end adapters, wheel kit and flanges. Measurement for payment shall be per unit installed
- .17 Installation of Gabion Mats. The unit price tendered shall include all equipment, labor and materials required for the installation of gabion mats and geotextiles. Measurement for payment will be by the measured sq.m. of gabion mat installed.

Part 1 General

1.1 PHASING AND SCHEDULE

- .1 As per tender documents, submit a price for one (1) phases of the project to be itemized under the TENDER FORM as attached and submitted on phase one of the tender closing date.
- .2 Work can proceed on phases prior to the originally specified year if; the Hamlet's water license has been issued, and the contractor receives written permission from the Government of Nunavut.

1.2 QUARRY PERMIT

- .1 The Government of Nunavut shall provide a Quarry Permit of the work covered by Phase 1.
- .2 The contractor shall be liable to meet the conditions and terms of the licence and shall remediate the site according to the stipulations of the permit.
- .3 If the works are not completed under the original Quarry permit as provided by the Government of Nunavut, the Contractor shall be responsible to obtain a new permit to complete the works in 2016. The cost of obtaining the new permit will be fully borne by the Contractor.

1.3 EQUIPMENT

- .1 As part of the tender, the contractor shall submit a list of equipment intended for use on the project, and shall submit a mechanics inspection report on the condition of the equipment.
- .2 The Contractor shall make available his equipment for inspection by the Government of Nunavut or there representative prior to shipping.

1.4 SCHEDULE OF WORK

- .1 The Contractor within seven (7) days of the notice of award of this contract shall submit to the Engineer a proposed final schedule in the form of a bar chart for his approval. The schedule shall include proposed dates for commencement and completion of each of the tasks required under this contract. The tasks will include, but will not be limited to, all manufacturing, preparation, shipping, and the installation of the items in this contract. The schedule will also include the anticipated dates for all testing, commissioning, and inspections as required elsewhere in this contract. The contractor will also provide all necessary and appropriate information and any other information deemed pertinent by the Engineer regarding sequence and co-ordination which will be required to ensure successful completion of the project.
- .2 If the contractor fails to adhere to the approved progress schedule, he must promptly adopt such other or additional means and methods of construction that will make up for the time lost and will assure completion in accordance with such schedule.
- .3 If at any time the Engineer determines the work, tools, plant or equipment to be insufficient, inefficient or inappropriate, the contractor shall take whatever action required to right the situation. The failure of the Engineer to instruct the contractor to

make such changes does not relieve the contractor of his obligation to ensure the quality of work and rate of progress to complete the work as required

1.5 MATERIALS LIST

- .1 Within three (3) days of the notice of award of this contract, the contractor shall provide a complete list of suppliers for the materials required for this contract. The list will include the supplier's name, a contact person, phone number, and address where applicable.
- .2 The contractor will provide verification for the Engineer that all equipment specified by make and model number has been supplied as specified. No equipment shall be installed prior to written approval given by the Engineer. No material will be paid for without having received the Engineer's approval.

1.6 ORAL ARRANGEMENTS

- .1 In all cases of misunderstandings or disputes, oral arrangements will not be considered. The contractor must produce written authority in support of his contentions, and shall not advance any claim against the Government of Nunavut or its representatives in the absence of such written authority.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Submit to Engineer submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Engineer in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer review.
- .10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 5 days for Engineer's review of each submission.

- .4 Adjustments made on shop drawings by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.
- .5 Make changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of revisions other than those requested.
- .6 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .7 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .8 After Engineer's review, distribute copies.
- .9 Submit 4 prints of shop drawings for each requirement requested in specification Sections and as Engineer may reasonably request.
- .10 Submit 4 copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Engineer where shop drawings will not be prepared due to standardized manufacture of product.

- .11 Submit 4 copies of test reports for requirements requested in specification Sections and as requested by Engineer.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .12 Submit 4 copies of certificates for requirements requested in specification Sections and as requested by Engineer.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .13 Submit 4 copies of manufacturers instructions for requirements requested in specification Sections and as requested by Engineer.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .14 Submit 4 copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Engineer.
 - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .15 Submit 4 copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Engineer.
- .16 Delete information not applicable to project.
- .17 Supplement standard information to provide details applicable to project.
- .18 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .19 This review shall not mean that the Engineer approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents. Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of all sub-trades.

1.3 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Engineer's business address.
- .3 Notify Engineer in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.
- .6 Make changes in samples which Engineer may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .3 Northwest Territories and Nunavut
 - .1 Safety Act, R.S.N.W.T. [1988].

1.2 SUBMITTALS

- .1 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .2 Submit 3 copies of Contractor's authorized representative's work site health and safety inspection reports to Engineer weekly.
- .3 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .4 Submit copies of incident and accident reports.
- .5 Submit WHMIS MSDS - Material Safety Data Sheets in to Engineer.
- .6 Engineer will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Engineer within 7 days after receipt of comments from Engineer.
- .7 Engineer's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .8 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Engineer.
- .9 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

- .1 File Notice of Project with Territorial authorities prior to beginning of Work.

1.4 SAFETY ASSESSMENT

- .1 Perform site specific safety hazard assessment related to project.

1.5 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Engineer prior to commencement of Work.

1.6 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Engineer may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.7 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.8 COMPLIANCE REQUIREMENTS

- .1 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.9 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Territory having jurisdiction and advise Engineer verbally and in writing.

1.10 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have minimum 2 years' site-related working experience specific to activities associated with similar work.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of Work.

1.11 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Territory having jurisdiction, and in consultation with Engineer.

1.12 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Engineer.
- .2 Provide Engineer with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Engineer may stop Work if non-compliance of health and safety regulations is not corrected.

1.13 BLASTING

- .1 Blasting or other use of explosives is not permitted [without prior receipt of written instruction by Engineer

1.14 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from Engineer.

1.15 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2 FIRES

- .1 Fires and burning of rubbish on site not permitted.

1.3 DISPOSAL OF WASTES

- .1 Do not bury rubbish and waste materials on site unless approved by Engineer.
- .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways or drainage systems.

1.4 DRAINAGE

- .1 Provide erosion and sediment control plan that identifies type and location of erosion and sediment controls to be provided. Plan: include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Nunavut, and Municipal laws and regulations.
- .2 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .3 Do not pump water containing suspended materials into waterways or drainage systems.
- .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.5 WORK ADJACENT TO WATERWAYS

- .1 Do not operate construction equipment in waterways.
- .2 Do not dump excavated fill, waste material or debris in waterways or drainage systems
- .3 Design and construct temporary crossings to minimize erosion to waterways or drainage systems.

1.6 NOTIFICATION

- .1 Engineer will notify Contractor in writing of observed noncompliance with Federal, Nunavut or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan. Contractor: after receipt of such notice, inform Engineer of proposed corrective action and take such action for approval by Engineer.
- .2 Engineer will issue stop order of work until satisfactory corrective action has been taken.
- .3 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Engineer. Do not burn waste materials on site, unless approved by Engineer.
- .3 Provide on-site containers for collection of waste materials and debris.
- .4 Dispose of waste materials and debris off site.
- .5 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

1.2 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris including that caused by Owner or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Engineer. Do not burn waste materials on site, unless approved by Engineer.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Clean lighting reflectors, lenses, and other lighting surfaces.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3 Copy will be returned after final inspection with Engineer's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Two weeks prior to Substantial Performance of the Work, submit to the Engineer, four final copies of operating and maintenance manuals in English.
- .6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7 Furnish evidence, if requested, for type, source and quality of products provided.
- .8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9 Pay costs of transportation.

1.2 FORMAT

- .1 Organize data as instructional manual.
- .2 **Binders: vinyl, hard covered, Heavy-duty Piano-style hinges.**
- .3 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD.

1.3 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project; Date of submission; names.
 - .1 Addresses, and telephone numbers of Consultant and [Contractor] [Design-Builder] with name of responsible parties.
 - .2 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

1.4 AS-BUILTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Engineer, one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples. Field test records.
 - .6 Inspection certificates.
 - .7 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Engineer.

1.5 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Engineer.

- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain [manufacturer's certifications,] [inspection certifications,] [field test records,] required by individual specifications sections.

1.6 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .3 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .4 Provide servicing and lubrication schedule, and list of lubricants required.
- .5 Include manufacturer's printed operation and maintenance instructions.
- .6 Include sequence of operation by controls manufacturer.
- .7 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

- .8 Provide installed control diagrams by controls manufacturer.
- .9 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .10 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .11 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .12 Include test and balancing reports.
- .13 Additional requirements: as specified in individual specification sections.

1.7 MATERIALS AND FINISHES

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-Protection and Weather-Exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

1.8 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.9 STORAGE, HANDLING AND PROTECTION

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.

- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and to satisfaction of Engineer.

1.10 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Engineer approval.
- .3 Warranty management plan to include required actions and documents to assure that Owner receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Engineer for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder and submit upon acceptance of work. Organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 9 month warranty inspection, measured from time of acceptance, by Engineer.
- .9 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.

- .3 Location where installed.
- .4 Name and phone numbers of manufacturers or suppliers.
- .5 Names, addresses and telephone numbers of sources of spare parts.
- .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
- .7 Cross-reference to warranty certificates as applicable.
- .8 Starting point and duration of warranty period.
- .9 Summary of maintenance procedures required to continue warranty in force.
- .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
- .11 Organization, names and phone numbers of persons to call for warranty service.
- .12 Typical response time and repair time expected for various warranted equipment.
- .4 Procedure and status of tagging of equipment covered by extended warranties.
- .5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in a timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification will follow oral instructions. Failure to respond will be cause for the Engineer to proceed with action against Contractor.

1.11 PRE-WARRANTY CONFERENCE

- .1 Meet with Engineer, to develop understanding of requirements of this section. Schedule meeting prior to contract completion, and at time designated by Engineer.
- .2 Engineer will establish communication procedures for:
 - .1 Notification of construction warranty defects.
 - .2 Determine priorities for type of defect.
 - .3 Determine reasonable time for response.
- .3 Provide name, telephone number and address of licensed and bonded company that is authorized to initiate and pursue construction warranty work action.
- .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.12 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Engineer.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.

- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.
 - .6 Inspector's signature.
 - .7 Construction Contractor.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

- .1 The product provided shall be a six inch portable priming assisted centrifugal pump driven by a liquid cooled diesel engine. Pump unit to include a liquid level control system. Pump unit shall be suitable for mounting on a trailer for over the road use. Model of pump shall be Gorman Rupp PA6A60-4045T or approved equal.
- .2 The primary purpose of the pump shall be for wastewater treatment plant use, lift station emergency standby, or pump station bypass.
- .3 The pump manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

.4 Performance Criteria

- .1 Pump must be designed to handle trash or debris up to 3" diameter solids. Pumps shall have 6" discharge connection. Each pump shall be selected to perform under following operating conditions.

Capacity (USGPM)	780
Total Dynamic Suction Lift (FT)	17 ft
Maximum Repriming Lift (FT)	xx ft
Total Discharge Static Head (FT)	24 ft

.2 Pump Performance Certifications

.1 Solids Handling Capability

- .1 All internal passages and impeller vanes shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted.
- .2 Upon request from the engineer, manufacturer's certified drawings showing passage size shall be submitted for approval.

.2 Dry Run Capability

- .1 Pump can be run dry at maximum speed with no damage to seals.
- .2 Seal lubricating oil temperatures should be checked to not exceed seal manufacturer's maximum continuous rating.

.3 Positive Suction Pressure Capability

- .1 Liquid to be used for this test shall be water.
- .2 Pump and priming system is to be operated with a positive suction pressure while allowing no water to discharge from the priming system.

- .3 Reprime Performance
 - .1 Consideration shall be given to the service anticipated in which the unit will operate unattended on an open sump. This could result in the liquid level in the sump dropping below the suction pipe entrance causing a loss of prime or reaching the automatic shutdown level. In either case, when the sump level is again restored needing pumping, it will require the pump to reprime itself automatically. Such occurrence shall be considered normal.
 - .2 Pump must demonstrate an automatic reprime of 25 vertical feet at the minimum operating condition point. Reprime lift is defined as the static height of the pump suction above the liquid. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Additional standards under which reprime tests shall be conducted are:
 - .1 Liquid to be used for reprime test shall be water.
 - .2 Angled seat flap discharge check valve shall be installed.
 - .3 Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90° elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.
 - .4 Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle. No water should be discharged from the priming system to the environment during priming or operation.
 - .5 Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer and certified by a registered professional engineer, shall be submitted for approval prior to shipment.
- .4 Manufacturer's Warranty
 - .1 The Gorman Rupp Company (herein "GR") warrants that its Prime Aire® Series pumps shall be free from defects in material and workmanship for a period of twenty-four (24) months from the date of purchase by the original end user when installation is made and use and maintenance is performed in accordance with GR's recommendations. Wear and tear resulting from use and items normally consumed in use are not covered.

Part 2 Products

2.1 MANUFACTURER

- .1 The specifications and project drawings depict equipment and materials manufactured by the Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

- .2 After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.
- .3 In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.
- .4 It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

2.2 PUMP DESIGN

- .1 Pump shall be horizontal, priming assisted centrifugal type, designed specifically for pumping trash or debris. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 – GENERAL of this section.
- .2 Pumps that require liquid to be maintained in the pump casing to enable priming will not be considered.
- .3 Pump shall have a 6" discharge connection.
- .4 Materials and Construction Features:
 - .1 Pump casing: Casing shall be made of ductile iron. Casing shall incorporate the following features:
 - .1 Dual 6" suction porting allowing for both standard axial and optional radial suction porting. Standard axial suction porting is perpendicular to the discharge porting and the optional radial suction porting is parallel to the discharge porting.
 - .2 Machined location on top of casing to mount priming chamber.
 - .3 Pump casing shall be capable of withstanding 100 psi (7kg/cm²) operating pressure.
 - .2 Coverplate: Cleanout coverplate shall be cast iron. Design must incorporate following maintenance features:
 - .1 Retained by easy grip hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, priming chamber, seal and wearplate without removing discharge piping.
 - .2 A replaceable wearplate secured to the coverplate by capscrews and lockwashers shall be made for ductile iron.
 - .3 Two O-rings of Buna-N material shall seal coverplate to pump casing.
 - .4 Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.

- .3 Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate the following features:
 - .1 Sealplate and bearing housing shall be cast iron. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Two lip seals will prevent leakage of oil.
 - .1 The bearing cavity shall be oversized, providing for a minimum of 1.8 gallons of oil to ensure continuous operation cooling and lubrication of seals. Oil level sight gauge and a fill/vent plug shall be installed. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil with removal of the fill/vent plug.
 - .2 Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft.
 - .3 Shaft shall be stainless steel. Pump shall also have a replaceable shaft sleeve made from stainless steel to protect the shaft from wear.
 - .4 Bearing shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearing shall be oil lubricated from a dedicated reservoir. Pump design which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
 - .5 Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be silicon carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall have a polished face and an external O-ring for sealing to the sealplate. Elastomers shall be viton. Cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 – GENERAL of this section.
 - .6 Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.
 - .4 Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.
 - .1 Clearances shall be maintained by external shimless coverplate adjustment, utilizing collar and adjusting screw design for incremental adjustment of clearances by hand. Requirement of alignment of belts, couplings, etc. shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings.
 - .2 There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating

- assembly side of the pump shall allow for further adjustment as described above (.4.1).
- .3 Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
 - .5 Angled Seat Flap Discharge Check Valve: Check valve casing shall be made for cast iron and the flap valve shall be molded Buna N. Removal or installation of the flap valve must be accomplished through a coverplate opening, without disturbing the discharge piping.
 - .6 Priming Chamber: priming chamber shall be made from cast iron and be mounted to the pump casing. Design must incorporate the following features:
 - .1 Priming system to have a priming valve that will ensure automatic prime and reprime while not allowing any liquid product being pumped to be bypassed to the environment. Performance criteria listed under PART 1 – GENERAL.
 - .2 Priming system should be capable of automatically operating under a flooded or positive suction pressure condition with performance criteria listed under PART 1 – GENERAL.
 - .3 Priming system shall create a vacuum on the suction side of the pump and in the priming chamber using a compressor to force air through a protectively mounted venturi. The valve system in the priming chamber should not allow compressed air into the pumping system should be vented become plugged.
 - .5 The pump manufacturer shall demonstrate to the engineer's satisfaction that due consideration has been given to reducing setup and maintenance costs by incorporating the following features:
 - .1 No special tools shall be required for replacement of any components within the pump.
 - .2 The unit shall be provided with a pump drain to the outside of the enclosure.
 - .3 Easy externally adjustable wearplate to maintain proper clearances for efficient performance.
 - .4 Replaceable wearplate and shaft sleeve.
 - .5 Oversized oil cooling capacity for seals when pump runs dry.
 - .6 Hard faced shaft seal for long life.
 - .7 Dual suction port feature, allowing for easier setup in space restricted areas.

2.3 Engine

- .1 The engine shall be a four (4) cylinder four cycle liquid cooled diesel engine. John Deere model 4045DF150 "Power Tech". The engine shall have the following minimum design characteristics:
 - .1 Displacement shall be 276 cubic inches.
 - .2 Maximum continuous BHP shall be 76 @ 2500 RPM.
 - .3 Governor shall be mechanical.
 - .4 Forced circulation lubrication.
 - .5 Dry type air cleaner.

- .6 Oil reservoir shall be 9 U.S. quarts dry; 8 U.S. quarts refill.
- .7 Fuel tanks shall be 84 U.S. gallons and shall be furnished with a 24 hour minimum operating time at full load. Fuel tank shall have drain line running to the outside of the enclosure.
- .8 Starter shall be 12 volt.
- .9 Compressor to be gear driven directly off the engine. No belts or couplings required. The compressor shall be capable of supplying a minimum of 13 cfm of air to the priming system.
- .2 Engine Autostart Control Panel to include the following features:
 - .1 Cold weather LCD display with backlighting.
 - .2 Safety shutdown switches / indicators for low oil pressure, engine overcrank and high coolant temperature.
 - .3 Displayed values for:
 - .1 Engine RPM
 - .2 Run Time
 - .3 Battery Voltage
 - .4 Coolant Temperature
 - .5 Oil Pressure
 - .4 Fault indication for:
 - .1 Low oil pressure
 - .2 High temperature
 - .3 Overcrank
 - .5 Engine MANUAL/STOP/AUTO key switch with key removable in any position.
 - .6 Warning alarm for eight seconds prior to start up.
 - .7 I.D. tags or equal applied:
 - .1 Throttle
 - .2 Float switch input only
 - .3 Circuit breaker
 - .4 MANUAL/OFF/AUTO
 - .8 10 AMP Panel Mounted Fuse
 - .9 Float switch connector in bottom of box adjacent to wiring harness connector.
 - .10 Low Battery Voltage Protection.
- .3 Additional features shall include:
 - .1 Radiator with drain valve on bottom of radiator with hose running to outside of the enclosure.
 - .2 The unit shall be equipped with an **Industrial Grade Muffler** w/guard and weather cap.
- .4 Because the engine shall be required to operate during emergency situations, the following minimum performance standards shall be used for engine selection:
 - .1 Engine speed shall be controlled by a manually adjustable, governor controlled throttle which shall maintain the preset speed over the range of expected pumping loads. This speed shall not be less than **1400 RPM** to insure adequate

cooling, nor more than 1900 RPM so that internal engine wear is held to a minimum.

- .2 The engine shall develop approximately 95 percent of manufacturer's published performance after a reasonable run-in period.
- .3 For selection of engine size, engine performance shall be de-rated according to manufacturer's specifications to allow for decreased performance if installed at elevations more than 100 feet above sea level.
- .4 For selection of engine size, engine performance shall be de-rated according to manufacturer's specifications to allow for decreased performance in an ambient temperature of 100 degrees F.
- .5 Engine rating shall be further reduced to conform to engine manufacturer's recommendations for continuous service applications.
- .6 Engine shall be specifically designed to operate continuously.

2.4 Control System

.1 Description

- .1 The engine shall be equipped with all controls and components required for manual and automatic operation when used with the engine controls and DC level control system described herein. Such components shall include, but not limited to, the following:
 - .1 12 volt DC electrical system, including starter and alternator.
 - .2 Digital elapsed running time meter.
 - .3 Shutdown sensors for engine temperature, oil pressure and overspeed.
 - .4 Keyed switch for manual, off, or automatic operation of the engine.
- .2 The electrical control components shall be provided by the pump supplier and shall be provided with the following:
 - .1 Indicating lights shall be LED type. LED emitting the colour Yellow shall indicate "Warning" and LED emitting the colour Red shall indicate "Fault".
 - .2 A four-digit elapsed time display shall be provided to indicate the total running time in "hours".
 - .3 Controls shall include a micro-processor based controller with 32 character two row LCD backlit display. It shall be housed in a lockable polycarbonate clear cover enclosure.

.2 Circuit details

- .1 Switches or other devices shall be provided and connected to perform as follows:
 - .1 When manual operation is selected, the operator will be prompted to push and hold the "enter" button on the control panel to start the engine. Once started, engine shall run until "OFF" is selected, or the engine failure circuit stops the engine.
 - .2 Operator can stop engine if it is running, and prevent it from starting during maintenance or repair.
 - .3 Engine failure circuits shall stop the engine, illuminate an LED, and display on LCD display on the control panel for each of the following conditions:

- .1 Engine speed exceeds maximum overspeed setting.
 - .2 Engine temperature exceeds safe operating temperature as specified by the engine manufacturer.
 - .3 Engine oil pressure falls below engine manufacturer's specified recommendations.
 - .4 Engine fails to start after several attempts.
- .4 Operating power for the engine shall be provided by the storage battery furnished with the engine.

2.5 Battery

- .1 Battery shall be 75 AMP hour industrial type with 900 cold cranking AMPS.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 This specification to be read in conjunction with all other sections and the drawings of the contract document.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM), C136-06, C117-13
 - .1 ASTM D4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.3 SAMPLES

- .1 Allow continual sampling by Engineer during production.
- .2 Provide Engineer with access to source and processed material for sampling.
- .3 Install sampling facilities at discharge end of production conveyor, to allow Engineer to obtain representative samples of items being produced. Stop conveyor belt when requested by Engineer to permit full cross section sampling.
- .4 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

Part 2 Products

2.1 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
- .2 Flat and elongated particles of coarse aggregate: Greatest dimension to exceed five times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Natural sand.
 - .2 Manufactured sand.
 - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel composed of naturally formed particles of stone.

.5 Type A Material

- .1 Crushed stone or gravel consisting of hard, durable, angular particles free from clay lumps, cementation, organic material, frozen material, and other deleterious materials.
- .2 Gradations to be within limits specified when tested to ASTM C136-06 and ASTM C117-13 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart.

ASTM Sieve Designation % Passing

26.5 mm	100
19 mm	85 – 100
13.2 mm	65 – 90
9.5 mm	50 – 73
4.75 mm	35 – 55
1.18 mm	15 – 40
0.300 mm	5 – 22
0.075 mm	0 - 8

- .3 Liquid Limit ASTM D4318-10e1 Maximum – 25
- .4 Plasticity Index ASTM D4318-10e1 Maximum – 0
- .5 Los Angeles Abrasion ASTM C131-06, Gradation “A” Maximum % loss by weight – 60

.6 Type B Material

- .1 Crushed pit run or screen stone, gravel or sand consisting of durable angular particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
- .2 Gradation to be within limits specified when tested to ASTM C136-06a and ASTM C117-13 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart.

ASTM Sieve Designation % Passing

100 mm	100
75 mm	95 - 100
26.5 mm	50 - 100
4.75 mm	20 – 55
1.80 mm	10 – 40
0.300 mm	5 – 22
0.075 mm	0 - 10

- .3 Other properties as follows:
 - .1 Liquid Limit ASTM D4318-10e1 Maximum - 25
 - .2 Plasticity Index ASTM D4318-10e1 Maximum – 0

- .3 Los Angeles Abrasion ASTM C131-06, Gradation "A" Maximum % lost by weight – 50
- .7 Type C Material
- .1 Natural sand and gravel consisting of hard, durable, angular particles free from clay lumps, cementation, organic material, frozen material, and other deleterious materials.
- .2 Gradation to be within limits specified when tested to ASTM C136-06 and ASTM C117-13 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart.
- ASTM Sieve Designation % Passing
- | | |
|----------|----------|
| 150 mm | 100 |
| 26.5 mm | 50 - 100 |
| 4.75 mm | 20 – 100 |
| 1.18 mm | 10 – 100 |
| 0.300 mm | 5 – 95 |
| 0.075 mm | 0 - 25 |
- .3 Liquid Limit ASTM D4318-10e1 Maximum – 25
- .4 Plasticity Index ASTM D4318-10e1 Maximum – 0
- .5 Los Angeles Abrasion ASTM C131-06 Gradation "A" Maximum % loss by weight – 50
- .8 Type D Material
- .1 Natural sand or manufactured sand consisting of hard, durable, angular particles free from clay lumps, cementation, organic material, frozen material, and other deleterious materials.
- .2 Gradations to be within limits specified when tested to ASTM C136-06 and ASTM C117-13 and to have a smooth curve without sharp breaks when plotted on semi-lot grading chart.
- ASTM Sieve Designation % Passing
- | | |
|----------|----------|
| 9.5 mm | 100 |
| 4.75 mm | 90 – 100 |
| 1.18 mm | 20 – 90 |
| 0.600 mm | 0 - 70 |
| 0.300 mm | 0 - 35 |
| 0.075 mm | 0 - 5 |
- .9 Riprap
- .1 Hard, with specified gravity no less than 2.65 durable quarry stone, free from seams, cracks or other structural defects, to meet following size distribution for use intended:
- .1 Random Riprap:
- .1 Not more than 10% of total volume of stones with individual volume less than 0.015m³.

- .2 Not less than 50% of total volume of stones with individual volume of 0.085m^3 or more.
- .3 Remaining percentage or total volume to have uniform distribution of stones between 0.015 and 0.085m^3 .
- .2 Hand Placed Riprap:
 - .1 Minimum size of individual stones 0.01m^3 .
 - .2 Not less than 75% of total volume of stones with individual volume of 0.025m^3 or more.
 - .3 Supply rock spalls or cobbles to fill open joints.
- .10 Stone Boulders
 - .1 Hard, with specified gravity no less than 2.65 durable field stone, free from seams, cracks or other structural defects, with a minimum size of 0.9m^3 and a maximum size of 1.4m^3 . The long dimension of the stone can not be greater than 1.5 times the shortest dimension

2.2 SOURCE QUALITY CONTROL

- .1 Inform Engineer of proposed source of aggregates and provide access for sampling at least 2 weeks prior to commencing production.
- .2 If, in opinion of Engineer, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.
- .3 Advise Engineer 2 weeks in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

Part 3 Execution

3.1 PREPARATION

- .1 Aggregate source preparation
 - .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as approved by authority having jurisdiction.
 - .2 Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.
 - .3 When excavation is completed dress sides of excavation to nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.
 - .4 Trim off and dress slopes of waste material piles and leave site in neat condition.
- .2 Processing

- .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, if required, to obtain gradation requirements, as specified. Use methods and equipment approved by Engineer.
 - .3 Wash aggregates, if required to meet specifications. Use only equipment approved by Engineer.
 - .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.
- .3 Handling
- .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .4 Stockpiling
- .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Engineer. Do not stockpile on completed pavement surfaces.
 - .2 Stockpile aggregates in sufficient quantities to meet Project schedules.
 - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
 - .4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.
 - .5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
 - .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Engineer within 24 h of rejection.
 - .7 Stockpile materials in uniform layers of thickness as follows:
 - .1 Max 1.5 m for coarse aggregate and base course materials.
 - .2 Max 1.5 m for fine aggregate and sub-base materials.
 - .3 Max 1.5 m for other materials.
 - .8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
 - .9 Do not cone piles or spill material over edges of piles.
 - .10 Do not use conveying stackers.
 - .11 Prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.2 CLEANING AND SITE GRADING

- .1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .2 Leave any unused aggregates in neat compact stockpiles as directed by Engineer.
- .3 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.

- .4 No separate payment will be made for the site grading.
- .5 Grading shall be done to prevent long term settlement and pond creation.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 This specification shall be read in conjunction with the drawings and all other sections of the contract documents.

1.2 WORK INCLUDED

- .1 The work under this section shall include the supply and placing of all equipment, labour and materials necessary to:
 - .1 Construct new roadways, including excavation to subgrade, subgrade preparation, supply, placement and compaction of granular “A”, “B” and “C” base, supply and placement of asphalt.
 - .2 Construct ditches and drainage works.

1.3 RELATED SECTIONS

- .1 Section 31 23 10 - Excavating, Trenching and Backfilling.
- .2 Section 32 11 23 - Aggregate Base Courses.
- .3 Section 32 11 19 - Granular Sub-base.

1.4 MEASUREMENT PROCEDURES

- .1 Granular materials will be measured by the Engineer by cubic metre in place and compacted for embankment fill, and subbase material, and by the square metre for the base and surface course material.
- .2 All measurements by the Engineer shall be final.

1.5 PAYMENT PROCEDURES

- .1 Subexcavation will be paid per cubic metre as measured by the Engineer at the tendered unit price and shall include any subexcavation ordered by the Engineer, and the supply, placement and compaction of the required extra backfill. No payment for subexcavation will be entertained if the Engineer deems it is required because of actions of the contractor.
- .2 Granular materials will be paid per cubic metre for embankment fill, and subbase material, and by the square metre for the base and surface course material as measured by the Engineer at the tendered unit price.
- .3 Excavation required in the contract or by the Engineer will be paid by the cubic metre as measured by the Engineer at the tendered unit price.

1.6 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).

- .1 ASTM D698-12e1 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort 12,400 ft-lbf/ft³

1.7 DEFINITIONS

- .1 Surface Course: The surface course shall be the top layer of material which will be exposed to vehicle traffic.
- .2 Base Course: The base course shall be the layer of material directly below the top course.
- .3 Subbase: The subbase shall be the layer of material below the base course.
- .4 Subgrade: The subgrade shall be the material which the road structure is founded on. This may be the existing ground, the prepared base of an excavation, or the top of an embankment of the engineered fill.

1.8 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Adhere to regulations of authority having jurisdiction when blasting is required.

Part 2 Products

2.1 MATERIALS

- .1 Granular "A": Granular "A" aggregates shall consist of crushed rock composed of hard, uncoated, fractured fragments, produced from rock formations or boulders of uniform quality, or a mixture of crushed gravel, and fines composed of hard durable, uncoated particles, produced from naturally formed deposits.

Granular "A" shall conform to the requirements listed in section 31 05 17 - Aggregates: General.

- .2 Granular "B": Granular "B" aggregates shall consist of crushed rock composed of hard, uncoated, fractured fragments, produced from rock formations or boulders of uniform quality, or a mixture of crushed gravel, and fines composed of hard durable, uncoated particles, produced from naturally formed deposits.

Granular "B" shall conform to requirements listed in section 31 05 17 - Aggregates: General.

Granular "C": Granular "C" aggregates shall consist of clean, hard, durable, uncoated particles obtained from deposits of gravel or sand, talus rock, quarried rock, iron blast furnace or blended nickel slag, clinkers, or other suitable granular materials.

Granular "C" does not require crushing except that the contractor may elect to either screen out or crush any oversize present.

Granular "C" shall conform to the requirements listed in section 31 05 17 - Aggregates: General.

Part 3 Execution

3.1 COMPACTION

- .1 The maximum rate of placing material shall be as specified or as instructed by the Engineer. The maximum rate will be determined by the adequacy of the compaction obtained.

Each layer of material shall be compacted to 95% Standard Proctor Density unless otherwise specified before the next layer is placed.

3.2 WATER DISTRIBUTORS

- .1 Apply water with equipment capable of uniform distribution.

3.3 STRIPPING ORGANIC MATERIAL

- .1 Unless specifically directed, there shall be no stripping of the organic layer of material for road construction.
- .2 Stripping of the organic material shall only occur in areas requiring excavation to prepare the subgrade at the design elevation.

3.4 EXCAVATION AND SUBGRADE PREPARATION

- .1 General:
 - .1 Notify Engineer when waste materials are encountered and remove to depth and extent directed.
 - .2 Subcut 500 mm below subgrade in cut sections unless otherwise directed. Compact top 150 mm below sub cut to minimum 95% maximum dry density, ASTM D698 (AASHTO T99). Replace with approved embankment material and compact.
 - .3 Treat ground slopes, where subgrade is on transition from excavation to embankment, at grade points as directed by Engineer.
 - .4 This work shall include all excavation necessary to prepare the subgrade in areas requiring new construction or reconstruction and shall include all hauling, spreading and levelling of excavated material.

The excavated material shall be hauled to the location as directed by the engineer. It shall be spread, graded and compacted as directed by the engineer.
 - .5 The contractor shall not excavate below the subgrade level unless directed by the Engineer.
 - .6 The bottom of the excavation shall provide a flat, uniform, dry surface for the construction of the subbase.
 - .7 Upon completion of the excavation to the subgrade elevation, the bottom of the excavation shall be inspected and approved by the engineer prior to the placement of any material for the construction of the subbase.
 - .8 If the bottom of the excavation is unsuitable for the placement of granular material, the contractor shall notify the Engineer.

- .2 Drainage:
 - .1 Maintain profiles, crowns and cross slopes to provide good surface drainage.
 - .2 Provide ditches as work progresses to provide drainage.
 - .3 Construct interceptor ditches as indicated or as directed before excavating or placing embankment in adjacent area.
- .3 Subgrade Filling
 - .1 In all areas requiring subgrade fill, the contractor shall be responsible to supply, haul, place and compact suitable material to the elevations as indicated on the drawings. No organic or other unsuitable materials will be acceptable. The material shall be placed to provide a width sufficient to allow for the driving surface specified, shoulders, side slope specified, base course and subbase. Material used to fill to subbase shall have a 2 horizontal to 1 vertical (2:1) side slope unless otherwise specified.
 - .2 Filling to subgrade shall be accomplished with Granular C unless an alternative has been otherwise specified and /or approved by the Engineer.
- .4 Use of Blast Rock for Road Construction
 - .1 Where blast rock is used for road construction, sand shall be added to the blast rock to fill the voids at the direction of the Engineer.
- .5 Construction of Roadway Granular Courses
 - .1 The granular courses and surface materials shall be kept free from clay and other types of deleterious materials. The contractor shall ensure that his operations do not disturb underlying work.

The granular courses shall be placed without segregation in uniform layers such that the thickness of the compacted layer is not greater than specified below without written approval from the Engineer;

Surface Course	100mm
Base Course	200mm
Subbase Course	300mm minimum
 - .2 Each layer shall be bladed to a smooth surface conforming to the required cross section.

Prior to closing down operations for each working day the granular material shall be bladed and compacted and, if necessary, covered with sufficient base material to carry traffic.
 - .3 In no case shall a layer of granular material be laid and compacted on frozen layer of granulars, as the top layer will not bind to the base. The contractor shall be responsible for making good any section of road which the Engineer considers to be below standard because granular material was laid on a frozen granular surface. All costs associated with this work will be borne by the contractor.
 - .4 The granular courses shall be maintained to the tolerances in grade and cross-section and to the specified density until the project is accepted.
 - .5 The Engineer may direct that soft or otherwise defective areas be cut out and backfilled with granular material. This work is to include the excavation, removal

and disposal on-site of contaminated material, and the supply, placing and compacting of granular "A" material.

- .6 Should, in the Engineer's opinion, the failure of granular course been caused by the contractor's negligence, the full reinstatement shall be carried out and the Engineer's word shall be final and binding upon this matter.

3.5 EMBANKMENTS

- .1 Scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces. Method used to be subject to prior approval of Engineer.
- .2 Break up or scarify existing road surface prior to placing embankment material.
- .3 Do not place material which is frozen nor place material on frozen surfaces except in areas authorized.
- .4 Maintain crowned surface during construction to ensure ready run-off of surface water.
- .5 Drain low areas before placing materials.
 - .1 Place and compact to full width in layers not exceeding 200 mm loose thickness. Engineer may authorize thicker lifts if specified compaction can be achieved and if material contains more than 25% by volume stone and rock fragments larger than 100 mm.
- .6 Where material consists of rock:
 - .1 Place to full width in layers of sufficient depth to contain maximum sized rocks, but in no case is layer thickness to exceed 1 m.
 - .2 Distribute rock material to fill voids with smaller fragments to form compact mass.
 - .3 Fill surface voids at subgrade level with rock spalls or selected material to form earth-tight surface.
 - .4 Do not place boulders and rock fragments with dimensions exceeding 150 mm within 300 mm of subgrade elevation.
- .7 Deductions from excavation will be made for overbuild of embankments.

3.6 FINISHING

- .1 The surface of the uppermost layer of granular material shall be bladed, shaped and compacted to produce the required surface contour.

The finished granular courses shall not deviate more than 30 mm from the specified grade and cross-section and the surface shall not deviate more than 15 mm at any place on a 3 metre template.

- .2 The finished granular courses shall not deviate more than the amount specified below from the specified grade and cross-section, shall not be consistently high or low, and the surface shall not deviate more than 15 mm at any place on a 3 metre template.

Surface Course	+15mm to -15mm
Base Course	+15mm to -25mm
Subbase Material	+25mm to -40mm
Subgrade	+25mm to -50mm

3.7

PROTECTION

- .1 Maintain finished surfaces in condition conforming to this section until acceptance by Engineer.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of polymeric geotextiles used in revetments, breakwaters, retaining wall structures, filtration, drainage structures, roadbeds and railroad beds purpose of which is to:
 - .1 Separate and prevent mixing of granular materials of different grading.
 - .2 Act as hydraulic filters permitting passage of water while retaining soil strength of granular structure.

1.2 RELATED SECTIONS

- .1 Section 33 41 23 – Sanitary Sewer Lagoon
- .2 Section 31 36 10 - Gabions and gabion Mats
- .3 Section 01 74 11 - Cleaning

1.3 MEASUREMENT PROCEDURES

- .1 Measure geotextiles in square metres of surface covered by material. No allowance will be made for seams and overlaps.

1.4 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D4491-2014, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .2 ASTM D4595-86 (2011), Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - .3 ASTM D4716-02, Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
 - .4 ASTM D4751-2004, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-4.2 No. 11.2-M89(2013), Textile Test Methods - Bursting Strength - Ball Burst Test (Extension of September 1989).
 - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes.
 - .1 No.2-M85, Methods of Testing Geosynthetics - Mass per Unit Area.
 - .2 No.3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles.
 - .3 No.6.1-93, Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles Under No Compressive Load.

- .4 No.7.3-92, Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.
- .5 No. 10-94, Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G40.20/G40.21-2013, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA-G164-M92(2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.5 SUBMITTALS

- .1 Submit to Engineer following samples at least 4 weeks prior to beginning Work.
 - .1 Minimum length of 2 m of roll width of geotextile.
- .2 Submit to Engineer 2 copies of mill test data and certificate at least 2 weeks prior to start of Work, and in accordance with Section 01 33 00 - Submittal Procedures.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

Part 2 Products

2.1 MATERIAL

- .1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.
 - .1 Width: 3.8 m minimum.
 - .2 Length: 110 m minimum.
 - .3 Composed of: minimum 85% by mass of polypropylene with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure for 60 days.
- .2 Physical properties:
 - .1 Mass per unit area: to CAN/CGSB-148.1, No.2, minimum 165 g/m².
 - .2 Grab tensile strength and elongation: to ASTM D4632.
 - .1 Breaking force: minimum 800 N, wet condition.
 - .2 Elongation at future maximum 50%.
 - .3 Mullen burst strength: to ASTM D3786, minimum 190 kPa wet condition.
 - .4 Puncture strength to ASTM D4833, 375 N.
 - .5 Trapezoidal tearing strength ASTM D4533, 265 N.
- .3 Hydraulic properties:
 - .1 Apparent opening size (AOS): to ASTM D4751, 0.212 mm.
 - .2 Filtration opening size (FOS): to CAN/CGSB-148.1 No.10 OPSS 1860.
 - .3 Permittivity: to ASTM D4491, 1.3 pers.

Part 3 Execution

3.1 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with sand bags.
- .2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
- .3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
- .4 Overlap each successive strip of geotextile [600] mm over previously laid strip.
- .5 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .6 After installation, cover with overlying layer within 4 h of placement.
- .7 Replace damaged or deteriorated geotextile to approval of Engineer.
- .8 Place and compact soil layers in accordance with Section 31 36 10 Gabions and Gabion Mats and Section 33 47 23 – Sanitary Sewage Lagoons.

3.2 CLEANING

- .1 Remove construction debris from Project site and dispose of debris in an environmentally responsible and legal manner.

3.3 PROTECTION

- .1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of geomembranes for use in waste water ponds, sewage lagoons, landfill and other containment structures as an impermeable membrane.

1.2 MEASUREMENT PROCEDURES

- .1 Geomembranes will be measured in square metres of surface covered by material. No allowance will be made for seams and overlaps.

1.3 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
- .2 ASTM D5261, 5890, 4643, 5993, 4632, 5084, 5887, 5321.

1.4 SUBMITTALS

- .1 Submit to Engineer following samples at least 4 weeks prior to beginning Work. And in accordance with Section 01 33 00 – Submittal Procedures
- .2 Submit shop drawings in accordance with engineering procedures.
- .3 Indicate installation layout, dimensions and details, including fabricated and field seams, anchor trenches and protrusion details.

1.5 CERTIFICATES

- .1 Submit to Engineer copies of manufacturer's mill test data at least 4 weeks prior to start of work.
- .2 Submit to Engineer certificates, including test results, at least 2 weeks prior to delivery to job site.

Part 2 Products

2.1 MATERIALS

- .1 Geosynthetic clay liner (thermal lock geosynthetic clay liner, non woven or equivalent).

Thermal Lock (NWL) Geosynthetic Clay Liner or equivalent.

- .1 The Thermal Lock “NWL” is a needlepunch reinforced GCL comprised of a uniform layer of granular sodium bentonite encapsulated between a scrim reinforced nonwoven and a virgin staple fibre nonwoven geotextile. The needlepunched fibres are thermally fused to the scrim reinforced nonwoven geotextile to enhance the reinforcing bond.

Geotextile Properties	Test Method	Minimum Test Frequency	Value – English -	Value – SI -
Cap Nonwoven -1 Mass/Unit Area	ASTM D 5261	1/200,000 sq.ft. (1/20,000 sq.m.)	6.0 oz/yd ² MARV	200 g/m ² MARV
Scrim Nonwoven -2 Mass/Unit Area	ASTM D 5261	1/200,000 sq.ft. (1/20,000 sq.m.)	6.0 oz/yd ² MARV	200 g/m ² MARV
Bentonite Properties				
Swell Index	ASTM D 5890	1/100,000 lbs (50,000 kg)	24 ml/2g Min	24 ml/2g Min
Moisture Content	ASTM D 4643	1/100,000 lbs (50,000 kg)	12% max.	12% max.
Fluid Loss	ASTM D 5891	1/100,000 lbs (50,000 kg)	18 ml max.	18 ml max.
Finished GCL Properties				
Bentonite Mass per Unit Area ¹	ASTM D 5993	1/40,000 sq.ft. (1/4,000 sq.m.)	0.75 lbs/sq. ft. MARV	3.66 kg/m ² MARV
Grab Strength ²	ASTM D 4632	1/40,000 sq.ft. (1/4,000 sq.m.)	150 lbs MARV	667 N MARV
Grab Elongation ²	ASTM D 4632	1/40,000 sq.ft. (1/4,000 sq.m.)	150% Typical	150% Typical
Peel Strength ³	ASTM D 4632	1/40,000 sq.ft. (1/4,000 sq.m.)	15 lbs min.	66 N
Permeability ⁴	ASTM D 5084	1/100,000 sq.ft. (1/10,000 sq.m.)	5 x 10 ⁻⁹ cm/sec max	5 x 10 ⁻⁹ cm/sec max
Index Flux ⁴	ASTM D 5887	1/Week	1 x 10 ⁻⁸ m ³ /m ² /sec max	1 x 10 ⁻⁸ m ³ /m ² /sec max
Internal Shear Strength ⁵	ASTM D 6243	Periodic	500 psf Typical	24 kPa Typical
Dimensions				
Width x Length	Nominal	Every Roll	15.5 x 150 ft.	4.7 x 45.72 m
Area per Roll	Nominal	Every Roll	2325 sq.ft.	216 sq.m.
Packaged Weight	Typical	Every Roll	2500 lbs	1179 kg

1. Oven-dried measurement. Equates to 0.84 lbs when indexed to 12% moisture content.
2. Measured at maximum peak in the weakest principal direction.
3. Modified to use a 4 inch wide grip. The maximum peak of five specimens averaged.
4. De-Aired Tap Water @ 5 psi maximum effective confining stress and 2 psi head.
5. Typical peak value for specimen hydrated to 24 hr. and sheared under a 200 psi normal stress.

- .2 The GCL shall be manufactured by mechanically bonding the geotextiles using a needlepunching process to enhance frictional and internal shear strength characteristics. In order to maintain these characteristics, no glues, adhesives or other non-mechanical bonding processes shall be used in lieu of the needlepunch process.
 - .3 The Contractor must present a quality control plan to the Engineer before undertaking any work related to the geosynthetic clay liner.
- .2 Flexible Lining
- .1 Place compacted layer of granular material in unfrozen condition on bottom and sides of lagoon as indicated.
 - .2 Check surface on which flexible liner is to be placed and remove projections that may puncture lining.
 - .3 Place liner panels as directed by the manufacturer. Anchor panels temporarily using sand bags or other weights that will not damage liner. A supervisor from the manufacturer must be present during the procedure to approve the installation.
 - .4 Excavate anchor trenches at locations as indicated.
 - .5 Place and secure liner in anchor trenches.
 - .6 Backfill and compact anchor trenches.
 - .7 Clean edges of panels to be spliced and join as outlined in the manufacturer's recommendations.
 - .8 Complete anchoring of panels at base of slope.
 - .9 Cut liner sheets to fit accurately around inlets, outlets, sleeves, concrete structures and other projections through lining.
 - .10 Complete flashing and sealing of penetrations as indicated.
 - .11 Place cover blanket as indicated.
 - .12 Flexible lining handling and placement:
 - .1 Shipping and Handling Equipment – The party responsible for unloading the GCL shall contact the manufacturer prior to shipment to determine the correct unloading methods and equipment if different from the pre-approved and specified methods.
 - .2 The GCL must be supported during handling to ensure worker safety and prevent damage to the liner. Under no circumstances should the rolls be dragged, lifted from one end, lifted with only the forks of a lift truck or pushed to the ground from the delivery vehicle.
 - .3 The QCA inspector shall verify that proper handling equipment exists which does not pose any danger to installation personnel or risk of damage or deformation to the liner material itself.
 - .4 Roll Identification and Labelling – Prior to shipment, the manufacturer shall label each roll, both on the GCL roll and on the surface of the plastic protective sleeve. Labels shall be resistant to fading and moisture degradation to ensure legibility at the time of the installation. At a minimum the roll labels shall identify the following:
 - .1 Length and width of roll
 - .2 Total weight of roll
 - .3 Type of GCL material

.4 Production Lot Number and Individual Roll Number

- .13 Storage/Stockpiling/Staging
- .1 Storage of the GCL rolls shall be the responsibility of the installer or other designated party. All GCL rolls shall be stockpiled and maintained dry, in a flat location area, away from high-traffic areas but sufficiently close to the active work area to minimize handling.
 - .2 For needlepunched GCLs, the presence of free-flowing water within the packaging shall require that the roll be set aside for further examination to ascertain the extent of damage, if any. Free-flowing water within the packaging of unreinforced GCLs shall be cause for rejection of that roll.
 - .3 GCL should be stored no higher than three to four rolls high or limited to the height at which the handling apparatus may be safely handled by installation personnel. Stacks or tiers of rolls should be situated in a manner that prevents sliding or rolling by “choking” the bottom layer of rolls.
 - .4 Rolls shall not be stacked on uneven or discontinuous surfaces in order to prevent bending, deformation, and damage to the GCL or cause difficulty inserting the core pipe.
 - .5 An additional tarpaulin or plastic sheet shall be used over the stacked rolls to provide extra protection for GCL material stored outdoors.
 - .6 Bagged bentonite material shall be stored and tarped next to GCL rolls unless other more protective measures are available. Bags shall be stored on pallets or other suitably dry surfaces which will prevent undue prehydration.
- .14 GCL Placement
- .1 GCL Material shall be placed in general accordance with the procedures specified below and the manufacturer’s specifications, or modified to account for site specific conditions.
 - .2 GCL Orientation – GCL Panels shall be placed with nonwoven side up on slopes.
 - .3 GCL Panel Position – All slope panels shall be installed parallel to the maximum slope.
 - .4 Seaming – A 9-inch lap line and a 12-inch match line shall be imprinted on both edges of the upper geotextile component of the GCL to assist in installation overlap quality control. Lines shall be printed as continuous dashes in easily observable non-toxic ink.
 - .1 Overlap seams shall be a minimum of twelve inches on panel edges and twenty four inches on panel ends.
 - .2 Loose granular bentonite should be placed between panels at a rate of ¼ pound per lineal foot of seam if the GCL is the primary hydraulic seal.
 - .3 The addition of bentonite to the seam area is optional when the GCL will be acting as a leak isolator for an overlying FML.
 - .5 Detailing – Detail work, defined as the sealing of the liner to pipe penetrations, foundation walls, drainage structures, spillways, and other appurtenances, shall be performed as recommended by the GCL Manufacturer.

.6 Damage Repair – Prior to cover material replacement, damage to the GCL shall be identified and repaired by the installer. Damage is defined as any rips or tears in the geotextiles, delamination of geotextiles or a displaced panel.

.7 Stop GCL installation work when it rains. The GCL must be covered before the rain starts. Personnel or equipment must not circulate directly on the GCL when it rains.

.15 Covering Materials

.1 Covering materials shall be compatible, as well as suitable, for use over the GCL, and placed in a manner appropriate to the particular subgrade. Regardless of the covering material, the uncovered edge of GCL panels shall be protected at the end of the working day with a waterproof sheet which is secured adequately with ballasts.

2.2 Material Warranty

.1 Provide the Owner with a written warranty against manufacturing defects for a period of twenty (20) years from the date of installation.

2.3 Guarantee

.1 Provide the Owner with a written guarantee against defects in installation and workmanship for a period of five (5) years from the date of final acceptance, at no cost to the Owner.

Part 3 Execution

3.1 CLEANING

.1 Remove construction debris from Project site and dispose of debris in an environmentally responsible and legal manner.

3.2 PROTECTION

.1 Do not permit vehicular traffic directly on membrane.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 05 17 – Aggregate Materials
- .2 Section 31 32 21 - Geotextiles.
- .3 Section 01 74 11 - Cleaning

1.2 MEASUREMENT PROCEDURES

- .1 Measure gabions in cubic metres of stone filled baskets and mats incorporated into Work.
- .2 Measure installation of gabions in cubic metres and include excavation and preparation of foundation bed and supply and installation of graded stone fill and supply and installation of backfill.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A313/A313M-13, Standard Specification for Stainless Steel Spring Wire.
 - .2 ASTM A764-95 (2011), Standard Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size For Mechanical Springs.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-G164-M92 (2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

Part 2 Products

2.1 MATERIALS

- .1 Gabion baskets:
 - .1 Factory fabricated so that sides, ends, lid and internal diaphragms can be readily assembled at site into rectangular baskets of sizes as indicated.
 - .2 Single unit construction or with joints having strength and flexibility equal to that of mesh.
 - .3 Provide diaphragms of same mesh as gabion walls, when length exceeds horizontal width. Diaphragms to divide basket into equal cells of length not to exceed horizontal width.
 - .4 Wire mesh gabions:
 - .1 Wire mesh: uniform hexagonal pattern wire woven in triple twist pattern with openings of approximately 80 x 100 mm, non-ravelling.
 - .2 Securely selvedge perimeter edges to form joints connecting selvedges with same strength as mesh body.
 - .3 Wire to have following dimensions:

- .1 Mesh: 3.0 PVC covered wire 2.4 mm diameter.
- .2 Selvedges: 3.8 PVC covered wire 3.4 mm diameter.
- .3 Binding: 2.0 mm diameter.
- .4 Wire: hot dip galvanized with minimum coverage of 260 g/m² to CAN/CSA G164. Cover with minimum 0.5 mm thick polyvinyl chloride coating.
- .5 Interlocking wire fasteners: galvanized steel to ASTM A764, finish 1, class 1, type 3.
- .5 Geogrid gabions:
 - .1 Geogrid mesh: rigid type, uniform, square pattern, non corrosive, high density polyethylene with inhibitors added to resist deterioration by ultra-violet and heat exposure.
 - .1 Geogrid openings: 50 x 50 mm.
 - .2 Geogrid mechanical properties: tensile modulus at 2% elongation: modified to manufacturer's recommendations, minimum 290 kN/m.
 - .1 Junction strength: minimum 90% of single rib strength.
- .2 Gabion mats:
 - .1 Factory fabricated sides, ends, lid and internal diaphragms ready to assemble at site into rectangular mats.
 - .2 Single unit construction or with joints having strength and flexibility equal to that of mesh.
 - .3 Provide diaphragms of same mesh as gabion walls, when length exceeds horizontal width. Diaphragms to divide mat into equal cells not to exceed 1 m x 3 m.
 - .4 Wire mesh gabion mats:
 - .1 Wire mesh: uniform hexagonal pattern wire woven in triple twist pattern with openings of approximately 80 x 100 mm, non ravelling.
 - .1 Securely selvedge perimeter edges of mesh to form joints connecting selvedges with same strength as mesh body.
 - .2 Wire to have following dimensions:
 - .1 Mesh: 2.20 mm diameter.
 - .2 Selvedges: 2.65 mm diameter.
 - .3 Binding: 2.20 mm diameter.
 - .3 Wire: hot dip galvanized with minimum coverage of 260 g/m² to CAN/CSA-G164.
 - .4 Interlocking wire fasteners: galvanized steel to ASTM A 764, finish 1 class 1, type 3.
 - .5 Geogrid gabion mats:
 - .1 Geogrid mesh: rigid type, uniform, square pattern, non corrosive, high density polyethylene with inhibitors added to resist deterioration by ultra-violet and heat exposure. Geogrid opening: 50 x 50 mm.
 - .2 Geogrid mechanical properties:

- .1 Tensile modulus at 2% elongation: minimum 290 kN/m.
- .2 Junction strength: minimum 90% of single rib strength.
- .3 Stone fill:
 - .1 Hard, durable, abrasion resistant, capable of resisting degradation from action of wetting and drying, wave action, freezing and thawing cycles.
 - .2 Minimum 100 mm to maximum 200 mm dimension for individual stones.
- .4 Geotextile filter: in accordance with Section 31 32 21 - Geotextiles.

Part 3 Execution

3.1 INSTALLATION

- .1 Install gabions and geotextiles to lines and grades as indicated. Follow manufacturer's instructions in assembling baskets and mats.
- .2 Excavate for and backfill behind gabions in accordance with Section 31 23 10 - Excavating Trenching and Backfilling.

3.2 PLACING GABIONS

- .1 Wherever possible, place baskets and mats in position prior to filling with stones.
- .2 Join adjacent baskets and mats together at corners as recommended by manufacturer, to ensure joints are as strong as mesh.

3.3 FILLING BASKETS AND MATS

- .1 Tension geogrid gabions according to manufacturer's instructions before filling with stone. Do not release wall tension until sufficient stone fill has been placed to prevent wall slackening.
- .2 On exposed faces of gabions, place stones by hand with flattest surfaces bearing against face mesh to produce satisfactory alignment and appearance.
- .3 For wire mesh gabions, fill gabion cells in lifts not to exceed 300 mm and connect opposite walls with two tie wires after each lift.
- .4 For geogrid gabions, fill cells in lifts not to exceed 300 mm and connect opposite walls with two polyethylene braids after each lift.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 05 17 - Aggregate Materials.

1.2 MEASUREMENT PROCEDURES

- .1 Measure granular sub-base in measured in place by cross section and calculated by average end area method.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C117-13, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C131-14, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C136-06a, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D422-63(2007), Standard Test Method for Particle-Size Analysis of Soils.
 - .5 ASTM D698-12e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .6 ASTM D1557-12, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).
 - .7 ASTM D1883-07, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .8 ASTM D4318-10e1, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

Part 2 Products

2.1 MATERIALS

- .1 Granular sub-base material: in accordance with Section 31 05 17 - Aggregate Materials and following requirements:

Part 3 Execution

3.1 PLACING

- .1 Place granular sub-base after subgrade is inspected and approved by Engineer.
- .2 Construct granular sub-base to depth and grade in areas indicated.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .7 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
- .8 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Engineer may authorize thicker lifts (layers) if specified compaction can be achieved.
- .9 Shape each layer to smooth contour and compact to a specified density before succeeding layer is placed.
- .10 Remove and replace portion of layer in which material has become segregated during spreading.

3.2 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Engineer before use.
- .3 Equipped with device that records hours of actual work, not motor running hours.
- .4 Compact to density of not less than 98% maximum dry density in accordance with ASTM D698-12e1.
- .5 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .6 Apply water as necessary during compaction to obtain specified density.
- .7 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Engineer.
- .8 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.3 PROOF ROLLING

- .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm maximum.
- .2 Obtain approval from Engineer to use non standard proof rolling equipment.
- .3 Proof roll at level in sub-base as indicated. If non standard proof rolling equipment is approved, Engineer to determine level of proof rolling.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .5 Where proof rolling reveals areas of defective subgrade:
 - .1 Remove sub-base and subgrade material to depth and extent as directed by Engineer.
 - .2 Backfill excavated subgrade with sub-base material and compact in accordance with this section.
 - .3 Replace sub-base material and compact.
- .6 Where proof rolling reveals areas of defective sub-base, remove and replace in accordance with this section at no extra cost.

3.4 SITE TOLERANCES

- .1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.5 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Engineer.

END OF SECTION

Part 1 General

1.1 MATERIALS

- .1 Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier as conforming to the following requirements:

<i>Physical property</i>	<i>Test</i>	<i>Requirements</i>
Filtering Efficiency	ASTM 5141	75% (minimum)
Tensile Strength at 20% (max.) Elongation	VTM-52	Extra Strength- 50 lbs./linear inch (minimum) Standard Strength- 30 lbs./linear inch (minimum)
Flow Rate	ASTM 5141	0.2 gal./sq. ft./min. (minimum)
Ultraviolet Radiation	ASTM-G-26	90% (minimum)

- .2 Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a maximum usable construction life.
- .3 If wooden stakes are utilized for silt fence construction, they must have a diameter of 50mm when oak is used and 100 mm when pine is used. Wooden stakes must have a minimum length of 1500mm.
- .4 If steel posts (standard “U” or “T” section) are utilized for silt fence construction, they must have a minimum weight of 1.33 pounds per linear foot and shall have a minimum length of 1500mm.
- .5 Wire fence reinforcement for silt fences using standard-strength filter cloth shall be a minimum of 14 gauge and shall have a maximum mesh spacing of 150mm.

Part 2 Execution

2.1 APPLICATION

- .1 The height of a silt fence shall be a minimum of 400 mm above the original ground surface and shall not exceed 850mm above ground elevation.
- .2 The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter cloth shall be spliced together only at a support post, with a minimum 150mm overlap, and securely sealed.
- .3 The trench shall be excavated approximately 200mm wide and 200mm deep on the upslope side of the proposed location of the measure.

- .4 When wire support is used, standard-strength filter cloth may be used. Posts for this type of installation shall be placed a maximum of 3000mm apart. The wire mesh fence must be fastened securely to the upslope side of the posts using heavy duty wire staples at least one inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two inches and shall not extend more than 850mm above the original ground surface. The standard-strength fabric shall be stapled or wired to the wire fence, and 200mm of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees.
- .5 When wire support is not used, extra-strength filter cloth shall be used. Posts for this type of fabric shall be placed a maximum of 1800mm apart. The filter fabric shall be fastened securely to the upslope using one inch long (minimum) heavy-duty wire staples or tie wires and eight inches of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees. This method of installation has been found to be more commonplace than #4.
- .6 If a silt fence is to be constructed across a ditch line or swale, the measure must be of sufficient length to eliminate end flow, and the plan configuration shall resemble an arc or horseshoe with the ends oriented upslope. Extra-strength filter fabric shall be used for this application with a maximum 900mm spacing of posts.
- .7 The 200mm by 200mm trench shall be backfilled and the soil compacted over the filter fabric.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 This specification shall be read in conjunction with the drawings and all other sections of the contract documents.

1.2 WORK INCLUDED

- .1 The work covered by this section shall include the supply and installation of sanitary sewers.

Part 2 Products

2.1 MATERIALS

Polyethylene Pipe: The sanitary sewer mains, Series 160 (1100 kPa) high density polyethylene pipe

All polyethylene pipe, fittings, stubends, etc. shall be of the same manufacturer's series, wall thickness, and the same grade of polyethylene. All gaskets will have the same internal diameter as the series pipe and all bolts and back up rings will be compatible to allow tightening without washers. Standard of acceptance shall be KWH Sclairpipe, Urecon UIP, or approved equal.

Part 3 Execution

3.1 GENERAL

- .1 The contractor shall read and be governed by the General Conditions, General Instruction, Instructions to Tenderers, Addenda, Form of Tender, Articles of Agreement, Plans and Specifications for this project.

The complete work under each trade shall be governed by the dictates of good practice in all details of materials and methods even if not minutely specified. The complete work shall be properly co-ordinated with the work of other trades

3.2 DRAINAGE

- .1 The contractor shall keep all portions of the work properly and efficiently drained during construction and until completion. He shall be held responsible for all damage, which may be caused as the result of water backing up or flowing over, through, from, or along any part of the work or surrounding properties due to his operation.

All costs associated with providing drainage for the work as required, shall be included in the unit prices for the installation of each associated item.

3.3 SITE RESTRICTIONS

- .1 When planning the work, the contractor shall make due allowance for the presence of the existing structures, access, utilities and the operation of others on the site.

3.4 RELOCATION OF MAINS

- .1 The Engineer has the right to relocate the mains throughout the project and he will advise the contractor well in advance of the work if any such move is contemplated.

3.5 INSPECTION

- .1 All material is subject to inspection and testing for soundness and suitability at the discretion of the Engineer.
- .2 All works shall be undertaken in strict adherence to the manufacturer's instructions, which are considered as being part of these Specifications. As each section of the work is completed, it shall be tested in the manner specified, and in the presence of, and as approved by, the Engineer.
- .3 All material found, during the progress of the work, to have cracks, flaws, or other defects, or to be of doubtful quality will be rejected by the Engineer. All rejected materials shall be promptly removed from the site of the work by the contractor and all costs associated with the removal and replacement of rejected material shall be borne by the contractor.

3.6 HANDLING OF MATERIAL

- .1 All material shall be delivered and distributed at the site by the contractor. All pipe and accessories shall be loaded and unloaded by lifting manually or with hoists so as to avoid shock or damage. Under no circumstances shall such materials be dropped.

In distributing the polyethylene pipe at the site of the work, each piece shall be unloaded opposite or near the place where it is to be installed.

- .2 Pipe shall be handled so the exterior and interior surfaces, prefabricated joints will not be damaged. If, however, any part of any surface is damaged, the repair shall be made by the contractor at his own expense, in a manner satisfactory to the Engineer.

3.7 ALIGNMENT AND GRADE

- .1 All pipe sections shall be laid and maintained to the required lines and grades, with fittings, at the proper locations and grade with joints centred.

No deviation from authorized lines and grades shall be made without the written approval of the Engineer. If, in the opinion of the Engineer, the contractor's method of setting grades is inaccurate or insufficient, the Engineer may direct that more suitable equipment and methods be used to insure that proper grades are established.

3.8 PIPE JOINTS

- .1 Thermal butt-fusion of polyethylene pipe shall be carried out as recommended by the supplier, but only by a certified butt-fusion technician.

When joining the sections of pipe, it is the fusion equipment that must be moved from joint to joint.

- .2 Should it become necessary, and only upon authorization by the Engineer, polyethylene spacer blocks, properly machined, and of the same material as the main, may be used when required to connect the mains to the access vaults. The spacer blocks shall be installed between the flanges. Only one spacer block is permitted for each connection.

Back up flanges for flange connections shall be ductile iron. Bolts shall be galvanized or cadmium plated. All required bolts and gaskets shall be provided by the contractor.

3.9 FLUSHING

- .1 Sewer mains to be flushed with a minimum flow of 1.5m/s with in the pipe for a duration of 10 minutes or until all foreign materials have been removed and flushed water is clear.
- .2 Flushing operations shall be performed under the direction of the Engineer. Provide 48 hours notice prior to start of flushing operations.

3.10 JOINT TESTING

- .1 The owner reserves the right to visually inspect and test fusion joints using nondestructive methods and visual inspection.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for pipe culverts.

1.2 RELATED SECTIONS

- .1 Section 33 41 23 - Sanitary Sewer Lagoon
- .2 Section 01 74 11 - Cleaning
- .3 Section 31 05 17 - Aggregate Materials.

1.3 MEASUREMENT PROCEDURES

- .1 Measure supply and installation of pipe culvert including excavation and backfill in metres in place for each size, type and class of pipe.

1.4 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-G401-07 (R2013), Corrugated Steel Pipe Products.

1.5 SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Engineer at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
- .3 Submit to Engineer for testing, at least 4 weeks prior to beginning Work, following samples of materials proposed for use.
- .4 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work.
- .5 Certification to be marked on pipe.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Divert unused metal materials from landfill to metal recycling facility as approved by Engineer.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 CORRUGATED STEEL PIPE

- .1 Corrugated steel pipe: to CSA-G401.
- .2 Water-tight cut-off collars: as indicated.
- .3 Prefabricated end sections: as indicated.
- .4 Corrugated fluming: to CSA-G401.

2.2 GRANULAR BEDDING AND BACKFILL

- .1 Granular bedding and backfill material to Section 31 05 17 - Aggregate Materials and following requirements:

Part 3 Execution

3.1 TRENCHING

- .1 Obtain Engineer's approval of trench line and depth prior to placing bedding material or pipe.

3.2 BEDDING

- .1 Dewater excavation, as necessary, to allow placement of culvert bedding in dry condition.
- .2 Place minimum thickness of 200 mm of approved granular material on bottom of excavation and compact to minimum 95% maximum density to ASTM D698.
- .3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to camber as indicated or as directed by Engineer, free from sags or high points.
- .4 Place bedding in unfrozen condition.

3.3 LAYING CORRUGATED STEEL PIPE CULVERTS

- .1 Begin pipe placing at downstream end.
- .2 Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length.
- .3 Lay pipe with outside circumferential laps facing upstream and longitudinal laps or seams at side or quarter points.
- .4 Lay paved invert or partially lined pipe with longitudinal centre line of paved segment coinciding with flow line.
- .5 Do not allow water to flow through pipes during construction except as permitted by Engineer.

3.4 JOINTS: CORRUGATED STEEL CULVERTS

- .1 Corrugated steel pipe:
 - .1 Match corrugations or indentations of coupler with pipe sections before tightening.
 - .2 Tap couplers firmly as they are being tightened, to take up slack and ensure snug fit.
 - .3 Insert and tighten bolts.
 - .4 Repair spots where damage has occurred to spelter coating by applying two coats of asphalt paint approved by Engineer.

3.5 BACKFILLING

- .1 Backfill around and over culverts as indicated or as directed by Engineer.
- .2 Place backfill material, approved by Engineer, in 150 mm layers to full width, alternately on each side of culvert, so as not to displace it laterally or vertically.
- .3 Compact each layer to 95% maximum density to ASTM D698-10e1 taking special care to obtain required density under haunches.
- .4 Protect installed culvert with minimum 600 mm cover of compacted fill before heavy equipment is permitted to cross. During construction, width of fill, at its top, to be at least twice diameter or span of pipe and with slopes not steeper than 1:2.
- .5 Place backfill in unfrozen condition.

3.6 FLUMING

- .1 Assemble and install fluming as indicated.
- .2 Set top edges of fluming flush with side slope.

Part 4 Measurement

4.1 MEASUREMENT

- .1 Supply, delivery and installation of pipe culverts shall be measured by the linear metre culvert installed.
- .2 All measurement by the Engineer shall be final.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 32 21 - Geotextiles.
- .2 Section 31 32 22 - Geomembranes.
- .3 Section 31 05 17 - Aggregate Materials.
- .4 Section 01 74 11 - Cleaning

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C117-13, Standard Test Method for Materials Finer than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D698-12a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort 600kN-m/m³.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

1.3 SHOP DRAWINGS

- .1 Indicate following items:
 - .1 Liner panels, details of anchoring panels, material, thickness and reinforcement.
 - .2 Projections through liner and method of sealing.
 - .3 Piping.

1.4 SAMPLES

- .1 Submit to Engineer for testing, samples of following materials at least 4 weeks prior to commencing work:
 - .1 Two samples 3600 mm square of flexible lining including joint or intersecting joints if included in Work.
 - .2 Two samples 600 mm long of flexible lining including joint or intersecting joints if included in Work.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused aggregate materials from landfill to facility for reuse as approved by Engineer.

- .2 Divert unused geotextiles from landfill to plastic recycling facility for disposal as approved by Engineer.

Part 2 Products

2.1 MATERIALS

- .1 Flexible liner: geomembrane in accordance with Section 31 32 22 - Geomembranes.
- .2 Geotextiles: in accordance with Section 31 32 21 - Geotextiles.
- .3 Rip-rap: in accordance with Section 31 37 17 - Rip-Rap.
- .4 Berm material in accordance with Section 31 05 17 – Type C material.

Part 3 Execution

3.1 EXCAVATION

- .1 Excavate effluent ditches, by-pass ditches or re-routed surface drainage ditches as directed by Engineer.
- .2 Remove unsuitable materials from dyke foundation to depth as indicated by Engineer.

3.2 DYKE CONSTRUCTION

- .1 Construct dykes as indicated.
- .2 Place dyke material in unfrozen condition.
- .3 Place dyke materials in layers of 300 mm loose thickness. Compact each layer to 95% maximum density to ASTM D698.
- .4 Moisture content of dyke material to be within optimum moisture content and 3 percent above optimum moisture content. Material with moisture content below optimum will be rejected.
- .5 Hand finish or grade slopes and top of completed dyke to remove stones over 25 mm in size and other debris.
- .6 Finish slopes and top of dyke as indicated.
- .7 Rip-rap areas indicated in accordance with Section 31 37 17 - Rip-Rap.

3.3 GEOMEMBRANES

- .1 Place geomembrane in accordance with Section 31 32 22 as outlined in manufacturer's recommendation.

3.4 GEOTEXTILES

- .1 Place geotextiles in accordance with Section 31 32 21 - Geotextiles as outlined I manufacturer's recommendations.

3.5 RIP-RAP

- .1 Place rip-rap in accordance with Section 31 37 17 - Rip-Rap and as indicated.

3.6 CLEAN UP

- .1 Remove surplus material and debris from site in accordance with Section 01 74 11 - Cleaning

END OF SECTION

- .18 Removal of existing berms with On-Site Disposal: The unit price tendered shall include all equipment, labor and materials necessary for the excavation of the existing berms to the alignment and grades shown on the drawing. The unit price shall also include all equipment, labor and materials necessary for the transportation and disposal on-site of excavated material. Measurement for payment shall be based on the cubic meter as measured in the field.

END OF SECTION