

Trout Brook Campground Phase Two

ISSUED FOR TENDER

Prepared for
Parks Canada

Date July 1st, 2020

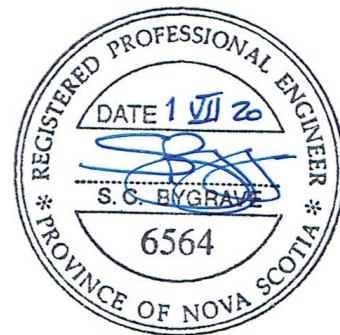
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The following Seals of the Consultants and sub-consultants refer to specific Sections of the Specification designated by symbols and listed in Table of Contents.

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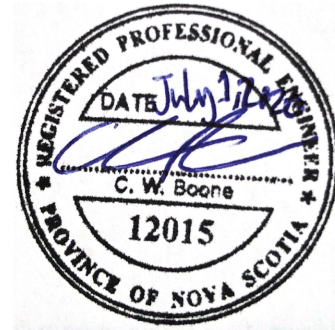
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END OF SECTION

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PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- .1 Work includes the completion of all exterior sitework, including final grading, landscaping, parking, beach access structure, site exit-stairs, accessibility ramps, solar array, exterior water supply.

1.2 PROJECT INFORMATION

- .1 Project Identification: Trout Brook Campground
 - .1 Project Location: Trout Brook Campground, Cape Breton Highlands National Park, Nova Scotia

1.3 FAMILIARIZATION WITH SITE

- .1 Before submitting a bid, it is recommended that bidders visit the site to review and verify the form, nature and extent of the work, materials needed, the means of access and the temporary facilities required to perform the Work.

1.4 CODES AND STANDARDS

- .1 Perform work in accordance with the Nova Scotia Building Code of Canada (NSBCC), National Fire Code of Canada (NFC) and B651-12 Accessible Design for the Built Environment, and all local codes and by-laws, including all amendments up to bid closing date, provided that in any case of conflict or discrepancy, the more stringent requirement shall apply.
- .2 Materials and workmanship must meet or exceed requirements of specified standards, codes and referenced documents.

1.5 SETTING OUT WORK

- .1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.
- .2 Provide devices needed to lay out and construct work.
- .3 Supply such devices as straight edges and templates required to facilitate Owner's inspection of work.
- .4 Supply stakes and other survey markers required for laying out work.

1.6 COST BREAKDOWN

- .1 Before submitting first progress claim submit breakdown of Contract Amount in detail as directed by Owner and aggregating contract amount. Required forms will be provided for application of progress payment.
- .2 List items of work numerically following the same division/section number system of the specification manual and thereafter sub-divide into major work components and building systems as directed by Owner.
- .3 Upon approval, cost breakdown will be used as basis for progress payment.

1.7 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each of the following:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda and amendments.
 - .4 Reviewed Shop Drawings.
 - .5 List of outstanding shop drawings.
 - .6 Change Orders.
 - .7 Other modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and other safety related documents.
 - .11 Other documents as stipulated elsewhere in the Contract Documents.

1.8 PERMITS

- .1 In accordance with the General Conditions, obtain and pay for building permit, certificates, licenses and other permits as required by municipal, provincial and federal authorities.
- .2 Provide appropriate notifications of project to municipal and provincial inspection authorities.
- .3 Obtain compliance certificates as prescribed by legislative and regulatory provisions of municipal, provincial and federal authorities as applicable to the performance of work.
- .4 Submit to Owner, copy of application forms and approval documents received from above referenced authorities.

1.9 ACCESS TO SITE

- .1 General: Contractor shall have use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- .2 Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - .1 Limits: Where the Work involves exterior work, limit site disturbance, including earthwork and clearing of vegetation, to 2 m beyond building perimeter.
- .3 Execute work with least possible interference or disturbance to building operations, occupants, public and normal use of premises. Arrange with Owner to facilitate execution of work.
- .4 Where security has been reduced by work of Contract, provide temporary means to maintain security.
- .5 Inform Owner when impending installation conflicts with other new or existing components.
- .6 Provide temporary dust screens, barriers, warning signs in locations where renovation and alteration work is adjacent to areas which will be operative during such work.

1.10 ROUGHING-IN

- .1 Be responsible for obtaining manufacturer's literature for correct rough-ins and hook-up of equipment.

1.11 CUTTING, FITTING AND PATCHING

- .1 Ensure that cutting and patching required by all trades is included in total bid amount submitted for the work.
- .2 Execute cutting including excavation, fitting and patching required to make work fit properly.
- .3 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work.
- .4 Do not cut, bore, or sleeve load-bearing members, except where specifically approved by Owner.
- .5 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.
- .6 Fit work airtight to pipes, sleeves ducts and conduits.

1.12 EXISTING SERVICES

- .1 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility. This includes disconnection of electrical power and communication services to tenant's operational areas. Adhere to approved schedule and provide notice to affected parties.
- .2 Where unknown services are encountered, immediately advise Owner and confirm findings in writing.
- .3 Protect, relocate or maintain existing active services as required. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction over service. Record locations of maintained, re-routed and abandoned service lines.

1.13 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions.

END OF SECTION

Part 1 General

1.1 ROLES, RESPONSIBILITIES AND DEFINITIONS

- .1 All references to the Departmental Representative shall mean:
 - .1 A representative of Parks Canada.
- .2 All references to Owner shall mean:
 - .1 Parks Canada.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises the following:
 - .1 The Contractor shall expect the Work to include, but not necessarily be limited to the following:
 - .1 Site
 - .1 Final grading and landscaping.
 - .2 Beach access structure
 - .3 Site exit stairs
 - .4 Solar array

1.3 CONTRACT METHOD

- .1 Construct Work under lump sum contract.
- .2 Relations and responsibilities between Contractor and subcontractors and subcontractors assigned by Owner are as defined in Conditions of Contract.

1.4 WORK BY OTHERS

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Consultant.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Consultant, in writing, any defects which may interfere with proper execution of Work.

1.5 WORK SEQUENCE

- .1 Construct Work in stages to accommodate Owner's continued use of premises during construction.
- .2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.
- .3 Construct Work in stages to provide for continuous public usage. Do not close off public usage of facilities until use of one stage of Work will provide alternate usage.
- .4 Maintain fire access/control.

1.6 CONTRACTOR USE OF PREMISES

- .1 Unrestricted use of site.
- .2 Co-ordinate use of premises under direction of Consultant.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Consultant.
- .6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.7 EXISTING SERVICES

- .1 There are limited services on this site. The Contractor will be responsible for providing their own services to complete the work.
- .2 Notify Consultant and utility companies of intended interruption of services and obtain required permission.
- .3 Provide alternative routes for personnel and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Consultant of findings.
- .5 Submit schedule to and obtain approval from Consultant for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.
- .7 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .8 Record locations of maintained, re-routed and abandoned service lines.

1.8 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy of each document as follows:
 - .1 Specifications.
 - .2 Addenda.
 - .3 Health and Safety Plan and Other Safety Related Documents.
 - .4 Other documents as specified.

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 Upon award of contract and prior to commencement of work, submit to Owner the following work management documents:
 - .1 Work Schedule as specified herein.
 - .2 Shop Drawing Submittal Schedule
 - .3 Waste Management Plan.
 - .4 Health and Safety Plan.
 - .5 Hot Work Procedures.
 - .6 Lockout Procedures.
 - .7 Dust Control Plan.
 - .8 List of workers requiring security clearance and those to be placed on Site Security Control list.

1.2 WORK SCHEDULE

- .1 Upon acceptance of bid submit:
 - .1 Detailed work schedule submitted within four (4) working days.
- .2 Schedule to indicate all calendar dates from commencement to completion of all work within the time stated in the accepted bid.
- .3 Provide sufficient details in detailed schedule to clearly illustrate entire implementation plan, depicting efficient coordination of tasks and resources, to achieve completion of work on time and permit effective monitoring of work progress in relation to established milestones.
- .4 Detailed work schedule content to include as a minimum the following:
 - .1 Bar (GANTT) Charts, indicating all work activities, tasks and other project elements, their anticipated durations, planned dates for achieving key activities and major project milestones supported with;
 - .2 Written narrative on key elements of work illustrated in bar chart, providing sufficient details to demonstrate a reasonable implementation plan for completion of project within designated time.
 - .3 Generally Bar Charts derived from commercially available computerized project management system are preferred but not mandatory.
- .5 Schedule work in cooperation with the Owner. Incorporate within Detailed Work Schedule, items identified by Owner during review of preliminary schedule.
- .6 Completed schedule shall be approved by Owner. When approved, take necessary measures to complete work within scheduled time. Do not change schedule without Owner's approval.
- .7 Ensure that all subtrades and subcontractors are made aware of the work restraints and operational restrictions specified.
- .8 Schedule Updates:

- .1 Submit on a monthly basis.
- .2 Provide information and pertinent details explaining reasons for necessary changes to implementation plan.
- .3 Identify problem areas, anticipated delays, impact on schedule and proposed corrective measures to be taken.
- .9 Owner will make interim reviews and evaluate progress of work based on approved schedule. Frequency of such reviews will be as decided by Owner. Address and take corrective measures on items identified by reviews and as directed by Owner. Update schedule accordingly.
- .10 In every instance, change or deviation from the Work Schedule, no matter how minimal the risk or impact on safety or inconvenience to tenant or public might appear, will be subject to prior review and approval by the Owner.

1.3 OPERATIONAL RESTRICTIONS

- .1 Safety Signage:
 - .1 Provide on site, and erect as required during progress of work, proper bilingual signage, mounted on self-supporting stands, warning of construction activities in progress and alerting need to exercise caution in proceeding through disturbed areas of the facility.
 - .2 Signage to be professionally printed and mounted on wooden backing, coloured and to express messages as directed by Owner.
 - .3 Generally maximum size of sign should be in the order of 1.0 square metres.
 - .4 Include costs for the supply and installation of these signs in the bid price.
- .2 Dust and Dirt Control:
 - .1 See Section 01 51 00 Temporary Facilities and Controls and Section 01 74 11 Cleaning for dust control and cleaning requirements.
 - .2 Effectively plan and implement dust control measures and cleaning activities as an integral part of all construction activities. Review all measures with Owner before undertaking work, especially for major dust generating activities.
 - .3 Do not allow demolition debris and construction waste to accumulate on site and contribute to the propagation of dust.
 - .4 As work progresses, maintain construction areas in a tidy condition at all times. Remove gross dust accumulations by cleaning and vacuuming immediately following the completion of any major dust generating activity.
 - .5 Inform workers and make them sensitive to the need for dust and dirt control. Stringently enforce rules and regulations, immediately address non-compliance.
- .3 Ensure that all sub-trades are made aware of and abide by the contents of this section.

1.4 WORK COORDINATION

- .1 The General Contractor is responsible for coordinating the work of the various trades and predetermining where the work of such trades interfaces with each other.
 - .1 Designate one person from own employ having overall responsibility to review contract documents and shop drawings, plan and manage such coordination.

- .2 The General Contractor shall convene meetings between trades whose work interfaces and ensure that they are fully aware of the areas and the extent of where interfacing is required.
 - .1 Provide each trade with the plans and specifications of the interfacing trade, as required, to assist them in planning and carrying out their respective work.
 - .2 Develop coordination drawings when deemed required illustrating potential interference between works of various trades and distribute to all affected parties including structural trade.
 - .1 Coordination drawings to identify all building elements, service lines, rough-in points and indicate from where various services are coming.
 - .3 Review coordination drawings at purposely called meetings. Have subcontractors sign-off on drawings and publish minutes of each meeting.
 - .4 Plan and coordinate work in such a way to minimize quantity of service line offsets.
 - .5 Submit copy of coordination drawings and meeting minutes to Owner for information purposes.
- .3 Submission of shop drawings and ordering of prefabricated equipment or prebuilt components shall only occur once coordination meeting for such items has taken place between trades and all conditions affecting the work of the interfacing trades has been made known and accounted for.
- .4 Work Cooperation:
 - .1 Ensure cooperation between trades in order to facilitate the general progress of the work and avoid situations of spatial interference.
 - .2 Ensure that each trade provides all other trades reasonable opportunity for the completion of the work and in such a way as to prevent unnecessary delays, cutting, patching and the need to remove and replace completed work.
- .5 No extra costs to the Contract will be considered by the Owner as a result of Contractor's failure to effectively coordinate all portions of the Work. Disputes between the various trades as a result of their not being informed of the areas and extent of interface work shall be the sole responsibility of the General Contractor to be resolved at own cost.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Lump Sum prices bid are full compensation for the work necessary to complete each item in the Contract and in combination for all work necessary to complete the Work as a whole.

1.2 MEASUREMENT AND PAYMENT

- .1 LUMP SUM: All Work is to be included in the single Lump Sum Item on the Bid Form, including, but not limited to.
 - .1 All mobilization/demobilization.
 - .2 Third party utility locator sub-contractor.
 - .3 Supply and installation of:
 - .1 Buildings

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 GENERAL REQUIREMENTS OF THE BID AND ACCEPTANCE FORM

- .1 Lump Sum price bids are full compensation for the work necessary to complete each item in the Contract and in combination for all work necessary to complete the Work as a whole.

1.2 MEASUREMENT AND PAYMENT

- .1 LUMP SUM: All work is to be completed in a single Lump Sum Item on the Bid Form.

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 RELATED REQUIREMENTS

- .1 Section 01 45 00 – Quality Control.

1.2 ADMINISTRATIVE

- .1 Submit to Departmental Representative 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 and product data 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 Departmental Representative. 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 Departmental Representative, 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 Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.3 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 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Nova Scotia, Canada as required.
- .3 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.

- .4 Allow 5 days for Departmental Representative's review of each submission.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in electronic PDF format, 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.
- .8 Submissions shall 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.
- .9 After Departmental Representative's review, distribute copies.
- .10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

- .11 Submit electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit electronic copy of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .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.
- .13 Submit electronic copy of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .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 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .15 Submit electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .16 Delete information not applicable to project.
- .17 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copy 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.

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

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Province of Nova Scotia
 - .1 Occupational Health and Safety Act, S.N.S. - Updated 2013.

1.2 DEFINITIONS

- .1 COSH: Canada Occupational Health and Safety Regulations made under Part II of the Canada Labour Code.
- .2 Competent Person means a person to who is:
 - .1 Qualified by virtue of personal knowledge, training and experience to perform assigned work in a manner that will ensure the health and safety of persons in the workplace.
 - .2 Knowledgeable about the provisions of occupational health and safety statutes and regulations that apply to the Work.
 - .3 Knowledgeable about potential or actual danger to health or safety associated with the Work.
- .3 Medical Aid Injury: any minor injury for which medical treatment was provided and the cost of which is covered by Workers' Compensation Board of the province in which the injury was incurred.
- .4 PPE: personal protective equipment.
- .5 Work Site: where used in this section shall mean areas, located at the premises where Work is undertaken, used by Contractor to perform all of the activities associated with the performance of the Work.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan prior to commencement of Work:
 - .1 Submit within ten (10) work days of notification of Bid Acceptance. Provide three (3) hard copies and one (1) electronic PDF file.
 - .2 Departmental Representative will review Health and Safety Plan and provide comments.
 - .3 Revise the Plan as appropriate and resubmit within five (5) work days after receipt of comments.
 - .4 Departmental Representative's review and comments made of the Plan shall not be construed as an endorsement, approval or implied warranty of any kind by Canada and does not reduce Contractor's overall responsibility for Occupational Health and Safety of the Work.
 - .5 Submit revision and updates made to the Plan during the course of Work.

- .3 Submit name of designated Health & Safety Site Representative and support documentation specified in the Safety Plan.
- .4 Submit building permit, compliance certificates and other permits obtained.
- .5 Submit copy of Letter in Good Standing from Provincial Workers Compensation or other department of labour organization:
 - .1 Submit update of Letter of Good Standing whenever expiration date occurs during the period of Work.
- .6 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .7 Submit copies of incident reports.
- .8 Submit WHMIS MSDS - Material Safety Data Sheets.

1.4 COMPLIANCE REQUIREMENTS

- .1 Comply with the Occupational Health and Safety Act for the Province of Nova Scotia, and the Regulations made pursuant to the Act.
- .2 Comply with Canada Labour Code Part II, and the Canada Occupational Safety and Health Regulations made under Part II of the Canada Labour Code.
- .3 Observe and enforce construction safety measures required by:
 - .1 2015 National Building Code of Canada, Part 8.
 - .2 Provincial Worker's Compensation Board.
 - .3 Municipal statutes and ordinances.
 - .4 Comply with Occupational R.S.Q., c. S-2.1, an Act respecting Health and Safety Code for the Construction Industry.
- .4 In event of conflict between any provisions of above authorities the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, Departmental Representative will advise on the course of action to be followed.
- .5 A copy of the Canada Labour Code Part II may be obtained by contacting:
Canadian Government Publishing
Public Works & Government Services Canada
Ottawa, Ontario K1A 0S9
Tel: (819) 956-5800 (1-800-635-7943)
Publication No. L31-85/2000 E or F
- .6 Observe construction safety measures of:
 - .1 Part 8 of National Building Code.
 - .2 Municipal by-laws and ordinances.
- .7 In case of conflict or discrepancy between above specified requirements, the more stringent shall apply.
- .8 Maintain Workers Compensation Coverage in good standing for duration of Contract. Provide proof of clearance through submission of Letter in Good Standing.

- .9 Medical Surveillance: Where prescribed by legislation or regulation, obtain and maintain worker medical surveillance documentation.

1.5 SITE CONTROL AND ACCESS

- .1 Control the Work and entry points to Work Site. Approve and grant access only to workers and authorized persons. Immediately stop and remove non-authorized persons:
 - .1 Departmental Representative will provide names of those persons authorized by Departmental Representative to enter onto Work Site and will ensure that such authorized persons have the required knowledge and training on Health and Safety pertinent to their reason for being at the site, however, Contractor remains responsible for the health and safety of authorized persons while at the Work Site.
- .2 Isolate Work Site from other areas of the premises by use of appropriate means:
 - .1 Erect fences, hoarding, barricades and temporary lighting as required to effectively delineate the Work Site, stop non-authorized entry, and to protect pedestrians and vehicular traffic around and adjacent to the Work and create a safe environment.
 - .2 Post signage at entry points and other strategic locations indicating restricted access and conditions for access.
 - .3 Use professionally made signs with bilingual message in the two (2) official languages or international known graphic symbols.
- .3 Provide safety orientation session to persons granted access to Work Site. Advise of hazards and safety rules to be observed while on site.
- .4 Ensure persons granted site access wear appropriate PPE. Supply PPE to inspection authorities who require access to conduct tests or perform inspections.
- .5 Secure Work Site against entry when inactive or unoccupied and to protect persons against harm.

1.6 PROTECTION

- .1 Give precedence to safety and health of persons and protection of environment over cost and schedule considerations for Work.
- .2 Should unforeseen or peculiar safety related hazard or condition become evident during performance of Work, immediately take measures to rectify situation and prevent damage or harm. Advise Departmental Representative verbally and in writing.

1.7 RESPONSIBILITY

- .1 Be responsible for safety of persons and property on work site and for protection of employees and general public circulating adjacent to work operations 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 FILING OF NOTICE

- .1 File Notice of Project and other Notices with Provincial authorities prior to commencement of Work.
- .2 Upon request, Departmental Representative will provide name and mailing address of provincial department to whom the Notice of Project must be sent.
- .3 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.9 PERMITS

- .1 Obtain permits, licenses and compliance certificates, at appropriate times and frequency as stipulated by authorities having jurisdiction.
- .2 Where particular permit or compliance certificate cannot be obtained at the required stage of work, notify Departmental Representative in writing and obtain Departmental Representative's approval to proceed prior to carrying out that portion of work.
- .3 Post all permits on site. Submit copies to Departmental Representative.

1.10 SAFETY ASSESSMENTS

- .1 Implement and carry out a health and safety hazard assessment program as part of the work. Program to include:
 - .1 Initial hazard assessment carried out immediately upon notification of contract award and prior to commencement of work.
 - .2 On-going hazard assessments performed during the progress of work identifying new or potential health risks and safety hazards not previously known. As a minimum, hazard assessments shall be carried out when:
 - .1 New subtrade work, new subcontractor(s) or new workers arrive at the site to commence another portion of the work.
 - .2 The scope of work has been changed by Change Order.
 - .3 Potential hazard or weakness in current health and safety practices are identified by Departmental Representative or by an authorized safety representative.
- .3 Hazard assessments to be project and site specific, based on review of contract documents, site and weather conditions.
- .4 Each hazard assessment to be made in writing. Keep copies of all assessments on site for duration of work. Upon request, make available to Departmental Representative for inspection.

1.11 PROJECT/SITE CONDITIONS

- .1 The following are known or potential project related safety hazards at site:
 - .1 Work immediately adjacent/atop high steep embankments and cliffs with heavy equipment and construction personnel.
 - .2 Highway traffic.
 - .3 Other construction contractors work on site.

- .2 Above lists shall not be construed as being complete and inclusive of safety and health hazards encountered as a result of Contractor's operations during the course of work. Include above items into the hazard assessment program specified herein.

1.12 SAFETY MEETINGS

- .1 Prior to commencement of work attend health and safety meeting conducted by Departmental Representative. Have Contractor's Site Superintendent in attendance. Departmental Representative will advise of time and location.
- .2 Provide site safety orientation session to all workers and other authorized persons prior to granting them access to work site. Brief persons on site conditions and on the minimum site safety rules in force at site.
- .3 Conduct site specific occupational health and safety meetings during the entire work as follows:
 - .1 Formal meetings on a minimum monthly basis.
 - .2 Informal tool box meetings on a regular basis from a predetermined schedule.
- .4 Keep workers informed of anticipated hazards, on safety practices and procedures to be followed and of other pertinent safety information related to:
 - .1 Progress of Work.
 - .2 New sub-trades arriving on site.
 - .3 Changes in site and project conditions.
- .5 Record and post minutes of meetings. Make copies available to Departmental Representative upon request.

1.13 HEALTH AND SAFETY PLAN

- .1 Develop written site-specific Project Health and Safety Plan, based on hazard assessments, prior to commencement of work. Submit plan to Departmental Representative within 7 calendar days of Contract Award date.
- .2 Health and Safety Plan shall contain the following three (3) parts:
 - .1 Part 1: List of individual health risks and safety hazards identified by hazard assessments.
 - .2 Part 2: List of specific measures to control or mitigate each hazard and risk identified in part one of Plan. Describe the engineering controls, personnel protective equipment and safe work practises to be implemented and followed when performing work related to each identified hazard or risk.
 - .3 Part 3: Emergency Measures and Communications Procedures as follows:
 - .1 Emergency Measures: on-site operating procedures, evacuation measures and emergency response to be implemented in the occurrence of an incident. Procedures to be specific and relevant to identified hazards. Measures to complement and be integrated with the facility and tenants Emergency Response Plans in place at site:
 - .1 Obtain information on existing emergency and evacuation plans from Departmental Representative and incorporate appropriate data.

.2 Communication Procedures:

- .1 List of names and telephone numbers of designated officials, to be contacted should an incident or emergency situation occur, including the following:
 - .1 General Contractor and all Subcontractors.
 - .2 Federal and Provincial Departments and local emergency resources organizations, as resources organizations, as applicable laws and regulations.
 - .3 Officials from Parks Canada. Departmental Representative will provide list of names to be included.
- .2 Procedures implemented at site to communicate and share information between workers, subcontractors, and General Contractor on work activities.
- .3 Prepare Health and Safety Plan in a three-column format, addressing the three parts specified above, as follows:

Column 1	Column 2	Column 3
Identified	Control	Emergency Measures and Communications
Hazard	Measures	Implemented Procedures

- .4 Develop Health and Safety Plan in collaboration with all subcontractors. Address all work and activities of subcontractors as they arrive on site. Immediately update Plan and submit to Departmental Representative.
- .5 Implement, maintain and enforce compliance with requirements of the Health and Safety Plan until final completion of work and demobilization from site.
- .6 As work progresses, review and update Plan addressing additional health risks and safety hazards identified by on-going hazard assessments.
- .7 Submit revised versions of Plan to Departmental Representative.
- .8 Post a typed written copy, including all updates, of the Health and Safety Plan in a common visible location at work site.
- .9 Submission of the Health and Safety Plan, and updates, to the Departmental Representative is for review and information purposes only. Its submission shall not be construed to imply approval by Departmental Representative, be interpreted as a warranty of being

complete, accurate and legislative compliant and shall not relieve Contractor of his legal obligations for the provision Health and Safety on the construction project.

1.14 SAFETY SUPERVISION AND INSPECTIONS

- .1 Employ Health & Safety Site Representative responsible for daily supervision of health and safety of the Work.
- .2 Health & Safety Site Representative may be the Superintendent of the Work or other person designated by Contractor and will be assigned the responsibility and authority to:
 - .1 Implement, monitor and enforce daily compliance with health and safety requirements of the Work.
 - .2 Monitor and enforce Contractor's site-specific Health and Safety Plan.
 - .3 Conduct site safety orientation session to persons granted access to Work Site.
 - .4 Ensure that persons allowed site access are knowledgeable and trained in health and safety pertinent to their activities at the site or are escorted by a competent person while on the Work Site.
 - .5 Stop the Work as deemed necessary for reasons of health and safety.
- .3 Health & Safety Site Representative must:
 - .1 Be qualified and competent person in occupational health and safety.
 - .2 Have site-related working experience specific to activities of the Work.
 - .3 Be on Work Site at all times during execution of the Work.
- .4 All supervisory personnel assigned to the Work must also be competent persons.
- .5 Inspections:
 - .1 Conduct regularly scheduled safety inspections of the Work on a minimum weekly basis. Record deficiencies and remedial action taken.
 - .2 Conduct Formal Inspections on a minimum monthly basis. Use standardized safety inspection forms. Distribute to subcontractors.
 - .3 Follow-up and ensure corrective measures are taken.
- .6 Keep inspection reports and supervision related documentation on site.

1.15 TRAINING

- .1 Use only skilled workers on Work Site who are effectively trained in occupational health and safety procedures and practices pertinent to their assigned task.
- .2 Maintain employee records and evidence of training received. Make data available to Departmental Representative upon request.
- .3 When unforeseen or peculiar safety-related 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 Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.16 MINIMUM SITE SAFETY RULES

- .1 Notwithstanding the requirement to abide by federal and provincial health and safety regulations, the following safety rules shall be considered minimum requirements at the work site and obeyed by all persons granted access:
 - .1 Wear personnel protective equipment (PPE) appropriate to function and task on site; the minimum requirements being hard hat, safety footwear (and eye protection where appropriate).
 - .2 Immediately report unsafe activities, conditions, near-miss accidents, injuries and damages.
 - .3 Maintain site in tidy condition.
 - .4 Obey warning signs and safety tags.
- .2 Brief workers on site safety rules, and on the disciplinary measures to be taken for violation or non-compliance of such rules. Post such information on site.

1.17 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative will stop Work if non-compliance of health and safety regulations is not corrected in a timely manner.

1.18 INCIDENT REPORTING

- .1 Investigate and report incidents and accidents as outlined in Provincial Occupational Safety and Health Act and Regulations.
- .2 Investigate and immediately report to Departmental Representative incidents and accidents which results, or has the potential of resulting in:
 - .1 Injuries requiring medical aid.
 - .2 Property damage in excess of \$10,000.00.
 - .3 Required notification to Workers Compensation Board or other regulatory agencies as stipulated by applicable regulations.
- .3 Medical aid in above clause shall have the same meaning as the term "medical aid injury" as defined in the Canadian Dictionary of Safety Terms - 1987 issue, from the Canadian Society of Safety Engineers (C.S.S.E) as follows:
 - .1 Medical Aid Injury: any minor injury for which medical treatment was provided and the cost of which is covered by Workers' Compensation Board of the province in which the injury was incurred.
- .4 Submit report in writing.

1.19 TOOLS AND EQUIPMENT SAFETY

- .1 Implement and follow a scheduled tool and equipment inspection / maintenance program at work site. Regularly check tools, equipment and machinery for safe operation and

perform maintenance at pre-established time and frequency intervals as recommended by manufacturer. Include subcontractors' equipment as part of the inspection process.

- .2 Use standardized checklists to ensure established safety checks are stringently followed.
- .3 Immediately tag and remove items found faulty or defective off site.
- .4 Maintain written documentation on each inspection. Make available to Departmental Representative upon request.

1.20 HAZARDOUS PRODUCTS

- .1 Comply with requirements of Workplace Hazardous Materials Information Systems (WHMIS).
- .2 Keep MSDS data sheets on site. Provide copies of all data sheets to Departmental Representative upon receipt of materials on site.
- .3 Post all MSDS data sheets on site, in a common area, visible to workers.
- .4 On building renovation projects where work is adjacent to occupied areas, locate data sheets in a public location accessible to tenant employees.

1.21 BLASTING

- .1 Blasting or other use of explosives is not permitted without prior written instructions from Departmental Representative.

1.22 POWDER ACTUATED DEVICES

- .1 Use powder actuated fastening devices only after receipt of written permission from Departmental Representative.

1.23 POSTING OF DOCUMENTS

- .1 Post documents indicated herein and as required by Authority having jurisdiction.
- .2 Post other documents as specified herein, including:
 - .1 Site specific Health and Safety Plan.
 - .2 WHMIS data sheets.

1.24 RECORDS ON SITE

- .1 Maintain on site copy of safety documentation as specified in this section and other safety related reports and documents issued to or received from authorities having jurisdiction.
- .2 Make available to Departmental Representative, or authorized safety representative, for inspection upon request.

1.25 BIRDS AND WILDLIFE

- .1 Any food or waste that could attract birds or wildlife can only be discarded in properly sealed waste containers.

1.26 RADIO COMMUNICATIONS

- .1 When radio communication is required between the Contractor's personnel, all radio equipment shall be supplied by the 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

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.

1.2 INSPECTION

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Owner shall pay cost of examination and replacement.

1.3 TESTING AGENCIES

- .1 Contractor shall engage a third-party materials testing agency for purpose of testing portions of Work as normally required under each Section.
- .2 If defects are revealed during inspection and/or testing, agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Owner. Pay for costs of re-testing and re-inspection.

1.4 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.5 PROCEDURES

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle materials on site. Provide sufficient space to store and cure test samples.

1.6 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in the opinion of the Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance to the Contract Documents, the Owner will deduct from the Contract Price the difference in value between the Work performed and that called for by the Contract Documents, the amount which will be determined by the Engineer.

1.7 REPORTS

- .1 Submit electronic PDF copies of inspection and test reports to Departmental Representative for review.

1.8 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.

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 TEMPORARY UTILITIES

- .1 Contractor shall provide temporary sanitary, water and power utilities as deemed necessary to complete the works.

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 GENERAL

- .1 Use new material and equipment unless otherwise specified.
- .2 Within 7 days of written request by Owner, submit following information for any materials and products proposed for supply:
 - .1 Name and address of manufacturer.
 - .2 Trade name, model and catalogue number.
 - .3 Performance, descriptive and test data.
 - .4 Compliance to specified standards.
 - .5 Manufacturer's installation or application instructions.
 - .6 Evidence of arrangements to procure.
 - .7 Evidence of manufacturer delivery problems or unforeseen delays.
- .3 Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.
- .4 Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.
- .6 See Appendix 02 - Existing Materials, A list of materials supplied by Parks Canada

1.2 PRODUCT QUALITY

- .1 Contractor shall be solely responsible for submitting relevant technical data and independent test reports to confirm whether a product or system proposed for use meets contract requirements and specified standards.
- .2 Final decision as to whether a product or system meets contract requirements rest solely with the Owner in accordance with the General Conditions of the Contract.

1.3 ACCEPTABLE MATERIALS AND ALTERNATIVES

- .1 Acceptable Materials: When materials specified include trade names or trade marks or manufacturer's or supplier's name as part of the material description, select and only use one of the names listed for incorporation into the Work.
- .2 Substitutions: After contract award, substitution of a specified material will be dealt with as a change to the Work in accordance with the General Conditions of the Contract.

1.4 MANUFACTURERS INSTRUCTIONS

- .1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods to be used. Do not rely on labels or enclosure provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Owner in writing of any conflict between these specifications and manufacturer's instructions, so that Owner will designate which document is to be followed.

1.5 AVAILABILITY

- .1 Immediately notify Owner in writing of unforeseen or unanticipated material delivery problems by manufacturer. Provide support documentation as per clause 1.1.2 above.

1.6 WORKMANSHIP

- .1 Ensure quality of work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed.
- .2 Remove unsuitable or incompetent workers from site as stipulated in the General Conditions of the Contract.
- .3 Ensure cooperation of workers in laying out work. Maintain efficient and continuous supervision on site at all times.
- .4 Coordinate work between trades and subcontractors. See Section 01 14 10 – Scheduling and Management of Work in this regard.
- .5 Coordinate placement of openings, sleeves and accessories.

1.7 FASTENINGS - GENERAL

- .1 Provide metal fastenings and accessories in same texture, colour and finish as base metal in which they occur. Prevent electrolytic action between dissimilar metals. Use non- corrosive fasteners, anchors and spacers for securing exterior work and in humid areas.
- .2 Space anchors within limits of load bearing or shear capacity and ensure that they provide positive permanent anchorage. Wood or organic material plugs not acceptable.
- .3 Keep exposed fastenings to minimum, space evenly and lay out neatly.
- .4 Fastenings which cause spalling or cracking of material to which anchorage is made, are not acceptable.
- .5 Do not use explosive actuated fastening devices unless approved by Owner. See section on Health and Safety Requirements in this regard.

1.8 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

1.9 STORAGE, HANDLING AND PROTECTION

- .1 Deliver, handle and store materials in manner to prevent deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled materials in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work. Provide additional cover where manufacturer's packaging is insufficient to provide adequate protection.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

- .6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Immediately remove damaged or rejected materials from site.
- .9 Touch-up damaged factory finished surfaces to Owner's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

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 GENERAL

- .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
- .2 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .3 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

1.2 MATERIALS

- .1 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.3 CLEANING DURING CONSTRUCTION

- .1 Maintain work site in a tidy condition, free from accumulations of waste material and debris. Clean areas on a daily basis.
- .2 Do not burn waste materials on site.
- .3 Keep building entrances, corridors, stairwells and tenant occupied areas of building in a clean dust free condition at all times. Conduct thorough cleaning of these areas when used by workers or affected by the Work.
- .4 Provide on-site dump type and recycling containers for collection of waste materials and debris.
- .5 Use separate collection bins, clearly marked as to purpose, for source separation and recycling of waste and debris in accordance with waste management requirements specified.
- .6 Remove waste materials, and debris from site on a minimum weekly basis.
- .7 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .8 Provide dust barriers, dividers, seals on doors and employ other dust control measures as required to ensure that dust and dirt, generated by work, are not transmitted to existing areas of building. Should dust migrate into tenant occupied and public areas of building, employ such means as may be necessary to immediately clean all contaminated surfaces to the satisfaction of the Owner.
- .9 Immediately clean all dust, dirt, smears, scuffs and soiled surfaces in lobbies, corridors, stairwells and within tenant occupied areas resulting from the Work.
 - .1 Perform cleaning, dusting and washing operations, carpet vacuuming (including shampooing if deemed required by Owner) and floor washing as necessary to thoroughly clean all soiled surfaces.
- .10 Remove snow and ice from access doors used by workforce.

1.4 FINAL CLEANING

- .1 In preparation for acceptance of the completed work perform final cleaning.

- .2 Remove grease, dust, dirt, stains, labels, fingerprints, marks and other foreign materials, from interior and exterior finished surfaces. Clean and polish surfaces including glass, hardware, stainless steel, chrome, and plastic laminate.
- .3 Replace items with broken pieces, scratches or disfigured.
- .4 Clean lighting reflectors, lenses, and other lighting surfaces.
- .5 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .6 Inspect finishes, fitments and equipment. Ensure specified workmanship and operation.
- .7 Inspect finishes, fitments and equipment. Ensure specified workmanship and operation.
- .8 Broom clean and wash exterior paved surfaces and walks; rake clean other surfaces of grounds.
- .9 Remove debris and surplus materials from crawl areas, roof areas and other accessible concealed spaces.
- .10 Clean equipment, washroom and kitchen fixtures to a sanitary condition. Replace filters of mechanical equipment.

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 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 11 - Cleaning

1.2 REFERENCES

- .1 Definitions:
 - .1 Approved/Authorized recycling facility: waste recycler approved by applicable provincial authority.
 - .2 Approved disposal area: Disposal area as designated by the Owner.
 - .3 Class III: non-hazardous waste - construction renovation and demolition waste.
 - .4 Construction, Renovation and/or Demolition (CRD) Waste: Class III solid, non-hazardous waste materials generated during construction, demolition, and/or renovation activities.
 - .5 Inert Fill: inert waste - exclusively asphalt and concrete.
 - .6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
 - .7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
 - .8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
 - .9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
 - .10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
 - .11 Separate Condition: refers to waste sorted into individual types.
 - .12 Source Separation: act of keeping different types of waste materials separate beginning from the point they became waste.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit on monthly basis, throughout project or at intervals agreed to by Departmental Representative the following:
 - .1 Receipts, scale tickets, waybills, and/or waste disposal receipts that show quantities and types of materials reused, recycled, or disposed of.

- .2 Written monthly summary report detailing cumulative amounts of waste materials reused, recycled and landfilled, and brief status of ongoing waste management activities.
- .3 Submit prior to final payment the following:
 - .1 Provide receipts, scale tickets, waybills, waste disposal receipts that confirm quantities and types of materials reused, recycled or disposed of and destination.

1.4 USE OF SITE AND FACILITIES

- .1 Execute Work with minimal interference and disturbance to normal use of premises.
- .2 Maintain security measures established by facility provide temporary security measures approved by Departmental Representative.

1.5 WASTE PROCESSING SITES

- .1 Contractor is responsible to research and locate waste diversion resources and service providers. Salvaged materials are to be transported off site to approved and/or authorized recycling facilities or to users of material for recycling.

1.6 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations so as to not interfere with Work.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to designated disposal facility.
- .5 Protect structural components not removed and salvaged materials from movement or damage.
- .6 Protect surface drainage, mechanical and electrical from damage and blockage.
- .7 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.
- .8 Separate and store materials produced during project in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated processing facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.
 - .3 Obtain waybills, receipts and/or scale tickets for separated materials removed from site.
 - .4 Materials reused on-site are considered to be diverted from landfill and as such are to be included in all reporting.

1.7 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.

- .2 Do not dispose of waste type into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.
 - .5 Reused or recycled waste destination.
- .4 Remove materials on-site as Work progresses.

1.8 SCHEDULING

- .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 APPLICATION

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 N/A.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request Departmental Representative's inspection.
 - .2 Departmental Representative's Inspection:
 - .1 Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates in that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted, balanced and fully operational.
 - .4 Operation of systems: demonstrated to Owner's personnel.
 - .5 Work: complete and ready for final inspection.
 - .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Departmental Representative and Contractor.
 - .2 When Work incomplete according to Departmental Representative, complete outstanding items and request re-inspection.
 - .5 Declaration of Substantial Performance: when Departmental Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
 - .6 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
 - .7 Final Payment:

- .1 When Departmental Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
- .2 When Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.
- .8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

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 SUMMARY

- .1 Section includes descriptions for demolishing, salvaging, recycling and removing site work items identified for removal in whole or in part, and for backfilling trenches and excavations resulting from site demolition activities.

1.2 RELATED REQUIREMENTS

- .1 Section 01 31 19 - Project Meetings.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 35 43 - Environmental Procedures.
- .4 Section 01 74 00 - Cleaning.
- .5 Section 01 74 19 - Waste Management and Disposal.
- .6 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.3 REFERENCE STANDARDS

- .1 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 2012
 - .2 Canadian Environmental Protection Act (CEPA), 2012
 - .1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations
 - .2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations
 - .3 Motor Vehicle Safety Act (MVSA), 1995
 - .4 Hazardous Materials Information Review Act, 1985
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S660-08, Standard for Non-metallic Underground Piping for Flammable and Combustible Liquids

1.4 DEFINITIONS

- .1 Selective Demolition: Sequencing demolition activities to allow separation and sorting of selected site materials.
- .2 Hazardous Substances: dangerous substances, dangerous goods, hazardous commodities and hazardous products, including but not limited to: asbestos PCB's, CFC's, HCFC's poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or well being or environment if handled improperly.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with Departmental Representative for the material ownership including the following:

- .1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Departmental Representative's property, demolished materials shall become Contractor's property and shall be removed from Project site.
- .2 Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Departmental Representative that may be encountered during demolition remain Departmental Representative's property:
 - .1 Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Departmental Representative.
- .2 Pre-Demolition Meetings.
 - .1 Convene pre-installation meeting 1 week before beginning work of this Section, with Contractor, Departmental Representative in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Verify existing site conditions adjacent to demolition work
 - .3 Coordinate with other construction sub trades
 - .4 Examine existing site conditions adjacent to demolition work, prior to start of Work
 - .5 Waste reporting requirements
 - .2 Hold project meetings every week.
 - .3 Ensure project manager, subcontractor representatives, key personnel and site supervisor attend.
 - .4 Departmental Representative will provide written notification of change of meeting schedule established upon contract award 24 hours prior to scheduled meeting.
- .3 Scheduling:
 - .1 Employ necessary means to meet project time lines without compromising specified minimum rates of material diversion.
 - .2 In event of unforeseen delay notify Representative in writing.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia, Canada as follows:
 - .1 Submit for review and approval selective site demolition drawings, diagrams or details showing sequence of selective site demolition.
 - .2 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Schedule of Selective Site Demolition Activities: Coordinate with the schedule and indicate the following:
 - .1 Detailed sequence of selective site demolition and removal work, with starting and ending dates for each activity

- .2 Interruption of utility services
- .3 Coordination for shutoff, capping, and continuation of utility services
- .4 Locations of temporary partitions and means of egress
- .3 Inventory: Submit a list of items that have been removed and salvaged after selective site demolition is complete
 - .1 Pre-demolition Photographs: Submit photographs indicating existing conditions of adjoining construction and site improvements prior to starting Work. Include finish surfaces that may be misconstrued as damage caused by selective site demolition operations.
- .2 Informational Submittals: Provide the following submittals when requested by the Consultant:
 - .1 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of Consultant and Departmental Representative, for work of similar complexity and extent.

1.7 QUALITY ASSURANCE

- .1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial/Territorial regulations.
- .2 Comply with hauling and disposal regulations of Authority Having Jurisdiction.

1.8 SITE CONDITIONS

- .1 Environmental protection:
 - .1 Ensure Work is done in accordance with Section 01 35 43 - Environmental Procedures.
 - .2 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
 - .3 Fires and burning of waste or materials is not permitted on site.
 - .4 Burying of rubbish waste materials is not permitted.
 - .5 Disposal of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum-based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers, is not permitted.
 - .6 Ensure proper disposal procedures are maintained throughout the project.
- .2 Pumping of water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties, is not permitted.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction.
- .4 Protect trees, plants and foliage on site and adjacent properties where indicated.
- .5 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.

- .6 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.
- .7 Departmental Representative will occupy another building immediately adjacent to demolition area.
- .8 Conduct selective site demolition so Representative's operations will not be disrupted:
 - .1 Provide not less than 72 hours' notice to Departmental Representative of activities that will affect operations.
 - .2 Maintain access to existing walkways, exits, and other adjacent occupied or used facilities:
 - .1 Closing or obstructing walkways, exits, or other occupied or used facilities without written permission from Departmental Representative is not permitted.
- .9 Departmental Representative assumes no responsibility for Selective Site elements being demolished:
 - .1 Conditions existing at time of inspection for bidding purpose will be maintained by Departmental Representative as far as practical.
 - .2 Before selective site demolition, remove, protect and store salvaged items as directed by Departmental Representative:
 - .1 Salvage items as identified by Departmental Representative.
 - .2 Deliver to Departmental Representative as directed.

1.9 EXISTING CONDITIONS

- .1 Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work:
 - .1 Hazardous materials will be as defined in the Hazardous Materials Act.
 - .2 Hazardous materials will be removed by Departmental Representative before start of the Work.
- .2 If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Departmental Representative. Hazardous materials will be removed by Departmental Representative under a separate contract or as a change to the Work.
- .3 If material resembling spray or trowel applied asbestos or other designated substance listed as hazardous be encountered in course of demolition, stop work, take preventative measures, and notify Departmental Representative immediately. Proceed only after receipt of written instructions have been received from Departmental Representative.
- .4 Site elements that will be demolished are based on their condition on date that tender is accepted.

Part 2 Products

2.1 EQUIPMENT

- .1 Equipment and Heavy Machinery:

- .1 On-road vehicles to: CEPA-SOR/2003-2, On-Road Vehicle and Engine Emission Regulations.
- .2 Machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

Part 3 Execution

3.1 EXAMINATION

- .1 Survey existing conditions and correlate with requirements indicated to determine extent of selective site demolition required.
- .2 Departmental Representative does not guaranty that existing conditions are the same as those indicated in Project Record Documents.
- .3 Inventory and record the condition of items being removed and salvaged.
- .4 When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to Departmental Representative.
- .5 Perform an engineering survey of condition of adjacent buildings to determine whether removing any site element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective site demolition operations.
- .6 Verify that hazardous materials have been remediated before proceeding with site demolition operations.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.
- .2 Protection of in-place conditions:
 - .1 Work in accordance with Section 01 35 43 - Environmental Procedures.
 - .2 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, parts of existing building to remain.
 - .1 Provide bracing, shoring and underpinning as required.
 - .2 Repair damage caused by demolition as directed by Departmental Representative.
 - .3 Support affected site elements and, if safety of site element being demolished adjacent structures or services appears to be endangered, take preventative measures, stop Work and immediately notify Departmental Representative.

- .4 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.
- .3 Surface Preparation:
 - .1 Disconnect and re-route electrical and service lines within the site to be demolished.
 - .1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of selective site demolition.
 - .2 Disconnect and cap mechanical services.
 - .1 Sewer and water lines: remove as directed by Departmental Representative and as indicated.

3.3 REMOVAL AND DEMOLITION OPERATIONS

- .1 Remove items as indicated.
- .2 Disruption of items designated to remain in place is not permitted.
- .3 Excavate at least 300 mm below pipe invert, when removing pipes under existing or future pavement area.
- .4 Remove designated trees during demolition.
 - .1 Obtain written approval of Departmental Representative prior to removal of trees.
- .5 Stockpile topsoil for final grading and landscaping:
 - .1 Provide erosion control and seeding if not immediately used.
- .6 Disposal of Material:
 - .1 Dispose of materials not designated for salvage or reuse on site as instructed by Departmental Representative.
 - .2 Trim disposal areas to approval of Departmental Representative.
- .7 Backfill: Backfill in areas as indicated and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.4 STOCKPILING

- .1 Label stockpiles, indicating material type and quantity.
- .2 Designate appropriate security resources/measures to prevent vandalism, damage and theft.
- .3 Locate stockpiled materials convenient for use in new construction to eliminate double handling wherever possible.
- .4 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

3.5 REMOVAL FROM SITE

- .1 Remove stockpiled material as directed by Departmental Representative, when it interferes with operations of project.
- .2 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.
- .3 Transport material designated for alternate disposal using approved facilities in accordance with applicable regulations:
- .4 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

3.6 RESTORATION

- .1 Restore areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas.
- .2 Use soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove debris, trim surfaces and leave work site clean, upon completion of Work
 - .3 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and/or reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 45 00 – Quality Control
- .3 Section 01 61 00 – Common Product Requirements
- .4 Section 01 74 11 – Cleaning
- .5 Section 01 74 21 – Construction Demolition Waste Management and Disposal
- .6 Section 03 20 00 – Concrete Reinforcing
- .7 Section 03 30 00 – Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA A23.1-19 /A23.2-19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA S269.1-16, Falsework and Formwork.
 - .3 CAN/CSA S269.3-M92 (R2013), Concrete Formwork.
- .2 ULC Standards
 - .1 CAN/ULC-S701.1-2017

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in formwork liners and coatings and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit copies of WHMIS SDS in accordance with 01 35 29.06 - Health and Safety Requirements.

1.4 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Retain a professional engineer registered or licensed in Nova Scotia, Canada, with experience in formwork design of comparable complexity and scope, to perform following services as part of Work of this Section:
 - .1 Design of formwork:
 - .2 Review, stamp, and sign fabrication and erection Shop Drawings, design calculations and amendments.
 - .3 Conduct on-site inspections and prepare and submit inspection reports verifying this part of Work is in accordance with Contract Documents.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect formwork from damages.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CSA O153, CAN/CSA O86, and CSA O437 Series.
 - .2 For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2.
 - .3 Rigid insulation board: to CAN/ULC-S701.
- .2 Form ties:
 - .1 For concrete not designated 'Architectural': removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes minimum 25 mm diameter in concrete surface.
 - .2 For Architectural concrete, snap ties complete with plastic cones and light grey concrete plugs.
- .3 Form release agent: Proprietary, non-volatile material not to stain concrete or impair subsequent application of finishes or coatings to surface of concrete, derived from agricultural sources, non-petroleum containing, non-toxic.
- .4 Falsework materials: to CSA S269.1.

Part 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels, and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .3 Fabricate and erect falsework in accordance with CSA S269.1.

- .4 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7 Fabricate and erect formwork in accordance with CAN/CSA S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.
- .8 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .9 Use 25 mm chamfer strips on external corners and 25 mm fillets at interior corners, joints, unless specified otherwise.
- .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .11 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
 - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .12 Line forms for following surfaces:
 - .1 Outer face of slab.
 - .2 Secure lining taut to formwork to prevent folds.
 - .3 Pull down lining over edges of formwork panels.
 - .4 Ensure lining is new and not reused material.
 - .5 Ensure lining is dry and free of oil when concrete is poured.
 - .6 Application of form release agents on formwork surface is prohibited where drainage lining is used.
 - .7 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.
 - .8 Cost of textile lining is included in price of concrete for corresponding portion of Work.
- .13 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 5 days for slabs and other structural members.
 - .2 2 days for footings and abutments.
- .2 Remove formwork when concrete has reached 70 % of its 28-day design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .3 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .4 Re-use formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and/or reuse in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 29.06 – Health and Safety Requirements
- .2 Section 01 45 00 – Quality Control
- .3 Section 01 61 00 – Common Product Requirements
- .4 Section 01 74 11 – Cleaning
- .5 Section 01 74 21 – Construction Demolition Waste Management and Disposal
- .6 Section 03 10 00 – Concrete Forming and Accessories.
- .7 Section 03 30 00 – Cast-in-Place Concrete.

1.2 PRICE AND PAYMENT PROCEDURES

- .1 Measurement and Payment:
 - .1 No measurement made under this Section.
 - .1 Include reinforcement costs in items of concrete work in Section 03 30 00 - Cast-In-Place Concrete.

1.3 REFERENCE STANDARDS

- .1 American Concrete Institute (ACI)
 - .1 SP-66-(04), ACI Detailing Manual 2004.
- .2 ASTM International (ASTM)
 - .1 ASTM A123/A123M – 17 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A143/A143M-07 (2014), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- .3 CSA Group (CSA)
 - .1 CSA A23.1-19 /A23.2-19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA A23.3-14, Design of Concrete Structures.
 - .3 CSA G30.18-09 (R2019), Carbon Steel Bars for Concrete Reinforcement.
- .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish, and limitations.
- .2 Submit copies of WHMIS Safety Data Sheet (SDS) in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia, Canada.
 - .1 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
 - .2 Indicate placing of reinforcement and:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement, with identifying code marks to permit correct placement without reference to structural drawings.
 - .3 Detail lap lengths and bar development lengths to CAN/CSA A23.3.
 - .1 Provide type B.
- .4 Quality Assurance Submittals:
 - .1 Submit in accordance with Section 01 45 00 - Quality Control.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .4 Handle, transport, store and install epoxy coated reinforcing steel bars to prevent damage to coating. Prevent bar-to-bar abrasion and excessive sagging. Do not drop or drag bars. Store on suitable non-metallic supports. For lifting use nylon lifting slings, padded slings, separators or other means recommended by epoxy coated reinforcing steel supplier.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Consultant.

- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA G30.18, unless indicated otherwise.
- .3 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .4 Tie wire: 1.5 mm diameter annealed wire.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada and CSA A23.1/A23.2.
- .2 Obtain Consultant's written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Ship bundles of bar reinforcement clearly identified in accordance with bar bending details and lists.

Part 3 Execution

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement.

3.2 PLACING REINFORCEMENT

- .1 Cutting or puncturing vapour retarder is not permitted; repair damage and reseal vapour retarder before placing concrete.
- .2 Place reinforcing steel as indicated on placing drawings in accordance with CSA A23.1/A23.2.
- .3 Prior to placing concrete, obtain Consultant's approval of reinforcing material and placement.
- .4 Maintain cover to reinforcement during concrete pour.

3.3 FIELD QUALITY CONTROL

- .1 Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and/or reuse in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 35 29.06 – Health and Safety Requirements
- .3 Section 01 45 00 – Quality Control
- .4 Section 01 74 11 – Cleaning
- .5 Section 01 74 21 – Construction Demolition Waste Management and Disposal
- .6 Section 03 10 00 – Concrete Forming Accessories
- .7 Section 03 20 00 – Concrete Reinforcing

1.2 PRICE AND PAYMENT PROCEDURES

- .1 Measurement and Payment:
 - .1 Measurement Procedures: in accordance with Section 01 29 00 - Payment Procedures.
 - .2 Measure cast-in-place concrete in cubic metres calculated from neat dimensions as indicated.
 - .1 Concrete placed beyond dimensions indicated not measured.
 - .3 No deductions made for volume of concrete displaced by reinforcing steel, structural steel, or piles.
 - .4 Supply and installation of anchor bolts, nuts and washers and bolt grouting not measured but considered incidental to work.
 - .5 Measure supply and installation of waterstops in lineal metres installed.

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C260/C260M-10a (2016), Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C494/C494M-17, Standard Specification for Chemical Admixtures for Concrete.
- .2 CSA Group (CSA)
 - .1 CSA A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283-19, Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005),

1.4 ABBREVIATIONS AND ACRONYMS

- .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement types:
 - .1 GU, GUb and GUL - General use cement.
 - .2 MS and MSb - Moderate sulphate-resistant cement.
 - .3 MH, MHb and MHL - Moderate heat of hydration cement.
 - .4 HE, HEb and HEL - High early-strength cement.
 - .5 LH, LHb and LHL - Low heat of hydration cement.
 - .6 HS and HSb - High sulphate-resistant cement.
- .2 Fly ash types:
 - .1 F - with CaO content maximum 8%.
 - .2 CI - with CaO content 15 to 20%.
 - .3 CH - with CaO minimum 20%.
- .3 GGBFS - Ground, granulated blast-furnace slag.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements
- .3 Site Quality Control Submittals:
 - .1 Provide testing results for review by Consultant and do not proceed without written approval when deviations from mix design or parameters found.
 - .2 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
 - .3 Concrete hauling time: provide for review by Consultant deviations exceeding maximum allowable time of 120 minutes for concrete delivered to site of Work and discharged after batching.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Provide Consultant, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture meet specified requirements.
- .3 At least 4 weeks prior to beginning Work, inform Consultant of source of fly ash.

- .1 Changing source of fly ash without written approval of Consultant is prohibited.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
- .2 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Modifying maximum time limit without receipt of prior written agreement from Consultant, laboratory representative and concrete producer as described in CSA A23.1/A23.2. is prohibited.
 - .2 Deviations submitted for review by Consultant.
 - .3 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

1.8 SITE CONDITIONS

- .1 Placing concrete during rain or weather events that could damage concrete is prohibited.
- .2 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/A23.2.
- .3 Cold weather protection:
 - .1 Maintain protection equipment, in readiness on Site.
 - .2 Use such equipment when ambient temperature below 5°C, or when temperature may fall below 5°C before concrete cured.
 - .3 Placing concrete upon or against surface at temperature below 5°C is prohibited.
- .4 Hot weather protection:
 - .1 Protect concrete from direct sunlight when ambient temperature above 27°C.
 - .2 Prevent forms of getting too hot before concrete placed. Apply accepted methods of cooling not to affect concrete adversely.
- .5 Protect from drying.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Consultant and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MIXES

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Consultant performance criteria to CSA A23.1/A23.2.

- .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
- .2 Provide concrete mix to meet following hard state requirements:
 - .1 Durability and class of exposure:
 - .1 Footings and pedestals: A-3
 - .2 Exterior slabs on grade and ramps: C-2
 - .2 Compressive strength at 28 age:
 - .1 Footings and pedestals: 30 MPa minimum.
 - .2 Exterior slabs on grade and ramps: 32 MPa minimum.
 - .3 Aggregate size 20 mm maximum.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain Consultant's written approval before placing concrete.
 - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitate placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete not permitted.
- .5 Disturbing reinforcement and inserts during concrete placement is prohibited.
- .6 Protect previous Work from staining.
- .7 Clean and remove stains prior to application for concrete finishes.
- .8 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, workability, air content, temperature and test samples taken.
- .9 Do not place load upon new concrete until authorized by Consultant.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Anchor bolts:
 - .1 Drilled holes: to manufacturers' recommendations.
 - .2 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
 - .3 Set bolts and fill holes with shrinkage compensating grout.
- .3 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .4 Finishing and curing:

- .1 Finish concrete to CSA A23.1/A23.2.
- .2 Use procedures as noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface not damaged.
- .3 Finish concrete floor to CSA A23.1/A23.2. Class A
- .4 Provide swirl-trowelled or hand screed finish unless otherwise indicated.

3.3 SURFACE TOLERANCE

- .1 Concrete tolerance to CSA A23.1 FF = 20; FL = 15.

3.4 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air content.
 - .4 Compressive strength at 7 and 28 days.
 - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials carried out by testing laboratory designated by Consultant for review to CSA A23.1/A23.2.
 - .1 Ensure testing laboratory certified to CSA A283.
- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Consultant.
- .4 Consultant will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .5 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .6 Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for recycling and/or reuse in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
 - .1 Construction and Demolition Waste Management: prepare Construction Waste Management plan in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
 - .2 Divert unused concrete materials from landfill to local facility.
 - .3 Provide appropriate area on job site where concrete trucks and be safely washed.
 - .4 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site.

- .5 Disposal of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location to pose health or environmental hazard is prohibited.
- .6 Prevent admixtures and additive materials from entering drinking water supplies or streams.
- .7 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.
- .8 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 61 00 – Common Product Requirements
- .3 Section 01 74 11 - Cleaning
- .4 Section 01 74 21 – Construction Demolition Waste Management and Disposal

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A36/A36M-19, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM F3125/F3125M-19, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum tensile Strength.
- .2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).
 - .1 Handbook of the Canadian Institute of Steel Construction.
 - .2 CISC/CPMA Standard 2-75, A Quick-drying Primer for use on Structural Steel.
- .3 CSA Group (CSA)
 - .1 CSA G40.20/G40.21-13(R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CAN/CSA-S16-14 (R2019), Design of Steel Structures.
 - .4 CAN/CSA-S136-16, North American Specifications for the Design of Cold Formed Steel Structural Members.
 - .5 CSA W47.1-09 (R2019), Certification of Companies for Fusion Welding of Steel.
 - .6 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.
 - .7 CSA W55.3-08(R2018), Certification of Companies for Resistance Welding of Steel and Aluminum.
 - .8 CSA W59-18, Welded Steel Construction.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia, Canada.
- .3 Fabrication drawings:
 - .1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in Nova Scotia, Canada.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.
- .3 Packaging Waste Management: remove for reuse by manufacturer and return of padding crates pallets packaging materials in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of CSA-S136 and CAN/CSA-S16 to resist forces, moments, shears and allow for movements indicated.
- .2 Shear connections:
 - .1 Select framed beam shear connections from an industry accepted publication such as “Handbook of the Canadian Institute of Steel Construction”; when connection for shear only (standard connection) is required.
 - .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .3 For composite construction select or design minimum end connection to resist reaction resulting from factored movement resistance as tabulated in the “Handbook of the Canadian Institute of Steel Construction” assuming 100% shear connection with depth of steel deck and/or slab shown on drawings.

2.2 MATERIALS

- .1 Structural steel: to CSA-G40.20/G40.21
 - .1 Rolled shaped sections: Grade 350W.
 - .2 Hollow Sections: Grade 350W
- .2 Bolts, nuts and washers: to ASTM F3125/F3125M
- .3 Welding materials: to CSA W48 Series, CSA W59 and certified by Canadian Welding Bureau.
- .4 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m².

2.3 FABRICATION

- .1 Fabricate structural steel in accordance with CAN/CSA-S136 CAN/CSA-S16 and in accordance with reviewed shop drawings.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

- .1 Structural steel work: in accordance with CAN/CSA-S136 CAN/CSA-S16.
- .2 Welding: in accordance with CSA W59.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.3 CONNECTION TO EXISTING WORK

- .1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Consultant for direction before commencing fabrication.

3.4 ERECTION

- .1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and CAN/CSA-S136.
- .2 Field cutting or altering structural members is prohibited.
- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

3.5 FIELD QUALITY CONTROL

- .1 Inspection and testing of workmanship will be carried out by Consultant.
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Consultant.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for recycling and/or reuse in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 29.06 – Health and Safety Requirements.
- .2 Section 01 61 00 – Common Product Requirements
- .3 Section 01 74 00 - Cleaning
- .4 Section 01 74 21 – Construction Demolition Waste Management and Disposal

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A653/A653M-19a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 CSA Group (CSA)
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
 - .2 CAN/CSA O80 Series-15, Wood Preservation.
 - .3 CSA O86-2019, Engineering Design in Wood.
 - .4 CAN/CSA-Z809-16, Sustainable Forest Management.
- .3 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001 (version 4-0), FSC Principle and Criteria for Forest Stewardship.
- .4 Green Seal Environmental Standards (GS)
 - .1 GS-36-13, Adhesives for Commercial Use.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .6 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2017 edition or most recent at the time or tendering.
- .7 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2015-2019 Standard.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood decking and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Submit copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia, Canada.

1.4 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wood decking from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials, padding, pallets, crates, in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Wood decking: to NLGA standard Grading Rules for Canadian Lumber, types and grades as follow:
 - .1 SPF No.1/No.2, pressure treated for bridge posts and bridge ledger boards.
 - .2 Cedar No.1/No.2 – non-treated to be used in bridge: handrails, guardrails, kick plates and decking boards.
 - .3 SPF No1/No2, pressure treated in accessibility ramps (see architectural and structural drawings to locate the ramps)
 - .4 Member sizes: sections as indicated in the drawings
 - .5 CAN/CSA-Z809 or FSC or SFI certified.
- .2 Decking lengths: use decking of same length as indicated in the drawings.
- .3 Nails: to CSA B111, galvanized finish; sizes to ASTM 653/653M or CSA O86. Supply 200 mm spiral spikes for lateral nailing.
- .4 Preservative: all cuts in pressure treated lumber shall be treated with two (2) coats of water-based pressure-treated wood sealer.

Part 3 Execution

3.1 INSTALLATION

- .1 Do wood deck work to CSA O86 except where specified otherwise.
- .2 Install decking to CSA O86, simple span pattern.
- .3 Apply preservative to end cuts of pressure treated lumber.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and/or reuse in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by wood decking installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 78 00- Closeout Submittals.
- .3 Section 01 74 11- Cleaning.

1.2 WORK INCLUDED

- .1 This section specifies requirements for the supply and installation of a water treatment system at the Trout Brook campground. Work generally includes the supply, installation, commissioning, and training for a series of water treatment components forming the overall water treatment system.

1.3 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CSA B137.3 – Rigid Poly (Vinyl Chloride) (PVC) Pipe for Pressure Applications
- .2 ASTM
 - .1 ASTM D2241 – Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR) PVC
- .3 NSF
 - .1 NSF-PW – NSF approved for potable water

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for water treatment devices and components and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia, Canada.
 - .2 Indicate:
 - .1 Equipment including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Descriptive narrative and schematic details on water treatment equipment arrangement.
- .4 Maintenance Manuals:
 - .1 Provide operating and maintenance data in accordance with Part 3 – Section 3.8.

- .5 Maintenance Parts:
 - .1 Provide manufacturer's recommended parts list.
 - .2 Indicate parts to be available for use on site within 24 hours.
 - .3 Provide spare parts that cannot be made available on-site within 24 hours.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for water treatment devices and components for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MANUFACTURER

- .1 Supplier of the water treatment system shall have proven experience supplying systems of similar configuration over the past five (5) years and trained service technicians available within 6 hours' driving time from the Trout Brook campground.
- .2 Supplier shall have local service representation.

2.2 DESIGN CRITERIA

- .1 Site water is supplied from groundwater via a single potable well drilled on-site. Design shall meet the Potable Water Guidelines and Standards for Parks Canada Agency. Finished water quality shall meet the Health Canada Guidelines for Canadian Drinking Water Quality.
- .2 Design Criteria:
 - .1 Peak day flows: 1 L/s.
 - .2 Average day flows: 9,000 L/day.
- .3 Water Quality Objectives:
 - .1 Primary and secondary disinfection required. Primary disinfection must achieve 4-log reduction of viruses.

- .2 Finished water quality shall meet the Health Canada Guidelines for Canadian Drinking Water Quality for aesthetic objectives (AO) and maximum allowable concentrations (MAC).
- .4 Electrical power supply:
 - .1 Electrical power will be supplied by the general contractor or electrical sub-contractor. 120V 15A duplex receptacles will be provided for the attachment of appliance cords and plugs connected to the water treatment devices.
 - .2 Electrical power will be derived from an on-site prime-power generator supplying 120/240V 1-phase 3-wire grounded service.

2.3 PLASTIC PIPE

- .1 Type 12454 Polyvinyl Chloride (PVC): to CAN/CSA B137.3 unless otherwise noted.
 - .1 SCH80 for pipes 150mm and smaller.

2.4 VALVES

- .1 Valves shall be a SCH 80 PVC compound that complies with NSF 61.
- .2 Check valves shall be ball-type check valves.
- .3 Air release valve to have 19 mm inlet size, 1.6 mm orifice.
- .4 Backpressure sustaining valve to have an adjustable setpoint. Operational setting to be 207 kPa.
- .5 Pressure relief valve to have adjustable setpoint. Operational setting to be 689.5 kPa. Provisions to be made for drain to sanitary system.

2.5 PRESSURE TANKS

- .1 General: to include steel pressure tanks with internal bladder and integral standpipe, pressure switch, ready for piping connections as indicated.
- .2 Tanks to be heavy-gauge steel with an electrostatically applied polyester paint finish, and ready for use with a 482 – 620.5 KPa (70/90 psi) pressure range system.
 - .1 Maximum operating pressure: 860 KPa.
 - .2 Total storage capacity: 635 L.
- .3 Internal bladder to be one-piece, seamless PVC, made from FDA-listed material.
- .4 Pressure switch to be capable of operating between 482 – 620.5 KPa, with a pump run time of no more than 2 minutes.
- .5 Pressure sensor to be capable of reading gauge pressure.

2.6 PRESSURE GAUGES

- .1 General: to include self-contained liquid-filled pressure gauge with pressure dial and gauge face reading in PSI pressure units.
- .2 Sensor to be resistant to freezing, with liquid silicone fill:
 - .1 Temperature: 66°C (150°F) max
 - .2 Connection: Brass ¼ NPT

- .3 Ranges: Vacuum thru 160 psi
- .4 Accuracy: 3-2-3%

2.7 TURBIDITY/SEDIMENT FILTERS

- .1 General: to include wall-mount housing and removable cartridge, ready for piping connections as indicated.
- .2 Housing to be high grade polypropylene, with EPDM o-rings, or suitable alternative.
 - .1 Maximum pressure for housing: 690 kPa.
 - .2 Maximum flow rate for housing: 1.00 L/s for single unit
- .3 Filter cartridge to high-grade polypropylene, or suitable alternative.
 - .1 Maximum pressure for filter cartridge: 690 kPa.
 - .2 Micron size: 25 um.
 - .3 Maximum flow rate for filter cartridge: 1.00 L/s for single unit.
 - .4 Head loss through filter to be < 6.9 kPa at 1 L/s.
 - .5 Temperature rating: 4.4 – 62.8 °C.

2.8 IRON REMOVAL

- .1 General: to include dual composite pressure vessels plumbed in parallel, granular catalytic filter media and electronic MR backwash control valves ready for piping and wiring connections as indicated.
- .2 Control valve to be capable of operating as a filter-only system or allow for a regeneration process, and have cycling and backwash capabilities.
 - .1 Pressure operating range: 138 kPa to 862 kPa.
 - .2 Service flow rate: 1.70 L/s at 103 kPa loss.
 - .3 Backwash flow rate: 1.70 L/s at 172 kPa loss.
- .3 Granular filter media to be capable of iron removal to concentrations below 0.3 mg/L.
 - .1 Expected volume of filter media: 0.06 m³.
 - .2 Service flow rate: 0.38 – 0.76 L/sec/0.03 m³ of media.
 - .3 Backwash flow rate: 0.50 – 0.60 L/sec/0.03 m³ of media.
- .4 Composite pressure vessel to be sized for storage of media plus required free board.
- .5 Provisions to be made for drain to sanitary system.

2.9 ARSENIC/LEAD REMOVAL

- .1 General: to include dual composite pressure vessels plumbed in parallel, adsorbant and electronic MR backwash control valves ready for piping and wiring connections as indicated.
- .2 Control valve to be capable of operating as a filter-only system or allow for a regeneration process, and have cycling and backwash capabilities.
 - .1 Pressure operating range: 138 kPa to 862 kPa.
 - .2 Service flow rate: 1.70 L/s at 103 kPa loss.

- .3 Backwash flow rate: 1.70 L/s at 172 kPa loss.
- .3 Adsorbant to be capable of iron removal of arsenic and lead to concentrations below 10 µg/L.
 - .1 Expected volume of filter media: 0.09 m³.
 - .2 Service flow rate: 0.50 – 0.60 L/sec/0.03 m³ of media.
 - .3 Backwash flow rate: 0.50 – 0.60 L/sec/0.03 m³ of media.
 - .4 Head loss: <34 kPa through media.
- .4 Composite pressure vessel to be sized for storage of media plus required free board.
- .5 Provisions to be made for drain to sanitary system.

2.10 WATER SOFTENER

- .1 General: to include softener tanks (active and standby), brine tank, brine distribution system, regenerating manifold and control system, ready for piping and wiring connections as indicated.
- .2 Control valve to be capable of operating system as alternating, allow for a regeneration process, and have cycling and backwash capabilities.
 - .1 Maximum operating pressure: 862 kPa.
 - .2 Service flow rate: 2.3 L/s at 103 kPa loss.
- .3 Softener tank to be constructed of a material suitable for application in potable water processes and compatible with selected resin.
 - .1 Resin removal requirements: 120,000 grains.
 - .2 Peak flow rate: 1.3 L/s.
 - .3 Expected volume of resin: 0.11 m³. Control valve to be capable of operating as a filter-only system or allow for a regeneration process, and have cycling and backwash capabilities.
- .4 Brine tank to be constructed of a material suitable for application in potable water processes and compatible with selected brine. Brine tank to be sized to supply sufficient brine for the selected softener system.
- .5 Provisions to be made for drain to sanitary system

2.11 BOOSTER PUMP

- .1 General: to include self-contained pressure-boosting pump capable of sustaining a constant outflow pressure at variable flow rates.
 - .1 Maximum setpoint: 586 kPa.
 - .2 Operational setpoint: 482.6 kPa.
 - .3 Maximum pressure: 793 kPa.
 - .4 Service flow rate: 2 l/s.
 - .5 Suction lift: 8 m.

2.12 LIQUID CHLORINATOR

- .1 General: to include simplex wall mounted peristaltic chemical metering pump system for injecting 12% Sodium Hypochlorite. All piping, fittings, interconnecting wiring, and electrical controls external to the system shall be supplied and installed by the contractor.
- .2 Peristaltic metering pump to be made of suitable materials of construction for 12% Sodium Hypochlorite and have removable pump head for ease maintenance.
 - .1 Capacity range: 0.006 – 30 L/hr.
 - .2 Maximum operating pressure: 689 kPa.
 - .3 Injection point: single point injection.
- .3 Dose rate of peristaltic metering pump to be flow-paced. Dosing to be controlled by in-line flow meter.

2.13 FLOW METER

- .1 General: to include water meter capable of water flow measurement in single direction, complete with totalizer, low-flow measuring capacity and connection capabilities to selected chlorine pump to allow for flow-paced chlorine dosing. All piping, fittings, interconnecting wiring, and electrical controls external to the system shall be supplied and installed by the contractor.
 - .1 Capacity range: 0.09 – 22 l/s.
 - .2 Maximum operating pressure: 1,600 kPa
- .2 Flow meter to be capable of digital and analog output. Meter to be capable of communication to selected chlorine pump to allow for flow-paced chlorine dosing.

2.14 CHLORINE CONTACT TANKS

- .1 General: to include steel pressure tanks with internal flow system capable of achieving required system contact time for primary disinfection with 12% Sodium Hypochlorite.
 - .1 Virus reduction: 4 log, or 99.99%.
 - .2 CT value: 6.
 - .3 Contact Time: 12 minutes.
 - .4 Residual free chlorine: 0.5 mg/L.
- .2 Contact tank to provide a minimum baffle efficiency of 0.4.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for water softener installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3 INSTALLATION

- .1 Install in accordance with manufacturers recommendations and as indicated.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.

3.5 INSPECTION, TESTING AND START-UP

- .1 Provide the services of qualified servicemen, mechanics or other trained personnel of the equipment suppliers or manufacturers to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the equipment manufacturer's representative to the Departmental Representative stating the following:
 - .1 That satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation.
 - .3 That the operation and maintenance instructions for the equipment have been presented to the Departmental Representative.
 - .4 Advise the Departmental Representative in writing at least one (1) week in advance of the proposed date for testing and start-up. Provide all necessary tools, materials and equipment for carrying out tests. Conduct all tests in the presence of the Departmental Representative.
 - .5 Replace defective material or equipment with new material or equipment. Bear all cost including re-testing and making good.
- .2 Test all pipework:
 - .1 Only hydrostatic pressure testing shall be acceptable for PVC/CPVC pipe.
 - .2 Hydrostatic pressure testing at 1.5 maximum operating pressure for two (2) hours in accordance with ASTM F2261.
 - .3 No leakage will be allowed.
- .3 Demonstrate Effectiveness:
 - .1 Effectiveness of treatment components to meet required drinking water criteria to be demonstrated through analytical testing, to the satisfaction of the Departmental Representative.

- .4 Submit a commissioning and start-up report within one (1) month of start-up. The report should include but not be limited to:
 - .1 Date and attendees.
 - .2 Equipment identification and logging.
 - .3 Site inspection comments.
 - .4 Equipment installation comments or photos.
 - .5 Deficiencies.
 - .6 Start-up activities and checks.
 - .7 Baseline or initial operating parameters, settings and/or measurements (for example: regen cycle settings, chlorine dosing, etc.)
 - .8 Site and equipment photos at start-up.
 - .9 Any other information recommended in the manufacturer's start-up report.

3.6 OPERATION AND MAINTENANCE MANUALS

- .1 Supply three hard copies of Operations and Maintenance Manuals for key equipment in the treatment systems and one electronic file copy in PDF format.
- .2 Content shall include but not be limited to:
 - .1 Transmittal & key contacts.
 - .2 System start-up reports.
 - .3 Detailed equipment and components list with descriptions and part numbers.
 - .4 Technical data sheets for all components.
 - .5 Manufacturer's installation guides.
 - .6 Manufacturer's operation and maintenance guides.
 - .7 Winterization procedures.
 - .8 Pump repair guide.
 - .9 Control panel operation and maintenance guide.

3.7 DEMONSTRATION AND TRAINING

- .1 Provide classroom and on-site training for Owner's personnel in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for piping, valves and fittings for gas fired equipment.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .2 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .3 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B75M-99, Standard Specification for Seamless Copper Tube Metric.
 - .4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
 - .1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.
 - .2 CAN/CSA B149.2-00, Propane Storage and Handling Code.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Indicate on manufacturers catalogue literature following: valves.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00- Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meeting:
 - .1 Convene pre-installation meeting one week prior to beginning on-site installations.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling or reuse in accordance with Section 01 74 21- Construction/Demolition Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
- .2 Copper tube: to ASTM B837.

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Brazing: to ASTM B837.

2.3 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.

- .3 Bolts and nuts: to ASME B18.2.1.
 - .4 Nipples: schedule 40, to ASTM A53/A53M.
 - .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ASME B16.18.
 - .2 Wrought copper fittings: to ASME B16.22.
- 2.4 VALVES**
 - .1 Provincial Code approved, lubricated plug type.
- 2.5 TANK WITH REGULATOR**
 - .1 Supplied and installed by propane supplier.
- Part 3 Execution**
- 3.1 MANUFACTURER'S INSTRUCTIONS**
 - .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 PIPING**
 - .1 Install in accordance with Section 23 05 05- Installation of Pipework, CAN/CSA B149.2, applicable Provincial Codes, and CAN/CSA B149.1, supplemented as specified.
 - .2 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.
- 3.3 VALVES**
 - .1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.
 - .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.
- 3.4 FIELD QUALITY CONTROL**
 - .1 Site Tests/Inspection:
 - .1 Test system in accordance with CAN/CSA B149.2, CAN/CSA B149.1 and requirements of authorities having jurisdiction.
 - .2 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.

- .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
- .3 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of work at 25% and 60% complete.
 - .3 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

3.5 ADJUSTING

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.2, CAN/CSA B149.1.
- .2 Pre-Start-Up Inspections:
 - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
 - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING

- .1 Cleaning: in accordance with Section CAN/CSA B149.1, CAN/CSA B149.2, supplemented as specified.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Requirements
- .3 Section 01 61 00 - Product Requirements.
- .4 Section 01 70 00 - Contract Closeout.
- .5 Section 01 74 11 - Cleaning.
- .6 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .7 Section 06 10 00 - Rough Carpentry.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .1 Institute of Electrical and Electronics Engineers (IEEE)/National Electrical Safety Code Product Line (NESC).
 - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit in accordance with the following sections unless superseded by more stringent specifications included elsewhere.
- .3 Submit for review:
 - .1 Single line electrical diagrams for the electrical distribution systems.
 - .2 Solar power design report produced by PVSyst indicating the input design parameters, quantities of each component (solar panel, battery, inverter/charger, etc.), and specifications for each component.
 - .1 Written statement from the contractor that the contractor's solar power renewable energy installation and generator will meet the design intent and support the loads and the load profile as indicated in the drawings and specifications.

- .4 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit:
 - .1 Functional description of equipment.
 - .2 Technical data for all devices.
 - .3 Device location plans and cable lists.
 - .4 Devices mounting location detail drawings.
 - .5 Typical devices connection detail drawings.
- .5 Shop drawings:
 - .1 Submit drawings, wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .2 Submit shop drawings for all solar PV components including, but not limited to, solar module, solar module mounting assembly, solar module array support structure, solar module array support structure foundations/footings, battery, battery rack, inverter/charger.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit two copies of 24 in. x 24 in. (600 mm x 600 mm) minimum size drawings to inspection authorities.
 - .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .6 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment or material is not available, submit such equipment or material to inspection authorities for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .7 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing.

1.5 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Single line electrical diagrams for each electrical distribution system.
- .3 Description of system operation.
- .4 Description of each subsystem operation.
- .5 Operation instructions, to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .6 List showing each piece of equipment in system or subsystem by its original manufacturer name and model number.
- .7 Part list showing parts used in equipment by identification numbers that are standard to electronics industry.
- .8 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .9 Post instructions where directed.
- .10 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .11 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.
- .12 List of recommended spare parts to be stocked by the Owner to facilitate rapid repair of systems in the event of damage or failure.
- .2 As-Built Record Drawings.
 - .1 General:
 - .1 The Contractor shall keep an accurate record of as-built conditions. Record any variations from the contract documents, showing all changes made on site, including but not limited to, actual dimensions, elevations, inverts, sizes and other description notations.
 - .2 Hard copy submission:
 - .1 Hard copies to be submitted in conjunction with required electronic files.
 - .2 All as-built drawings are to be prints of the electronic version and are to be identical to the CAD drawings. All electronic copies of as built record drawings are to bear the electronic seal of the designer as per the hard copy.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, packaging materials.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.
- .4 The types, capacities, ratings, and dimensions of many of the components shown on the drawings and included in the specifications are based on a generic design using assumed data. The contractor shall review, verify and revise the types, capacities and ratings to suit the equipment selected by the contractor. Revisions may include (but are not limited to) quantities of solar PV equipment, circuit breaker ratings, conductor sizes, cable sizes, raceway sizes, etc. The contractor shall submit proposed changes to the Departmental Representative in accordance with section 1.4 ACTION AND INFORMATIONAL SUBMITTALS above, and receive written approval to proceed prior to procurement and installation of materials.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified equipment or material is not available, submit such equipment or material to inspection authorities for special approval before delivery to site as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

- .4 All devices, equipment, and systems must be capable of off-season storage in-place without supplemental heat, and without the need to “winterize” any item(s).
- .5 Deviations from or substitutions of electrical equipment, appliances, luminaires and mechanical equipment that utilises electricity shall not be permitted without written approval of the Departmental Representative.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment, and controls, as indicated.
- .2 Verify coordination of overload and overcurrent protective devices for coordination as required by the Canadian Electrical Code (CSA22.1-2018) rule 38-062.
- .3 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections or as shown on mechanical drawings.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of CSA C22.1, the authority having jurisdiction and the Departmental Representative.
- .2 Decal signs, minimum size 175 mm x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 All switchboards, panels, disconnect switches, power/voice/data/outlets, transformers, control panels, and motor starters are to be provided with lamicoid nameplates. Nameplates shall be affixed true and level, and plumb in all instances.
- .2 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: lamicoid, matt white finish face, black core, mechanically attached with self tapping screws lettering accurately aligned and engraved into core.

- .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .4 Wording on nameplates to be approved by Departmental Representative prior to manufacture.

- .5 Allow for minimum of twenty-five (25) letters per nameplate.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of 'equipment green' finish enamel.

Part 3 Execution

3.1 ADMINISTRATION

- .1 Obtain and pay for all necessary permits required to perform the work. Comply with all permit requirements and conditions.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.4 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

- .2 Do complete installation in accordance with the National Building Code of Canada 2015 Edition except where specified otherwise.
- .3 All drawings, diagrams, sketches, raceway locations and routings, cable locations and routings, etc. illustrate intent only. Symbols on drawings indicate approximate locations. Refer to architectural plans and details. The contractor shall make all necessary adjustments to suit supplied equipment and shall achieve the required functionality.
- .4 Establish a detailed work plan with the general contractor. Submit the workplan to the Departmental Representative for approval.
- .5 Coordinate electrical work requirements with all other trades on site to avoid conflict. Report any conflicts to the Departmental Representative. All electrical and control circuits provided for mechanical equipment shall be coordinated with the mechanical contractor. Verify equipment nameplate ratings prior to installation and connection and report any discrepancies to the Departmental Representative. Coordinate routing and final installation locations on site with mechanical trades. Provide all necessary equipment, raceways, fittings, fasteners and device boxes to provide a complete system. Coordinate all routing of data/communications raceways with communications contractor.
- .6 Coordinate the sealing of all penetrations created by new installation with the general contractor. Fire-rated CSA approved compound required upon entering or exiting data/server rooms. Fire rating integrity in all other areas shall be maintained.

3.5 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.6 LOCATION OF OUTLETS

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3 m, and information is given before installation.
- .3 Locate light switches on latch side of doors.

3.7 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 Install electrical equipment at following heights unless indicated otherwise or superseded by other Codes or Standards.
 - .1 Local switches: 1420 mm.
 - .2 Light switches: 1420 mm.
 - .3 Manual Motor Starter switches: 1420 mm, or as required by CSA C22.1.
 - .4 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Exterior: 450 mm.

- .3 Exterior 'Twistlock' receptacle/inlet: 1000 mm above grade.
- .4 Above top of counters or counter splash backs: 150 mm.
- .5 Panelboards: as required by Code or as indicated.
- .6 Interior telephone outlets: 300 mm.
- .3 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.8 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.9 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .1 Solar powered roadway lighting: test to ensure that each fixture remains illuminated for a minimum uninterrupted period of 8 hours during the hours of darkness or when the solar collector is covered by an opaque material.
 - .4 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable.
 - .5 Insulation resistance testing:
 - .1 Test circuits, feeders and equipment rated up to 350 V with a 500 V instrument.
 - .2 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.10 STARTUP, COMMISSIONING AND TRAINING SERVICES

- .1 Provide training and instruction from factory authorised representatives in the operation, care and maintenance of all systems, system equipment and components. The contractor is to include an allowance for two consecutive days of on-site training.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.11 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18.1-13, Metallic Outlet Boxes.
 - .2 CAN/CSA-C22.2 No.65-13, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for TECK cable, flexible conduit, armoured cable, as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
- .2 The use of bushing stud connectors is not acceptable.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .3 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings.
- .4 Section 26 05 43.01 - Installation of Cables in Trenches and Ducts.
- .5 Section 33 65 76 - Direct Buried Underground Cable Ducts.

1.2 PRODUCT DATA

- .1 Provide product data in accordance with Section 26 05 00 - Common Work Results for Electrical.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: copper, stranded for #12 AWG and larger. Minimum size: #12 AWG.
- .2 Copper conductors: size as indicated
 - .1 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE Non Jacketed.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90. Minimum size: #12 AWG.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: anti short connectors.

2.3 CONTROL CABLES

- .1 Type: low energy 300 V control cable: solid annealed copper conductors sized as required or as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: thermoplastic jacket.
 - .3 Shielding: metallized tapes over conductors.

2.4 TECK90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Bonding conductor: copper.

- .2 Circuit conductors: copper.
- .3 Size as indicated, minimum size: #12 AWG.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Colour coded.
 - .3 Rating: 600V.
- .4 Inner jacket: flame retardant and moisture resistant polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project, UV rated, moisture resistant, suitable for use at -40 Degrees C. Black.
- .7 Fastenings:
 - .1 One-hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.5 SOLAR PHOTOVOLTAIC MODULE WIRING

- .1 Cable and conductor size: in accordance with CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition).

2.6 FLEXIBLE CORD

- .1 Outdoor flexible cord for extra-hard usage in wet locations.
- .2 Conductors: insulated, stranded, copper.
- .3 Minimum size: #12 AWG.
- .4 Cord type: SOOW, size as indicated.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Cables installed in trenches shall be type TECK90 cable.

- .2 Cables connecting to devices located external to buildings, or where exposed to damp or wet conditions shall be type TECK90.
- .3 Install cable in trenches in accordance with Section 26 05 43.01 - Installation of cables in Trenches and Ducts.
- .4 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .5 Conductor insulation colour coding: to Section 26 05 00 - Common Work Results for Electrical.
- .6 Conductor length for parallel feeders to be identical.
- .7 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .8 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .9 Shared neutrals shall not be used in 2-wire branch circuit wiring for lighting, receptacles and permanently wired computer and electronic equipment.
- .10 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 In buried ducts in accordance with Section 33 65 76 - Direct Buried Underground Cable Ducts.
- .2 Install pull string in all unused conduits intended for the future installation of building wires.
- .3 Install insulated bonding conductors in all conduits containing building wires.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by straps.

3.5 INSTALLATION OF ARMoured CABLES

- .1 AC90 shall only be permitted for branch circuit wiring drops from ceiling junction boxes to light fixtures, receptacles and other equipment in the same room requiring electrical power. The installation of AC90 cable for branch circuit wiring home runs or runs between rooms is not acceptable. Raceway and building wire shall be used for this purpose unless otherwise noted.
- .2 AC90 shall not be used where the cable remains exposed, following completion of construction, at any point between the finished floor level to a point 2m above finished floor.

- .3 All AC90 fixture or device feeds shall originate from the sides of outlet boxes and not from the box cover.
- .4 Termination of AC90 cable is to utilize steel connections with accompanying lock nuts similar to or equal to T&B 3301 series.

3.6 INSTALLATION OF FLEXIBLE CORD

- .1 Prepare flexible cord and attachment plug in accordance with the drawings.
- .2 Turn over cord to Owner.

3.7 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

3.8 INSTALLATION OF SOLAR PHOTOVOLTAIC MODULE WIRING

- .1 Comply with CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations, section 64.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
 - .2 CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Long barrel copper compression connectors to CSA C22.2 No.65 as required sized for conductors and according to application.
 - .1 Copper, two-hole, long barrel (dual crimp) type lugs are to be used for all wire sizes #3 AWG and larger.
- .2 One-hole short-barrel compression connectors to CSA C22.2 No.65 as required sized for conductors and according to application.
 - .1 Copper, one-hole, short barrel (single crimp) type lugs are to be used for all wire sizes up to, and including #4 AWG.

2.2 INSTALLATION

- .1 Install terminations in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2 No.41.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 22 - Connectors and Terminations

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-14, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground metallic water pipe.
- .2 Rod electrodes: 19mm diameter copper clad steel by minimum 3m long.
- .3 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .4 Grounding and bonding conductors sized up to and including #10 AWG, are to have green coloured RW90 X-link insulation. Type TW75 is not acceptable.
- .5 Insulated grounding conductors: green, copper conductors, size as indicated. Green coloured RW90 X-link insulation. Type TW75 is not acceptable.
- .6 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Crimp type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.
 - .7 The use of U-bolt, split bolt, servit or similar connectors are not permitted.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections and connections to electrodes using exothermic "Thermit" welding process.
- .5 Make connections to electrically conductive underground metallic water pipe using permanent mechanical connectors approved for the purpose and for the type of pipe.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Soldered joints are not permitted.
- .8 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 The main "incoming ground" conductor is to run unbroken to the main electrical service entrance overcurrent device ground bus.
- .11 All cables, feeder and branch circuit conductors installed in conduit are to be complete with a separate minimum size #12 AWG copper bond/ground wire as follows:
 - .1 Bond wire sized as required by Canadian Electrical Code Table 16, or as otherwise noted.
 - .2 No.12 AWG and larger size ground or bond conductors shall be of soft drawn stranded copper of 98% conductivity, and of full size and AWG gauge.
 - .3 Size of grounding conductor is to be based upon the Canadian Electrical Code.
- .12 The "feed" bonding conductor shall be secured (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors, and/or providing a "pig-tail" lead for device terminations.
- .13 All ground wires are to be twisted together with a screw-on type wire connector, and then placed in rear of outlet box in such manner as to minimize obstructions.

3.2 ELECTRODES

- .1 Install rod electrodes and make grounding connections as indicated.
- .2 Bond separate, multiple electrodes together.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding/bonding connections to typical equipment including, but not necessarily limited to the following list. Service equipment, transformers, switchgear, battery racks, duct systems, frames of motors, motor control centres, starters, control panels, building

steel work, generators, battery chargers/inverters, distribution panels, outdoor lighting, cable trays.

- .2 Grounding of dc systems, dc/ac inverters and charge controllers shall comply with CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition).

- .1 Each separately derived AC system shall be grounded at one point only. Care shall be taken to prevent multiple grounds.

3.4 CONDUITS AND RACEWAYS

- .1 All conduit and EMT raceways for all electrical systems are to contain a minimum #12 AWG insulated copper bond wire. All metallic conduit stubs shall be bonded regardless of length.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 41 x 82 mm, 2.5 mm thick, supported from concrete base.
- .2 Galvanised steel (HDG) for interior use.
- .3 Stainless steel for exterior use.
- .4 Corrosion resistant hardware.

Part 3 Execution

3.1 INSTALLATION

- .1 Support channel independent of building structure, cladding and surface finishes.
- .2 Secure to poured concrete with expandable inserts.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 Use 41 x 82 mm back-to-back manufactured welded pairs as required to support equipment.
- .5 Fasten exposed conduit or cables to support system using straps.
 - .1 One-hole galvanised steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole galvanised steel straps for conduits and cables larger than 50 mm.
- .6 Provide metal brackets, frames and related types of support structures where indicated or as required to support conduit and cable runs.
- .7 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .8 Do not use supports or equipment installed for other trades for conduit or cable support.
- .9 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .10 Apply zinc paint or manufacturer approved equivalent to cut and blemished surfaces to prevent corrosion.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 29 – Hangers and Supports for Electrical Systems.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Construction:
 - .1 Indoor use: welded steel enclosure.
 - .2 Outdoor use or where exposed to moisture:
 - .1 Stainless steel.
 - .2 PVC.
 - .3 Polyester fibreglass composite.
- .2 Covers Flush Mounted: 1 in. (25 mm) minimum extension all around. Same material as the enclosure.
- .3 Covers Surface Mounted: screw-on turned edge covers. Same material as the enclosure.

Part 3 Execution

3.1 JUNCTION BOXES, PULL BOXES AND CABINET INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification labels: size 2 indicating circuit, voltage, or as indicated.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 4 in. (102 mm) square or octagonal outlet boxes for lighting fixture outlets.
- .2 Extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 CONDUIT BOXES

- .1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.4 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 29 - Hangers and Supports for Electrical Systems.
- .3 Section 33 65 76 - Direct Buried Underground Cable Ducts.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18.1-13 Metallic Outlet Boxes.
 - .2 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.
 - .4 CSA C22.2 No. 211.1-06(R2016), Rigid Types EB1 and DB2/EB2 PVC Conduit.
 - .5 CSA C22.2 No. 211.2-06(R2016), Rigid PVC (Unplasticized) Conduit.

Part 2 Products

2.1 RACEWAYS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure metallic surface conduits trade size 35 and smaller.
 - .1 Two-hole steel straps for conduits larger than trade size 35.
- .2 Two-hole PVC straps to secure PVC surface conduits.
- .3 Threaded rods, 6 mm diameter, to support suspended channels.
- .4 Corrosion resistant hardware and fasteners.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Use of factory "ells" is not permitted.
- .3 Watertight connectors and couplings for EMT.
 - .1 Setscrews are not acceptable.

2.4 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in service rooms and in unfinished areas.
- .3 Use electrical metallic tubing (EMT) except where otherwise indicated.
- .4 Use rigid PVC conduit underground and in wet areas.
- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.
- .6 Minimum conduit size for lighting and power circuits: trade size 21.
- .7 Minimum conduit size for communications circuits: trade size 16.
- .8 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over trade size 21.
- .10 Install fish cord in all empty conduits.
- .11 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .12 Dry conduits out before installing wire.
- .13 Flexible Conduit:
 - .1 Liquid-tight flexible conduit, not smaller than trade size 21 shall be used for final connections to all vibrating and/or mechanical equipment, including various systems' controls and related devices.
 - .2 Steel type connectors are to be used on flexible type conduits. Malleable type connectors are not permitted.
 - .3 A bonding conductor shall be installed inside each length of flexible conduit and terminated at each end to ensure bonding continuity through the flexible conduit.
- .14 EMT:
 - .1 Screw-on metal (malleable) type bushings are to be installed on all EMT connectors of trade size 35 and larger. To be installed prior to drawing-in conductors.

- .2 EMT connectors of trade size 27 and smaller do not require insulated throats nor any types of screw-on type bushings.
 - .3 Rain-tight EMT connectors and couplings are to be used. The use of “set-screw” connectors is not permitted.
 - .4 EMT raceway stub is to be off-set out of wall into accessible ceiling space of room containing flush installed device box and have steel EMT connector complete with plastic or grounding type bushings screwed on same. EMT plastic end cap bushings that are CSA approved may also be used.
 - .5 All EMT raceway wall stubs and associated boxes are to be adequately bonded to ground as per CEC requirements.
- .15 All various types of systems, including lighting and power, whose wiring is to be installed on any exposed types of surfaces are always to be completely installed in raceway as per the following guidelines:
- .1 Use EMT conduit in unfinished areas.
 - .2 Ceiling mounted conduit/raceway is to be secured directly to overhead structure.
 - .3 Wall mounted conduit/raceway is to be secured directly to, or directly on, exposed walls.

3.3 SURFACE RACEWAYS

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on surface channels.
- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED RACEWAYS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS UNDERGROUND

- .1 In buried ducts in accordance with Section 33 65 76 - Direct Buried Underground Cable Ducts.
- .2 Slope conduits to provide drainage.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 33 65 76 - Direct Buried Underground Cable Ducts.

Part 2 Products

2.1 CABLE PROTECTION

- .1 38 x 140 mm (trade size 2 in. x 6 in.) wood planks, pressure treated.

2.2 CABLE IDENTIFICATION

- .1 Mesh-type, detectable, marker system. The mesh shall have the following minimum specifications:
 - .1 Colour: red.
 - .2 Central longitudinal cord to provide visible element indicating the presence of the buried hazard.
 - .3 Integrated stainless-steel tracer wire, 0.8mm diameter, coated in black polypropylene. 1.3mm overall diameter.
 - .4 Mesh: five support elements,
 - .5 Exterior tapes: two, longitudinal.
 - .6 Overall width: 200mm minimum.
 - .7 Standard of acceptance: TechnoConso Plyage HzD, or equivalent.

Part 3 Execution

3.1 DIRECT BURIAL OF CABLES

- .1 Cables shall be buried to a depth (as measured from the top of the cable(s) to the surface of the land immediately surrounding the trench) that conforms with CSA 22.1-18 Table 53.
- .2 Prepare the trench with a bed of sand with a minimum thickness (depth) of 100 mm.
- .3 Lay cable(s) on the sand bed. Surround the cable(s) with 150 mm of sand above and on outer sides of the cable(s), and a minimum of 75 mm between adjacent cables.
 - .1 Do not pull cable into trench.
- .4 Fill the trench with native material.
 - .1 Native materials shall not contain rocks greater than 50 mm in diameter for the first 300 mm above the sand bed.
 - .2 Compact the backfill every 300 mm of depth.
- .5 Underground cable splices not acceptable.

- .6 Cable separation:
 - .1 Maintain 75 mm minimum separation between cables of different circuits.
- .7 Notify the Departmental Representative for field review upon completion of direct buried cables and obtain acceptance prior to backfill.

3.2 CABLE PROTECTION

- .1 Install continuous row of pressure treated 38 x 140 mm wood planks to cover length of run.
 - .1 The wood planks shall extend no less than 50 mm beyond the edge of the outermost cable on each side of the trench. Additional wood planks shall be installed as required.
 - .2 The wood planks shall be located 300 mm below the surface of the trench (as measured from the underside of the planks to the surface of the land immediately surrounding the trench).

3.3 CABLE IDENTIFICATION

- .1 Install mesh-type, detectable marker system to extend the entire length of the run.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
 - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Acceptance Tests:
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 29 10 - Motor Starters to 600V.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No. 100-14 (R2019), Motors and Generators.
 - .2 CSA C22.2 No. 145-11 (R2015), Electric Motors and Generators for Use in Hazardous Locations.

Part 2 Products

2.1 FRACTIONAL HORSEPOWER MOTOR

- .1 Non-hazardous locations: to CSA C22.2 No. 100.
- .2 Hazardous locations: to CSA C22.2 No. 145.
- .3 Motor with inherent overheating protectors.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install wiring, flexible connections and grounding.
- .2 Check rotation before coupling to driven equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 28 - Grounding – Secondary.
- .3 Section 26 24 16.01 - Panelboards Breaker Type.
- .4 Section 26 28 23 - Disconnect Switches – Fused and Non-Fused.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.29-15, Panelboards and Enclosed Panelboards.

Part 2 Products

2.1 EQUIPMENT

- .1 Fused disconnect switch: in accordance with Section 26 28 23 - Disconnect Switches - Fused and Non-Fused, rating as indicated.
- .2 Panelboard. Breaker type: in accordance with Section 26 24 16.01 - Panelboards Breaker Type, rating as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install service equipment.
- .2 Connect to incoming service or energy source.
- .3 Connect to outgoing load circuits.
- .4 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.42-10(R2015), General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-15, Special Use Switches.
 - .4 CSA C22.2 No.111-10(R2015), General-Use Snap Switches (Bi-national standard, with UL 20).

Part 2 Products

2.1 SWITCHES

- .1 15 A, 120 V, single pole, double pole, three-way, four-way switches to CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory toggle.
- .3 Toggle operated, 100% capacity rated for tungsten filament, LED and fluorescent lamps, and up to 80% capacity rated for motor loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles to CSA C22.2 No.42:
 - .1 CSA type 5-20 R, "T-Slot", 125 V, 20 A, U ground,
 - .2 Extra Heavy duty, spec grade.
 - .3 GFCI.
 - .4 Ivory urea moulded housing.
 - .5 Suitable for No. 10 AWG for back and side wiring.
 - .6 Eight back wired entrances, four side wiring screws.
 - .7 Triple wipe contacts and rivetted grounding contacts.

- .2 Simplex locking recessed male receptacle inlet to CSA C22.2 No.42:
 - .1 CSA type L5-20P, 125 V, 20 A, "Twistlock".
 - .2 Watertight, NEMA 4X, safety shroud.
 - .3 Neoprene/EPDM closure cap, attached to inlet.
 - .4 Impact resistant thermoplastic construction, spec grade.
 - .5 Stainless steel mounting fasteners.
 - .6 Suitable for No. 8 AWG, back wiring.
 - .7 Certified for current interrupting at full rated current
 - .8 Suitable for installation in wet locations as defined by CSA 22.1, rule 26-708.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 GFCI receptacles as required.

2.3 ATTACHMENT PLUG

- .1 Simplex locking female plug to CSA C22.2 No.42:
 - .1 CSA type L5-20R, 125 V, 20 A, "Twistlock".
 - .2 Watertight, NEMA 4X, safety shroud.
 - .3 Neoprene/EPDM closure cap, attached to plug.
 - .4 Neoprene diaphragm seal for cord entry.
 - .5 Impact resistant thermoplastic construction, spec grade.
 - .6 Suitable for No. 10 AWG, back wiring.
 - .7 Certified for current interrupting at full rated current
- .2 Other plugs with ampacity and voltage as indicated.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Nylon ivory cover plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Heavy duty, weatherproof cover plates, complete with gaskets for receptacles as indicated.
- .6 Cover plates from one manufacturer throughout project.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.

- .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .3 Pig-tail type leads are to be installed on conductors in all device or outlet boxes where feeding through to other receptacles. Daisy-chain or looping through of conductors from one device to another is not acceptable. Provide separate pig-tail conductor leads for final termination to each receptacle for phase, neutral and bond conductors.
 - .4 Provide GFCI receptacles as indicated.
 - .5 Receptacles installed in outdoor locations shall comply with and be suitable for installation in wet locations as defined by CSA 22.1, rule 26-708.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 24 16.01 - Panelboards Breaker Type.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 The use of tandem circuit breakers is not acceptable.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .6 When installed in panelboards or switchboards, the manufacturer of the circuit breakers shall be the same as the manufacturer of the panelboard or switchboard.
- .7 Each circuit breaker mounted in a switchboard shall be equipped with individual padlocking facility such that the circuit breaker may be locked in the open position and may not be moved to the closed position while the padlock is in place.
- .8 All devices, equipment, and systems must be capable of off-season storage in-place without supplemental heat, and without the need to "winterize" any item(s).

2.2 THERMAL MAGNETIC BREAKERS DESIGN A

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 OPTIONAL FEATURES

- .1 Include:

- .1 On-off locking device.
- .2 Handle mechanism.

2.4 ACCEPTABLE MANUFACTURERS

- .1 Eaton.
- .2 Schneider Electric.
- .3 Siemens.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.4-16, Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMJ-J-162-2004 and UL 98).
 - .2 CSA C22.2 No.39-13, Fuseholder Assemblies.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Horsepower rated, fusible, heavy duty, disconnect switch to CAN/CSA-C22.2 No.4 size as indicated.
 - .1 In CSA 12 dust-tight enclosure, or as indicated elsewhere.
- .2 Provision for padlocking in ON and OFF switch positions by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01- Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39, relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

2.2 DOUBLE-THROW SWITCHES

- .1 Non-fusible, double-throw 'change-over' switch to CAN/CSA-C22.2 No.4 size as indicated.
 - .1 In CSA 1 general-purpose enclosure, or as indicated elsewhere.
- .2 1-pole or 2-pole as indicated.
- .3 240 VAC, 30 AMP, or as otherwise indicated.
- .4 ON-OFF-ON switch position.
- .5 Provision for padlocking in OFF position by 3 locks.
- .6 Mechanically interlocked door to prevent opening when handle in either ON position.
- .7 Quick-make, quick-break action.
- .8 Switch position indication on switch enclosure cover.

2.1 SOLAR PHOTOVOLTAIC SYSTEM DISCONNECT SWITCHES

- .1 Comply with CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations, section 64.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

2.3 ACCEPTABLE MANUFACTURERS

- .1 Eaton.
- .2 Schneider Electric.
- .3 Siemens.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 80 - Fractional Horsepower Motors.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No. 14-18, Industrial Control Equipment.

Part 2 Products

2.1 MATERIALS

- .1 Starters: to CSA C22.2 No. 14.

2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type, and rating as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 One overload heater, manual reset, trip indicating handle.
 - .3 CSA 1 general purpose enclosure.
- .2 Accessories:
 - .1 Toggle switch: standard, labelled as indicated.
 - .2 Indicating light: no indicating light.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.

- .2 Install and wire, starters and controls as indicated.
- .3 Confirm motor nameplate and select or adjust overload device to suit.
- .4 Manual Motor Starters:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 03 30 00 - Cast-In-Place Concrete.
- .5 Section 26 05 00 - Common Work Results for Electrical.
- .6 Section 26 05 21 - Wires and Cables (0-1000 V).
- .7 Section 26 05 22 - Connectors and Terminations.
- .8 Section 26 05 28 - Grounding – Secondary.
- .9 Section 26 28 23 - Disconnect Switches - Fused and Non-Fused.
- .10 Section 26 32 13.02 - Power Generation to 50 kW.
- .11 Section 26 32 13.03 - Installation of Electric Power Generation Equipment.
- .12 Section 26 33 16 - Batteries and Battery Racks.
- .13 Section 26 33 43 - Battery Chargers.

1.2 REFERENCE STANDARDS

- .1 International Electrotechnical Commission
 - .1 IEC 61215 2016, Terrestrial photovoltaic (PV) modules.
 - .2 IEC 61701 2011, Salt mist corrosion testing of photovoltaic (PV) modules.
 - .3 IEC 62548 2016, Photovoltaic (PV) arrays – Design Requirements.

1.3 COORDINATION OF SPECIFICATIONS

- .1 The renewable energy system requires the coordination of many design elements and specifications including, but not limited to:
 - .1 Section 26 31 00 - Solar PV
 - .2 Section 26 32 13.02 - Power Generation to 50 kW.
 - .3 Section 26 32 13.03 - Installation of Electric Power Generation Equipment
 - .4 Section 26 33 16 - Batteries and Battery Racks.
 - .5 Section 26 33 43 - Battery Chargers.

1.4 PRODUCT DATA

- .1 Provide product data in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review:

- .1 Single line electrical diagrams for the solar PV electrical distribution systems.
- .2 Solar power design report produced by PVSyst indicating the input design parameters, quantities of each component (solar panel, battery, inverter/charger, etc.), and specifications for each component.
 - .1 Written statement from the contractor that the contractor's solar power renewable energy installation and generator will meet the design intent and support the loads and the load profile as indicated in the drawings and specifications.
- .3 Shop drawings for all components of the solar PV system including, but not limited to, solar module, solar module mounting assembly, solar module array support structure, solar module array support structure foundations/footings, battery, battery rack, charge controller, inverter/charger, converters, and disconnect switches.
- .4 Supporting documentation illustrating interconnectivity of power and controls between the generator, inverter/charger, solar panels and batteries.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance materials (spare parts) in accordance with Section 01 78 00 - Closeout Submittals. Materials shall be new, previously unused, and in the manufacturer's original packaging.
- .2 Include:
 - .1 One complete solar panel.
 - .2 One DC combiner box.
 - .3 One battery.
 - .4 One set of each type/length/size of battery cable with terminals.
 - .5 One solar PV array inverter of each type.
 - .6 One battery inverter/charger of each type.
 - .7 One DC Disconnect switch of each type.
 - .8 Special tools for unit servicing (if required).
- .3 Provide conclusive evidence that Canadian distributor has been established and will stock in Canada spare parts likely to be required during normal life of engine.

1.7 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: submit operation and maintenance data for the Solar PV system for incorporation into manual.
 - .1 Operation and maintenance instructions concerning component functions and maintenance requirements to permit effective operation, maintenance and repair.
 - .2 Factory test records.
 - .3 List of recommended spare parts to be stocked by the Owner to facilitate rapid repair of the solar PV system components in the event of damage or failure.
 - .1 As a minimum, include the following items:
 - i. Solar panel.
 - ii. Solar panel mounting structure module.
 - iii. DC Combiner box.
 - iv. DC Disconnect switch of each type.

- v. Battery.
- vi. Battery cables, terminals and clamps.
- vii. Solar PV array inverter of each type.
- viii. Battery inverter/charger of each type.
- .2 Parts lists with catalogue numbers and names and addresses of suppliers.
- .3 Include itemised list of current cost of each item in Canadian currency, including freight, duties and delivery costs, excluding taxes.

Part 2 Design and Performance Requirements

2.1 TERMINOLOGY

- .1 Nominal battery capacity: the published nameplate rated capacity of the battery.
- .2 Useable battery capacity: the capacity of the battery allowing for derating due to temperature, efficiency and other factors.
- .3 Utilisation equipment: the loads supplied from the electrical power distribution system.
- .4 Solar panel, solar module: an assembly of connected solar photovoltaic cells into a single panel that absorbs light to generate electrical energy.
- .5 Solar array, PV array: a collection of solar panels assembled and connected to create a common array mounted on a support structure, erected and optimally oriented to receive incident solar radiation.

2.2 GENERAL

- .1 The Solar PV Renewable Energy Systems supply AC power to their loads and are supported by solar photovoltaic cells (solar panels), storage batteries and generators, and shall be supplied to coordinate fully with each component of each system.
- .2 The Contractor shall evaluate, design, deliver, supply, install, set-up, test and commission the Solar PV Renewable Energy Systems to supply the electrical loads located at the site. This shall include all civil, structural, electrical, mechanical and miscellaneous devices, equipment, services, labour and systems to support the Solar PV Renewable Energy Systems.
- .3 The nominal utilisation equipment (the loads) that are to be supplied from the renewable energy solar photovoltaic system are listed on the drawings. The contractor shall coordinate with suppliers, vendors and other trades to revise the equipment load specifications and supply voltage and current requirements to ensure that the equipment selected will be supported by the renewable energy solar photovoltaic system.
- .4 The installation will consist of two separate systems that will operate independently while sharing some assets.
 - .1 System 1. This system consists of solar panels, rechargeable batteries, propane-fuelled generator, propane storage tanks and piping, PV array inverter, battery charger/inverter and all ancillary devices and systems including (but not limited to) support structures; wires, cables and raceways, disconnects, power distribution panelboards, etc. This system supplies renewable energy to all areas of the site except those supplied from System 2.
 - .2 System 2. This system consists of solar panels, rechargeable batteries, propane-fuelled generator, propane storage tanks and piping, PV array inverter, battery charger/inverter and all ancillary devices and systems including (but not limited

to) support structures; wires, cables and raceways, disconnects, power distribution panelboards, etc. This system supplies energy to the Water Treatment Plant.

- .5 System 1 and System 2 will not be electrically interconnected and will not be connected to the utility.
- .6 Propane-fuelled generators will be used to supplement the power supply to System 1 and System 2. The intent is to use the generator as infrequently as possible in order to minimize the noise and combustion products emitted by the generators. The generator will be used only when there is insufficient energy provided by the solar panels or stored in the batteries to supply power to the inverter. The electrical output of each generator shall be connected to the input of the battery inverter/charger. The generator shall be controlled by start/run/stop commands from the battery inverter/charger. The contractor shall ensure that the design and specification of the solar panels, PV array inverter, battery charger/inverter, batteries and generator are coordinated to provide a fully functional system to supply uninterrupted electrical power. Generally, the principle of operation will be:
 - .1 Loads are supplied from the PV Array inverter, the battery inverter/charger or the generator through one or more distribution panelboards.
 - .2 The PV Array inverter receives energy from the solar panels and delivers power to the 120V or 240V loads.
 - .3 The battery inverter/charger receives energy from the storage batteries or the generator and delivers power to the 120V or 240V loads.
 - .4 The batteries are charged from the battery inverter/charger when the demand of the loads is met by the solar photovoltaic panels, and excess energy is available. The batteries may also be charged from the generator.
 - .5 The loads receive supplemental power from the batteries if the energy available from the solar panels is insufficient to meet the electrical demand.
 - .6 The battery inverter/charger causes the generator to run and supply power to the battery inverter/charger if the energy stored in the batteries falls below a present amount, and there is insufficient energy available from the solar panels to meet the electrical demand. The generator continues to run until the energy stored in the batteries reaches a preset amount.

2.3 DESIGN AND PERFORMANCE REQUIREMENTS - GENERAL

- .1 The design shall meet the Nova Scotia Building Code and the Canadian Electrical Code.
- .2 The system shall operate isolated from any utility source.
- .3 The types, capacities, ratings, and dimensions of many of the components shown on the drawings and included in the specifications are based on a generic design using assumed data. The contractor shall review, verify and revise the types, capacities and ratings to suit the equipment selected by the contractor. Revisions may include (but are not limited to) types and quantities of solar PV equipment, generator ratings, circuit breaker ratings, conductor sizes, cable sizes, raceway sizes, etc. The contractor shall submit proposed changes to the Departmental Representative in accordance with section 1.4 ACTION AND INFORMATIONAL SUBMITTALS above, and receive written approval to proceed prior to procurement and installation of materials.
- .4 Solar panels shall be grouped together in a solar module array that is enclosed in a perimeter fence of a construction, size and dimensions to prevent access to all but authorized personnel.

- .5 The solar module array configuration and orientation shall be designed and optimized for energy production over the course of the operating season. Selection of solar module technology shall be based on the optimum cost-effective solution considering construction costs, energy output, and operation and maintenance costs.
 - .1 Primary operating season: 1 May to 31 October.
 - .2 Occasional-use operating season: 1 November to 30 April.
 - .3 Maximum incident solar radiation shall be assumed to occur for 3.5 hours each day during the operating season.
 - .4 Geographic location: 46.63427 degrees N, -61.00918 degrees E, 100 metres above sea level.
 - .5 Full solar illumination of the solar modules (zero shadowing) between 2 hours before and 2 hours after peak solar altitude during the primary operating season.
- .6 The solar module array shall be oriented as follows:
 - .1 General location and approximate orientation as indicated on the drawings.
 - .2 Solar module dimensions of 2m long and 1m wide.
 - .3 Solar modules stacked 2-high erected in two or more parallel rows.
 - .4 Solar module tilt of 45 degrees from the horizontal.
 - .5 Solar modules aligned to face 195 degrees (azimuth) from true (geodetic) north.
 - .6 The separation between rows of solar modules, and between a row and any obstruction that may place the solar modules in shadow shall be a minimum of 2.8m.
 - .7 The angle measured perpendicular to the lowest edge on the active (energy gathering) face of any solar module to the top of any obstruction shall not be greater than 22.3 degrees measured from the horizontal.
 - .8 The separation between the solar module array perimeter fence and the lowest edge of the active (energy gathering) face of the solar modules nearest the fence shall be sufficient to prevent the lowest edge of the active face from being in shadow during the operating season.
 - .9 The contractor shall confirm that the separation is adequate to provide full solar illumination of the solar modules, and shall supply supporting documentation.
- .7 All devices, systems, and equipment must function satisfactorily during the operating seasons, and, when not in operation, out-of-season under the environmental conditions that are present at the site and that may reasonably be expected to be encountered at the site. This shall include allowances for the proximity to a marine environment, and Les-Suêtes winds. The contractor is advised to consult Environment Canada to determine the magnitude, direction, duration and frequency of the winds to ensure that the systems and their support structures and foundations will meet the design, performance and warranty requirements.
- .8 All devices, equipment, and systems must be capable of off-season storage in-place without supplemental heat, and without the need to “winterize” any item(s). Devices shall be selected to give priority to long life as stated in Part 3 WARRANTY.
- .9 Access to solar panels, batteries, inverters, concentrators, controllers, and all associated equipment by unauthorized persons shall be prevented at all times by the use of fencing with locked gates, or locked buildings. Such methods of access control shall comply with the Canadian Electrical Code and bulletins issued by the authority having jurisdiction.
- .10 Batteries, battery racks and inverter/chargers shall be located inside Building ‘H’.

- .11 The renewable energy solar photovoltaic system shall include lightning surge arrestors as additional protection in the inverters.
- .12 A maximum DC average voltage drop of 1%; inclusive of string PV source circuits and PV output circuits. DC Voltage Drop = Average PV Source Circuit Voltage Drop + Average PV Output Circuit Voltage Drop.
- .13 A maximum AC average voltage drop of 1.5%; inclusive of all AC cables. AC Voltage Drop = Average Inverter Cable Voltage Drop + Average Sub Panel Cable Voltage Drop + Average Transformer Cable Voltage Drop.
- .14 Storage batteries shall not discharge below 50% of nominal ampere-hour capacity under normal operating conditions, and except as noted in these specifications.
- .15 The contractor shall coordinate with electrical, structural and architectural trades professionals to ensure that the buildings and structures are capable of safely supporting and containing the solar modules, batteries, chargers, inverters, and other devices, systems and equipment, and for all environmental conditions as noted.

2.4 PERFORMANCE REQUIREMENTS – SYSTEM 1

- .1 System 1 shall supply power to the existing and new buildings on the site with the exception of the Water Treatment plant in Building ‘C’. There shall be no interconnection with System 2.
- .2 The Solar PV Renewable Energy System and associated components shall be designed and built to produce:
 - .1 An ac system voltage of 120/240 VAC, 60 Hz, 1-phase 3-wire, grounded.
 - .2 A dc system voltage of 48 VDC.
 - .3 A nominal minimum 19 kWh (average daily consumption).
 - .4 A nominal peak load of 7 kW.
 - .5 Refer to the drawings for the most current data. Consumption and load data shown on the drawings shall prevail.
- .3 The contractor may use the existing components previously installed at the site subject to evaluation of suitability for intended purpose, capacity, and condition:
 - .1 Solar panels. Jinko JKM360M-72V.
 - .2 Batteries: Rolls S6-460AGM, and associated interconnecting conductors.
 - .3 Battery rack.
 - .4 Distribution panelboard “P-1”
- .4 The contractor shall not use the following existing components previously installed at the site:
 - .1 Solar module array support post, foundation and supplemental anchors and straps.
 - .2 DC Combiner Box.
 - .3 Conduits between the solar module array and the inverter/charger.
 - .4 Conductors between the solar module array DC Combiner Box and the inverter/charger.
- .5 Where required, additional components of each type shall be the same as the existing components that are re-used:
 - .1 Solar panels. Jinko JKM360M-72V.

- .2 Batteries: Rolls S6-460AGM.
- .6 The forecasted energy production is to be shown in PVSyst using as-built conditions and typical mean year meteorological data for Chéticamp, Nova Scotia. The final energy production forecast is to use actual design parameters, calculated losses, and specifications of the installed equipment. Prepare and submit to the Departmental Representative the PVSyst solar power design report.
- .7 The PV Array inverter shall be configured to accept power input from
 - .1 The solar panels.
- .8 The battery inverter/charger shall be configured to accept power input from
 - .1 The 48VDC battery banks.
 - .2 The 120/240V generator.
 - .3 The 120V/240V distribution bus.
- .9 Alternate renewable energy arrangements and configurations will be considered subject to review and acceptance by the Departmental Representative prior to procurement.
- .10 The PV Array inverter and the battery inverter/charger shall be configured to deliver
 - .1 120/240VAC 1-phase 3-wire, grounded power to the existing panelboard "P-1" in Building H.
 - .2 48VDC to the System 1 batteries.
- .11 The batteries, when charged to 95% of useable battery capacity, shall be capable of supplying the loads for up to 48 hours without generator or solar input and without the batteries falling below 50% of useable battery capacity.
- .12 The solar panels, when exposed to sunlight as previously indicated, shall be capable of supplying the loads and maintaining the battery charge over a 24 hour period.
- .13 When battery capacity falls to 60% or less of useable battery capacity, the generator shall:
 - .1 Start, run and stop automatically,
 - .2 Supply the loads,
 - .3 Divert excess generator electrical output not required to supply the loads into recharging the batteries to 95% of useable battery capacity within 24 hours of useable battery capacity falling to 60%,
 - .4 Operate only between the hours of 9 am and 5 pm.

2.5 PERFORMANCE REQUIREMENTS – SYSTEM 2

- .1 System 2 shall supply power to the Water Treatment plant in Building 'C'. There shall be no interconnection with System 1.
- .2 The Solar PV Renewable Energy System and associated components shall be designed and built to produce:
 - .1 An ac system voltage of 120/240 VAC, 60 Hz, 1-phase 3-wire, grounded.
 - .2 A dc system voltage of 48 VDC.
 - .3 A nominal minimum 41 kWh (average daily consumption).
 - .4 A peak load of 29 kW.

- .5 Refer to the drawings for the most current data. Consumption and load data shown on the drawings shall prevail.
- .3 The contractor may use the existing components previously installed at the site subject to evaluation of suitability for intended purpose, capacity, and condition:
 - .1 Solar panels. Jinko JKM360M-72V.
 - .2 Batteries: Rolls S6-460AGM, and associated interconnecting conductors.
 - .3 Battery rack.
 - .4 Distribution panelboard "PP-C"
- .4 The contractor shall not use the following existing components previously installed at the site:
 - .1 Solar module array support post, foundation and supplemental anchors and straps.
 - .2 DC Combiner Box.
 - .3 Conduits between the solar module array and the inverter/charger.
 - .4 Conductors between the solar module array DC Combiner Box and the inverter/charger.
- .5 Where required, additional components of each type shall be the same as the existing components that are re-used:
 - .1 Solar panels. Jinko JKM360M-72V.
 - .2 Batteries: Rolls S6-460AGM.
- .6 The forecasted energy production shall be shown in PVSyst using as-built conditions and typical mean year meteorological data for Chéticamp, Nova Scotia. The final energy production forecast is to use actual design parameters, calculated losses, and specifications of the installed equipment. Prepare and submit to the Departmental Representative the PVSyst solar power design report.
- .7 The PV Array inverter shall be configured to accept power input from
 - .1 The solar panels.
- .8 The battery inverter/charger shall be configured to accept power input from
 - .1 The 48VDC battery banks.
 - .2 The 120/240V generator.
 - .3 The 120V/240V distribution bus.
- .9 Alternate renewable energy arrangements and configurations will be considered subject to review and acceptance by the Departmental Representative prior to procurement.
- .10 The PV Array inverter and the inverter/charger shall be configured to deliver
 - .1 120/240VAC 1-phase 3-wire, grounded power to the existing panelboard "PP-C" in Building C.
 - .2 48VDC to the System 2 batteries.
- .11 The batteries, when charged to 95% of useable battery capacity, shall be capable of supplying the loads for up to 48 hours without generator or solar input and without the batteries falling below 50% of useable battery capacity.
- .12 The solar panels, when exposed to sunlight as previously indicated, shall be capable of supplying the loads and maintaining the battery charge over a 24 hour period.

- .13 When battery capacity falls to 60% or less of useable battery capacity, the generator shall:
 - .1 Start, run and stop automatically,
 - .2 Be capable of supplying the loads,
 - .3 Divert excess generator electrical output not required to supply the loads into recharging the batteries to 95% of useable battery capacity within 24 hours of useable battery capacity falling to 60%,
 - .4 Operate only between the hours of 9 am and 5 pm.

Part 3 Products and Execution

3.1 EQUIPMENT REQUIREMENTS

- .1 All equipment shall be CSA certified, or certified by a testing laboratory acceptable to the province of Nova Scotia. The use of the CSA Special Inspection service to certify equipment will not be acceptable.
- .2 Warranty. The warranty period shall commence from the date of substantial performance and shall apply to new components devices and systems, and any existing components devices and systems used for System 1 and System 2.
 - .1 Installation workmanship: 2 years.
 - .2 Solar module: 25 years performance rating: 10 years.
 - .3 Solar array inverter: 10 years
 - .4 Battery inverter/charger: 5 years
 - .5 Solar module supports and racking: 20 years

3.2 SOLAR PHOTOVOLTAIC MODULE WIRING

- .1 Comply with CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations, section 64.
- .2 Conductors: sun resistant and not placed in continuous direct sunlight.
- .3 Connectors: Use components of one manufacturer throughout.

3.3 SOLAR ARRAY INVERTER

- .1 Bankable.
 - .1 Minimum of two inverters operating in parallel for each system.
- .2 Pure sine wave inverter.
- .3 AC output voltage to match system voltage.
- .4 THD_V: <4%.
- .5 Minimum 98% CEC efficiency.
- .6 Multifunction digital display.
- .7 DC disconnect and DC reverse polarity protection.
- .8 Ground fault monitoring.

- .9 AC short-circuit protection.
- .10 Arc fault circuit interrupter.
- .11 Indoor, lockable general-purpose CSA 1 enclosure.
- .12 Integral disconnects.
- .13 Operating and idle temperature range: -25 degrees C to +40 degrees C.
- .14 Comply with CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations, section 64.
- .15 Standard of acceptance: Outback Power, SMA Sunny Boy, or equivalent.

3.4 BATTERY INVERTER/CHARGER

- .1 Bankable.
 - .1 Minimum of two inverters operating in parallel for each system.
- .2 Compatible with the selected battery type, voltage and charging current.
- .3 Compatible with the selected generator.
- .4 Pure sine wave inverter.
- .5 AC output voltage to match system voltage.
- .6 THD_V: <3%.
- .7 Rated battery input voltage: 48 VDC.
- .8 Battery charging current: 85A, not to exceed battery's charging current rating.
 - .1 Charge protection with automatic full charge and equalisation charge.
- .9 Minimum 94% CEC efficiency.
- .10 Multifunction digital display.
- .11 DC reverse polarity protection.
- .12 AC short-circuit and overload protection.
- .13 Battery over-temperature protection.
- .14 Battery deep discharge protection.
 - .1 Adjustable/programmable between 40% and 60%.
- .15 Generator control and support.
 - .1 Adjustable/programmable time of day control.
- .16 Indoor, lockable general-purpose CSA 1 enclosure.
- .17 Integral disconnects.
- .18 Operating and idle temperature range: -25 degrees C to +40 degrees C.
- .19 Comply with CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations, section 64.
- .20 Standard of acceptance: Outback Power, SMA Sunny Boy, or equivalent.

3.5 SOLAR PANEL

- .1 Application class "A" or "C".

- .2 Minimum module power rating of 360W STC.
- .3 Monocrystalline.
- .4 Passive Emitter Rear Contact (PERC) technology.
- .5 Low-light performance and severe weather and extreme environment resiliency.
- .6 Standard of acceptance: Canadian Solar, Jinko or equivalent.
- .1 Solar modules for both systems shall be from a single manufacturer and of the same type.

3.6 SOLAR ARRAY SUPPORTS

- .1 Solar module supports and racking: ground mounted supported from multiple support legs.
- .2 Penetrating, non-ballasted.
- .3 Rust proof.
- .4 Wind tunnel tested.
- .5 Permit water to flow underneath.
- .6 Includes protective padding under the racking. Standard of acceptance: Schletter-Group Open Area or equivalent.

3.7 COMBINER BOXES, DISCONNECTS, JUNCTION BOXES AND SUB-PANELS

- .1 Steel enclosure.
- .2 Indoor (CSA 1, general purpose) or outdoor (CSA 4X, water-tight for corrosive atmospheres) rated according to location.

3.8 EXECUTION

- .1 The contractor is to carry-out the final design, procurement, installation, and commissioning of the renewable energy solar photovoltaic systems.
- .2 Examine areas and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the work. Proceed with installation only after unsatisfactory conditions have been corrected.
- .3 Examine area to verify actual locations of equipment, cable lengths and routing before equipment installation.
- .4 Dismantle, disconnect, remove and salvage components from the existing solar photovoltaic system, as appropriate. Remove the existing array mounting post and foundation.
- .5 Install the renewable energy solar photovoltaic system in the approximate locations shown on the drawings and in conjunction with the Owner's representative. Ground-mounted solar arrays shall be aimed and aligned to suit site conditions and the design parameters for optimum energy collection.
- .6 Install all equipment per manufacturers' manuals and instructions.
- .7 Install the renewable energy solar photovoltaic system support systems, combiner boxes, disconnects, batteries, battery racks, inverters, controllers, chargers, conductors, cables and other devices in the approximate location shown on the drawing.

- .8 Install all solar panels and complete panel to panel interconnections in series using panel manufacturer approved connectors, providing jumper cables and connectors when required.
- .9 Place string cables behind the solar panels. Coil the excess cable. Secure the cable to the metal frame racking with heavy-duty sunlight resistant zip tie or approved clips at 80cm spacing.
- .10 All conductors should be mechanically protected, fastened, and routed professionally with cable management fasteners. Conductors should be kept clear of sharp edges and roofing material.
- .11 Do not use metallic LB, LL or LR fittings. Provide goose neck bends where possible.
- .12 Do not exceed the minimum bending radius of the cables.
- .13 Provide weather resistant labeling for all string wiring, at both ends, installed between the array and the harness, UV resistant if exposed to the sun.
- .14 Install complete DC system grounding, including panels, racking systems, combiner boxes as per CSA requirements, local electrical code, and manufacturer specifications.
- .15 Install complete AC system grounding as per single line diagrams, CSA requirements, local electrical code, and manufacturer specifications.
- .16 Install the AC power distribution panelboard and grounding electrodes in the approximate location shown on the drawing.
- .17 Seal all ends of exposed conduits to prevent ingress of dirt, debris, moisture, etc.
- .18 The use of overhead power distribution conductors will not be permitted.
- .19 Provide weather resistant labeling and signage as per code requirements and the requirements of the authority having jurisdiction.

3.9 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Service. Engage and pay for a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- .2 Perform tests and inspections with the assistance of a factory-authorized service representative.
- .3 Submit legible red-lines of construction drawings in Adobe Acrobat™ PDF format upon completion of construction, highlighting changes.
- .4 Renewable energy solar photovoltaic system equipment will be considered defective if it does not pass tests and inspections.
- .5 Prepare written test and inspection reports and submit to the Owner's representative.

3.10 STARTUP, COMMISSIONING AND TRAINING SERVICES

- .1 Engage and pay for a factory-authorized service representative to perform startup services. Complete installation and startup checks per manufacturer's written instructions.
- .2 Engage and pay for a factory-authorized service representative to provide training on the system, including first-level diagnostic and trouble-shooting practices. Provide in accordance with Section 26 05 00 - Common Work Results for Electrical.

- .3 Submit drawings, equipment warranties and manuals in a binder to the owner. Submit three printed copies.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 31 00 - Solar PV
- .3 Section 26 32 13.03 - Installation of Electric Power Generation Equipment
- .4 Section 26 33 16 - Batteries and Battery Racks.
- .5 Section 26 33 43 - Battery Chargers.

1.2 REFERENCE STANDARDS

- .1 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA MG1, Motors and Generators.
- .2 Canadian Environmental Protection Act (CEPA)
 - .1 CCME PN 1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
- .3 CSA International
 - .1 CSA C22.2, No. 14-M91 Industrial Control Equipment.
 - .2 CSA C22.2 No.100-14, Motors and Generators.
- .4 International Electrotechnical Commission.
 - .1 IEC8528 part 4, Control Systems for Generator Sets.
 - .2 IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
- .5 International Organization for Standardization (ISO)
 - .1 ISO 3046-1, 2002, Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations of Power, Fuel and Lubricating Oil Consumptions, and Test Methods - Additional requirements for engines for general use.
- .6 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S601, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.

1.3 COORDINATION OF SPECIFICATIONS

- .1 The renewable energy system requires the coordination of many design elements and specifications including, but not limited to:
 - .1 Section 26 31 00 - Solar PV

- .2 Section 26 32 13.02 - Power Generation to 50 kW.
- .3 Section 26 32 13.03 - Installation of Electric Power Generation Equipment
- .4 Section 26 33 16 - Batteries and Battery Racks.
- .5 Section 26 33 43 - Battery Chargers.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Refer to Section 26 05 00 - Common Work Results for Electrical. Make all submissions in accordance with Section 26 05 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and data sheets for power generators and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 List of recommended spare parts to be stocked by the Owner to facilitate rapid repair of the generator in the event of damage or failure.
 - .1 As a minimum, include the following items:
 - i. Lubricating Oils and greases;
 - ii. Coolant, or coolant antifreeze additive;
 - iii. Filter(s);
 - iv. Engine starter;
 - v. Battery;
 - vi. Battery cables;
 - vii. Radiator hoses;
 - .2 Include current cost of each item in Canadian currency, including freight, duties and delivery costs, excluding taxes.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Nova Scotia, Canada, and include:
 - .1 Factory published specification sheet.
 - .2 Manufacturer's catalog cut sheets of all auxiliary components such as battery charger, control panel, enclosure, etc.
 - .3 Weights of all equipment.
 - .4 Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
 - .5 Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
 - .6 Dimensioned drawing of set including engine, alternator, control cubicle, exhaust system, fuel system and accessories.
 - .7 Line diagram showing alternator, control cubicle, manual bypass switch, voltage regulator, battery, battery charger, governor specifications.
 - .8 Diagram for automatic engine ventilation.

- .9 Flow diagrams for:
 - .1 Fuel.
 - .2 Lubricating oil.
 - .3 Cooling air.
- .10 Continuous full load output at 0.8 power factor lagging.
- .11 Type and make of governor.
- .12 Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at the specified site conditions with the specified loads.
- .13 Manufacturer's and dealer's written warranty.
- .14 British standard or DIN rating of engine.
- .15 Set operation:
 - .1 Automatic starting and shut down from external controls input.
 - .2 Manual starting.
 - .3 Automatic shut down on over cranking, overspeed, high engine temperature, low lube oil pressure, short circuit and alternator over voltage.

1.5 CLOSEOUT SUBMITTALS

- .1 Refer to Section 26 05 00 - Common Work Results for Electrical. Make all submissions in accordance with Section 26 05 00.
- .2 Operation and maintenance instructions for engine, alternator, control panel, battery charger, fuel system and accessories to permit effective operation, maintenance and repair.
- .3 Technical data:
 - .1 Illustrated parts lists with parts numbers.
 - .2 Schematic diagram of electrical controls
 - .3 Flow diagrams for fuel, lube oil and cooling air.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals. Deliver to site and turn over to Departmental Representative.
- .2 Include for each generator:
 - .1 Two fuel filter replacement elements (if equipped).
 - .2 Two lube oil filter replacement elements.
 - .3 Two air cleaner filter elements.
 - .4 One MAIN circuit breaker.
 - .5 One battery.
 - .6 One set of battery cables and terminals.
 - .7 One set of radiator hoses.
 - .8 Two spare keys for enclosure door locks.

- .9 Special tools for unit servicing (if required).
- .3 Provide conclusive evidence that Canadian distributor has been established and will stock in Canada spare parts likely to be required during normal life of engine.

Part 2 Products

2.1 SYSTEM DESCRIPTION - GENERAL

- .1 The Solar PV renewable energy system supplies AC power to its loads and is supported by storage batteries and a generator, and shall be supplied to coordinate fully with each component of that system.
- .2 Generator set consists of:
 - .1 Engine.
 - .2 Alternator.
 - .3 Main circuit breaker, 100%-rated.
 - .4 Control cubicle and controls system.
 - .5 Battery and engine-driven battery charger.
 - .6 Automatic ventilation equipment.
 - .7 Fuel supply system.
 - .8 'Critical' engine exhaust system with silencer/muffler and insulation.
 - .9 Antifreeze, ethylene glycol.
 - .10 Fault annunciator.
 - .11 Corrosion-free weather-proof and environment resistant 'Critical' sound attenuating enclosure.
 - .12 Mounting base.
- .3 In order to minimize the load on the solar PV system, the generator shall not be equipped with:
 - .1 Externally supplied battery charger.
 - .2 Externally supplied block heater, coolant heater, jacket heater or other heater.
 - .3 Externally supplied ventilation, ventilation dampers, etc.
 - .4 Externally supplied lighting.
- .4 Set designed and rated for intermittent-operation service to operate unattended in remote location for the duration of the site's operating season.
- .5 All devices, equipment, and systems must be capable of
 - .1 Off-season storage in-place without supplemental heat, and without the need to "winterize" any item(s).
 - .2 Resistance to a maritime environment.
 - .3 Resistance to Les Suêtes winds.
- .6 The types, capacities, ratings, and dimensions of many of the components shown on the drawings and included in the specifications are based on a generic design using assumed data. The contractor shall review, verify and revise the types, capacities and ratings to

suit the equipment selected by the contractor. Revisions may include (but are not limited to) quantities of solar PV equipment, generator ratings, circuit breaker ratings, conductor sizes, cable sizes, raceway sizes, etc. The contractor shall submit proposed changes to the Departmental Representative in accordance with section 1.3 ACTION AND INFORMATIONAL SUBMITTALS above, and receive written approval to proceed prior to procurement and installation of materials.

2.2 GENERATING SET - GENERAL

- .1 Capacity:
 - .1 Total output of engine in hp (brake) = British standard rating as defined to ISO 3046-1 expressed in hp (brake), minus the sum of the following:
 - .1 Power to drive cooling fan.
 - .2 Power loss for site conditions.
 - .2 Site conditions, de-rate and make allowance in all respects for:
 - .1 Proximity to maritime environment.
 - .2 Les Suêtes winds.
 - .3 Ambient temp:
 - .1 Operating season: minus 15 degrees C to plus 40 degrees C.
 - .2 Storage (in place) season: minus 30 degrees C to plus 20 degrees C.
 - .3 Generator rating in kW x 1.34 divided by generator efficiency.
- .1 Engine: to ISO 3046-1, liquified petroleum (LP) gas (propane), operating speed 1800 rpm, air or liquid cooled:
 - .1 Air cooled: pressure cooled with engine driven direct drive blower.
 - .2 Liquid cooled: radiator with engine driven fan and ethylene glycol anti-freeze non-sludging above minus 46 degrees C.
 - .3 The fuel delivery and control system shall be integral with the engine. A flexible fuel line shall be plumbed to the generator set skid base for ease of connection. A secondary gas pressure regulator shall be installed integral to the generator set package capable of regulating the incoming gas pressure.
 - .4 Starting system:
 - .1 12 V dc motor, remote control, 12 V storage battery of sufficient capacity to crank engine for 3 min at minus 15 degrees C without using more than 25% battery capacity.
 - .5 Battery charger: on-board alternator supplied, constant voltage, solid state.
 - .6 Governor:
 - .1 Mechanical hydraulic with:
 - .1 Steady state speed band of +/-0.5%.
 - .2 Speed regulation no load to full load 5% maximum.
 - .2 Electronic type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of +/- 0.25%.
 - .7 Shock mounted engine instrument panel with:

- .1 Lube oil pressure gauge.
 - .2 Lube oil temperature gauge.
 - .8 Fuel rack solenoid energized when engine running.
 - .9 Engine Alarm/Shutdown.
 - .1 Low oil pressure alarm/shutdown.
 - .2 High coolant temperature alarm/shutdown.
 - .3 Loss of coolant shutdown.
 - .4 Overspeed shutdown.
 - .5 Overcrank shutdown.
 - .6 Low battery voltage alarm.
 - .7 High battery voltage alarm.
- .2 Alternator: to NEMA MG1, single bearing, revolving field, self ventilated, coupled to engine by means of semi-flexible coupling and SAE housing, drip proof, amortisseur windings, synchronous type, class F insulation with:
 - .1 Brushless exciter, direct driven.
 - .2 Voltage regulator: solid state.
 - .3 Output:
 - .1 120/240VAC, 1-phase, 3-wire, 60 Hz.
 - .2 Power factor of 0.80.
 - .3 Floating neutral.
 - .4 150% full load for 1 min.
 - .5 110% full load for 1 hour.
 - .6 100% full load continuously at 40 degrees C ambient.
 - .4 Generator Alarm/Shutdown.
 - .1 Generator phase sequence.
 - .2 Generator over voltage.
 - .3 Generator under voltage.
 - .4 Generator over frequency.
 - .5 Generator under frequency.
 - .6 Generator reverse power (real and reactive).
 - .7 Generator overcurrent.
 - .5 Voltage Regulator Alarm/Shutdown.
 - .1 Loss of excitation alarm/shutdown.
 - .2 Instantaneous over excitation alarm/shutdown.
 - .3 Time over excitation alarm/shutdown.
 - .4 Rotating diode failure.
 - .5 Loss of sensing.
- .3 Circuit Breaker
 - .1 Generator mounted circuit breaker, moulded case, 2 pole, 100%-rated, CSA listed.

- .2 Solid state trip.
- .3 Connected to engine/generator safety shutdowns.
- .4 Housed in an extension terminal box isolated from vibrations induced by the generator set.
- .5 Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker. Suitable for one copper conductor per phase
- .4 Include materials as follows:
 - .1 Conduits and boxes as required.
 - .2 Electrical components as indicated.
 - .3 Wiring material.
 - .4 The power circuit cables will be copper, RW90 (minus 40 degrees C) cross link polyethylene, single conductor.
 - .5 Battery cable shall be welding cable type, extra flexible, rope stranded copper conductor with neoprene oil-resistant insulation, sized to limit voltage drop to 5% at time of peak load.
- .5 Control Panel
 - .1 Totally enclosed, mounted on generator.
 - .2 Panel door with formed edges and lockable handle with 2 keys.
 - .3 Flexible conductors between door and fixed panel.
 - .4 Instruments: ac ammeter and voltmeter with selector switches, frequency meter, engine running time meter, with miniature glass fast acting fuses for indicating instruments fitted at rear of instrument.
 - .5 Controls:
 - .1 Engine start and stop buttons, test button, alternator output moulded case circuit breaker, 3-position program selector switch, voltage control rheostat.
 - .6 Automatic shut-down and alarms:
 - .1 Engine overcrank, overspeed, high temp, low lube oil pressure, short circuit, low battery voltage to alarm only, and alternator overvoltage.
 - .2 Alarms to be illuminated annunciator, manual reset and set of NC/NO contacts be provided wired to terminal block for future connection to remote annunciator.
- .6 Generating Set Operation
 - .1 Program selector switch set at "Automatic".
 - .1 Provision for input from transfer switch or solar power / battery inverter to start, run and stop the generator.
 - .2 Program Selector Switch set at "Manual"
 - .1 START button and STOP button controls engine.
 - .3 Program selector switch set at "OFF".
 - .1 Running engine stops.
 - .2 Stopped engine will not start.

- .3 Switch lockable in this position.
- .7 Exhaust System
 - .1 Heavy duty, critical grade silencer, horizontally mounted exhaust silencer with condensate drain, plug and flanged couplings.
 - .2 Heavy duty flexible exhaust hose with flanged couplings as indicated.
 - .3 Expansion joints, stainless steel, corrugated, of suitable length to absorb both vertical and horizontal expansion.
- .8 Enclosure
 - .1 The complete engine generator set, including generator control panel, and engine starting batteries shall be enclosed in a factory assembled, weather protective sound attenuated enclosure mounted on the generator base. Intake openings shall be screened to prevent the entrance of rodents or pests.
 - .2 Weatherproof enclosure suitable for prolonged exposure to a marine environment and Les Suêtes winds.
 - .3 Low-flammability fire resistant material.
 - .4 Corrosion free suitable for proximity to a maritime environment.
 - .5 Ready access to internal components by hinged/removable lockable doors/covers.
 - .6 Viewports in enclosure to essential systems.
 - .7 Sound attenuation: maximum permissible noise level of 50 dB(A) at 7 metres (23 feet) from exterior surface.
- .9 Fuel System
 - .1 Liquified petroleum (LP) gas (propane).
 - .2 Copper feed line with flexible terminations at engine, shut-off cock, renewable cartridge filter and fire valve.
 - .3 Isolating valves on fuel lines serving auxiliaries.
 - .4 Provide LP fuel for testing and leave full tanks on acceptance.
- .10 Cooling Air System
 - .1 Engine ventilating system:
 - .1 Recirculating damper assembly with modulating motor.
 - .2 Cold air inlet damper assembly with modulating motor.
 - .3 Air intake and discharge gooseneck weatherhoods.
 - .4 Modulating thermostat, and replaceable intake air filters.
- .11 Battery Charger
 - .1 On-board battery charger.
 - .2 No provision for external battery charger.
 - .3 Generator to start and run to charge batteries when a low battery voltage condition is detected.
- .12 Ancillary Heaters
 - .1 No provision for heating of oil, coolant or engine body.

- .2 Engine and generator shall start and operate during the operating season without the need for ancillary heat.
- .13 Annunciation System
 - .1 No audible warning of system status.
 - .2 Provide visible warning light to indicate one or more engine or generator faults.
 - .1 Weathertight and resistant to environmental conditions.
 - .2 Mounted on roof of enclosure, visible from the adjacent highway.
 - .3 Red lens.
 - .4 LED, steady (not flashing) illumination when fault condition(s) is/are present.
 - .5 Active when one or more faults is/are present on the generator or the engine that prevents the generator from continued operation or would prevent the generator from starting.
- .14 Equipment Identification
 - .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Controls: size 4 nameplates.
 - .3 Meters, alarms, indicating lights: size 2 nameplates.
 - .4 Provide weather resistant labeling and signage as per code requirements and the requirements of the authority having jurisdiction.
- .15 Source Quality Control
 - .1 Complete generator set factory tested.
 - .2 Tests:
 - .1 24-hour test at 100% rated load.
 - .2 1-hour test at 110% rated load.
 - .3 Automatic shut down devices on trouble alarms.
 - .4 Automatic start-up, transfer to loads back to normal power and shutdown.
 - .5 Battery charger's ability to revert to high rate charge after cranking.
 - .3 Submit certified copy of test results to Departmental Representative before shipment to site.

2.3 GENERATING SET – SYSTEM 1

- .1 Nominal generator rating of 10 kW. Contractor shall calculate the size of generator required to supply the loads as indicated:
 - .1 Single step transition:
 - .1 Battery room ventilation fan (sized by contractor).
 - .2 Building 'A' (provision for future).
 - .3 Building 'B'.
 - .4 Building 'E'.
 - .5 Building 'H'.

- .6 Building 'K' (provision for future).
- .2 Allow for 10% future additional load.
- .3 Allow for system losses and equipment efficiencies.
- .4 Refer to the drawings for the most current data. Consumption and load data shown on the drawings shall prevail.

2.4 GENERATING SET – SYSTEM 2

- .1 Nominal generator rating of 15 kW. Contractor shall calculate the size of generator required to supply the loads as indicated:
 - .1 Single step transition:
 - .1 1 hp 240V well pump.
 - .2 2.1 hp 240V booster pump.
 - .3 LED lighting. 120V. 3 fixtures. Nominal 32 W each.
 - .4 Chlorine dosing pump. 120V. Nominal 190 W.
 - .5 Filters. 120V. Two units. Nominal 12 W each.
 - .6 Water softener. 120V. Nominal 60 W.
 - .7 Flow meter. 120V. Nominal 7 W.
 - .8 Renewable energy system (solar panel system inverter) battery charger (sized by contractor)
 - .2 Allow for 10% future additional load.
 - .3 Allow for system losses and equipment efficiencies.
 - .4 Refer to the drawings for the most current data. Consumption and load data shown on the drawings shall prevail.

Part 3 Execution

3.1 DEMOLITION

- .1 Disconnect the existing diesel generator.
- .2 Disconnect and remove the generator's batteries.
- .3 Drain the diesel fuel from the storage tank in the base of the generator.
- .4 Remove the batteries, the generator, in-base fuel tank, and enclosure from the site and deliver all to the Chéticamp Campground. Include all rigging, loading/offloading, permits, escorting and transportation. Site preparation at Chéticamp Campground, installation and reconnection is excluded.
- .5 Disconnect and remove the existing load bank and deliver to the Chéticamp Campground. Installation and reconnection is excluded.
- .6 Demolish and remove from site the existing concrete generator pad and sub-grade works.
- .7 Disconnect and remove miscellaneous items including but not limited to conduit, wire, terminals, etc.
- .8 Return the site and the building to its previous condition, patch all holes and penetrations, replace insulation, replace fill, soils and grasses.

3.2 INSTALLATION

- .1 Position generating set and install on new reinforced concrete pad as indicated.
- .2 Install fuel supply as indicated in accordance with CSA-B139.
- .3 Install ventilating air dampers, ducts, hoods, enclosure, filters and fittings, exhaust system as indicated.
- .4 Complete wiring and interconnections as indicated.
- .5 Access to generator and all associated equipment by unauthorized persons shall be prevented at all times by the use of fencing with locked gates, or locked buildings. Such methods of access control shall comply with the Canadian Electrical Code and bulletins issued by the authority having jurisdiction.
- .6 Provide clearance around systems, equipment and components for observation of operation, inspection, re-fuelling, servicing, maintenance and as recommended by manufacturer and CSA-B139.

3.3 FIELD QUALITY CONTROL, STARTUP, COMMISSIONING AND TRAINING SERVICES

- .1 Notify Departmental Representative 10 working days in advance of test date.
- .2 Engage and pay for a factory-authorized service representative to perform factory recommended startup services. Complete installation and startup checks per manufacturer's written instructions.
- .3 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .4 Preparation: before starting unit, carry out thorough mechanical and electrical inspection of equipment, and perform checks and adjustments by factory authorised personnel and in accordance with manufacturer's instructions.
- .5 For wet batteries, inspect individually each battery cell and check electrolyte level.
 - .1 Check charge condition by measuring temperature and specific gravity of electrolyte.
 - .2 Consult manufacturer's instructions for recommended readings.
 - .3 If readings are lower, give batteries freshening charge until acceptable readings are reached.
- .6 Have at hand, during initial start-up, means for choking off air supply to engine air induction manifold in event of engine run away or other emergency.
- .7 Start unit only in presence of Departmental Representative.
- .8 Start generating set and test to ensure proper performance. Stop unit if abnormal conditions are encountered. Demonstrate:
 - .1 Manual start and shut down.
 - .2 Operation of automatic shut-down devices and alarms.
 - .3 Check for and correct leakage from exhaust system, fuel system, cooling system, and lubricating oil system.
 - .4 Adjust vibration isolators.

- .5 Observe and confirm lubricating oil pressure and coolant temperature are within limits and no harmful vibration or sounds are evident.
- .6 Ensure voltage is within operating parameters and automatic voltage regulator is operating correctly.
- .7 Ensure manual voltage control is operating correctly.
- .8 Ensure frequency is within operating parameters and electronic governor is operating correctly.
- .9 Check engine air ventilation system for proper operation.
- .10 Check operation of engine-mounted protective sensing devices and adjust as necessary.
- .9 Run unit on load for a minimum of 2 hours continuous operation.
- .10 Engage and pay for a factory-authorized service representative to provide familiarization training of operating and maintenance staff on the system, including proper care, operation, maintenance and first-level diagnostic and trouble-shooting practices. Provide in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .11 Deliver.
 - .1 Include instruction to site operation and maintenance staff for of equipment.
 - .2 Maintain services for such period, and for as many visits as necessary to put equipment in operation, and confirm that operating personnel are conversant with aspects of its care and operation.
- .12 Submit drawings, equipment warranties and manuals in a binder to the owner. Submit three printed copies.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 31 00 - Solar PV
- .3 Section 26 32 13.02 - Power Generation to 50 kW.
- .4 Section 26 33 16 - Batteries and Battery Racks.
- .5 Section 26 33 43 - Battery Chargers.

1.2 REFERENCE STANDARDS

- .1 Canadian Environmental Protection Act (CEPA)
 - .1 CCME PN 1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
- .2 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada.

1.3 COORDINATION OF SPECIFICATIONS

- .1 The renewable energy system requires the coordination of many design elements and specifications including, but not limited to:
 - .1 Section 26 31 00 - Solar PV
 - .2 Section 26 32 13.02 - Power Generation to 50 kW.
 - .3 Section 26 32 13.03 - Installation of Electric Power Generation Equipment
 - .4 Section 26 33 16 - Batteries and Battery Racks.
 - .5 Section 26 33 43 - Battery Chargers.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Refer to Section 26 05 00 - Common Work Results for Electrical. Make all submissions in accordance with Section 26 05 00.
- .2 Submit commissioning report.

1.5 QUALIFICATIONS

- .1 Use qualified LPG technician.

Part 2 Products

2.1 MATERIALS

- .1 Include materials as follows:

Issue for Tender

- .1 Conduits and boxes as required.
- .2 Copper fuel lines and fittings as required.
- .3 Primary fuel filter/water separator.
- .4 Insulation for exhaust system.
- .5 Electrical components as indicated.
- .6 Wiring material.
- .7 Antifreeze, ethylene glycol.
- .8 Wiring and materials, including necessary conduits and fittings for making connections.
- .9 The power circuit cables.
- .10 The control circuit cables.
- .11 Battery cable shall be welding cable type, extra flexible, rope stranded copper conductor with neoprene oil-resistant insulation, sized to limit voltage drop to 5% at time of peak load.

Part 3 Execution

3.1 LOCATING AND MOUNTING

- .1 Fit and adjust isolators in accordance with manufacturer's installation and adjustment instruction bulletin contained in unit manual.
- .2 Do not bolt housings to foundation if isolator housing feet are equipped with 6 mm rubber sound pads.

3.2 ALIGNMENT CHECK

- .1 Since engine-generator shaft alignment is adjusted at factory, check to ensure that no change has occurred due to shipment and handling.

3.3 FUEL SUPPLY SYSTEM

- .1 Install fuel tanks.
- .2 Inspect thoroughly fuel tank and lines to confirm they are clean and free of foreign material before connecting fuel system.
- .3 Install primary fuel filter/water separator and servicing shut-off valves as indicated. Provide three spare filter elements.
- .4 Neatly install fuel lines parallel or perpendicular to building lines with no kinks or dents.

3.4 BATTERIES AND CHARGER

- .1 For dry charged batteries, activate in accordance with manufacturer's instructions manual prior to installation.
- .2 For wet batteries, inspect individually each battery cell and check electrolyte level.
 - .1 Check charge condition by measuring temperature and specific gravity of electrolyte.

Issue for Tender

- .2 Consult manufacturer's instructions for recommended readings.
- .3 If readings are lower, give batteries freshening charge until readings are reached.
- .3 Locate batteries as indicated and ensure batteries are accessible for service.
- .1 Run and protect cables to starting motor using cables supplied with unit.
- .4 Clean connections and tighten securely.

3.5 EXHAUST SYSTEM

- .1 Install exhaust pipe and silencer using material supplied with unit.
- .2 Install exhaust system fireproof insulating material, after test run.

3.6 COOLING AND VENTILATION

- .1 Install air outlet and inlet louvres and hoods in their respective openings.
- .2 Install louver motors and linkages, adjust to ensure louvres are tight in closed position and give free damper movements from fully closed to fully open.
- .3 Fill engine radiator with water/ethylene glycol antifreeze mix good for -40 degrees C.

3.7 CONTROL AND TRANSFER PANEL

- .1 Locate panels as indicated.
- .2 Make control and power circuit connections as indicated.
- .3 Identify cables at both ends.
- .4 Tag with slip-on wire marker, each wire end with number corresponding to number in panel.
- .5 Make terminations with self-insulated terminals of flanged fork or ring type.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 31 00 - Solar PV
- .3 Section 26 32 13.02 - Power Generation to 50 kW.
- .4 Section 26 32 13.03 - Installation of Electric Power Generation Equipment
- .5 Section 26 33 43 - Battery Chargers.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 Institute of Electrical and Electronic Engineers (IEEE)
 - .1 IEEE 484-2002, IEEE Recommended Practices for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications.
 - .2 IEEE 485-2010, IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.
 - .3 IEEE 450-2010, Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
- .3 Underwriters Laboratories Inc. (UL)
 - .1 UL 94-15, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.3 COORDINATION OF SPECIFICATIONS

- .1 The renewable energy system requires the coordination of many design elements and specifications including, but not limited to:
 - .1 Section 26 31 00 - Solar PV
 - .2 Section 26 32 13.02 - Power Generation to 50 kW.
 - .3 Section 26 32 13.03 - Installation of Electric Power Generation Equipment
 - .4 Section 26 33 16 - Batteries and Battery Racks.
 - .5 Section 26 33 43 - Battery Chargers.

1.4 PRODUCT DATA

- .1 Provide product data in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Submit two copies of WHMIS MSDS to the departmental representative.
- .3 Shop Drawings:

- .1 Dimensioned sketch showing battery rack, individual battery cells, recommended aisle space, headroom, assembly and anchoring of rack.
- .2 Individual battery cells, type, size, Ah capacity.
- .3 Specific gravity at full charge and 25 degrees C.
- .4 Cell charge and discharge curves of voltage, current, time and capacity.
- .5 Derating factor for temperature range (-10 degrees C to -30 degrees C).
- .6 Maximum short circuit current.
- .7 Maximum charging current recommended for fully discharged condition.
- .8 Full charge voltage per cell.
- .9 Fully discharged voltage per cell.
- .10 Hydrogen generation and ventilation requirements.

1.5 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: submit operation and maintenance data for storage batteries and racks for incorporation into manual.
 - .1 Operation and maintenance instructions concerning component functions and maintenance requirements to permit effective operation, maintenance and repair.
 - .2 Installation details of battery rack, individual cells, inter-cell connectors.
 - .3 Replacement instructions for individual cells.
 - .4 Electrolyte handling.
 - .5 Parts lists with catalogue numbers and names and addresses of suppliers.
 - .6 Factory test records.

Part 2 Products

2.1 SYSTEM DESCRIPTION - GENERAL

- .1 The Solar PV renewable energy system supplies AC power to its loads and is supported by storage batteries and a generator, and shall be supplied to coordinate fully with each component of that system.

2.2 MATERIALS

- .1 Batteries.
- .2 Steel for battery racks: to CSA G40.20.
- .3 Battery gas fume exhaust fan.
- .4 All devices, equipment, and systems must be capable of off-season storage in-place without supplemental heat, and without the need to "winterize" any item(s).

2.3 LEAD ACID BATTERIES

- .1 Type: flooded electrolyte, Absorptive Glass Microfibre (AGM) Valve Regulated Lead Acid (VRLA), deep cycle, suitable for renewable energy applications.
- .2 Cell voltage: 6V.

- .3 Capacity: nominal 415 Ah (20-hour discharge rate).
- .4 Charge current: 85A, 125A maximum.
- .5 Mounting: rack mountable.
- .6 Nominal battery voltage at full charge: 6 Volts
- .7 Battery to deliver specified output (85% to 102%) in ambient temperature from 0 degrees C to +40 degrees C.
- .8 Cover: one-piece moulded plastic, flame retardant to UL 94.
- .9 Posts: bolted type, stainless steel hardware.
- .10 Electrolyte: solution of sulphuric acid, specific gravity 1.280
- .11 Cell containers: polypropylene.
- .12 Electrolyte level lines: high and low on container surfaces, visible from front of rack.
- .13 Batteries: in clean state with no evidence of electrolyte on outside of cell containers.
- .14 Batteries shall be from a single manufacturer and of the same type.
- .15 Cells: of identical construction and from same production run.
- .16 Standard of acceptance: Rolls type S6-460AGM or equivalent.

2.4 BATTERY RACKING

- .1 Cold shaped steel.
- .2 Two-tier racks capable of mounting two rows of batteries per tier.
- .3 Racking to have electrolyte protected coating, electrical insulation. and isolators.
- .4 Lowest rack/tier/shelf: 100 mm (minimum) above floor. Top of battery cells on highest tier not more than 2.5 m above floor.
- .5 Frames: steel channels.
- .6 Rails: steel channels, bolted to frames.
- .7 Plastic strips to insulate rails from cells.
- .8 Insulated from ground and floor.
- .9 Free standing - not bolted to floor.
- .10 Corrosion resistant bolts and hardware.
- .11 Configuration permitting any one cell to be removed without removing any other cell.
- .12 Dimensions of space available as indicated.
- .13 Standard of acceptance: Alpha/Passoni SGS2; SBS Battery, or equivalent.

2.5 ACCESSORIES

- .1 Accessories: self-adhesive numbers for cell identification, no-oxide grease, plastic topping-up bottle, 1000 cc, hydrometer holder with wall mount brackets, hydrometer.
- .2 2 spare intercell connectors, nuts and bolts.

- .3 2 spare inter-tier connectors, nuts and bolts.

2.6 SOURCE QUALITY CONTROL

- .1 Complete battery factory tested.
- .2 Submit written copy of test results to Departmental Representative.

2.7 EQUIPMENT REQUIREMENTS

- .1 All equipment shall be CSA certified, or certified by a testing laboratory acceptable to the province of Nova Scotia. The use of the CSA Special Inspection service to certify equipment will not be acceptable.
- .2 Warranty. The warranty period shall commence from the date of substantial performance.
 - .1 Installation workmanship: 2 years.
 - .2 Battery: 5 years, not pro-rated.
 - .3 Battery racking and supports: 10 years.

Part 3 Execution

3.1 INSTALLATION

- .1 Supply and install fume exhaust fan to discharge battery gases to the building exterior.
- .2 Locate and erect battery rack.
- .3 Install bonding conductors to interconnect battery racks and to ground.
- .4 Install battery cells on rack.
- .5 Clean posts and connectors and apply no-oxide grease.
- .6 Install inter-cell and inter-tier connectors, and tighten nuts in accordance with manufacturer's instructions.
- .7 Using torque wrenches, tighten nuts in accordance with manufacturer's recommended value.
- .8 Connect battery to load circuit.

3.2 FIELD QUALITY CONTROL

- .1 Check battery voltage and specific gravity of each cell in accordance with manufacturer's instructions.
- .2 Float charge battery for 24 hours.
- .3 Discharge battery at rated load for 72 hours.
- .4 Check battery voltage at terminals, and specific gravity of each cell.
- .5 Recharge battery to full charge.
- .6 Check battery voltage and specific gravity of each cell.

- .7 Leave battery in fully charged state.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.
- .3 Section 26 31 00 - Solar PV
- .4 Section 26 32 13.02 - Power Generation to 50 kW.
- .5 Section 26 32 13.03 - Installation of Electric Power Generation Equipment
- .6 Section 26 33 16 - Batteries and Battery Racks

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No.107.2-R2016, Battery Chargers.

1.3 COORDINATION OF SPECIFICATIONS

- .1 The renewable energy system requires the coordination of many design elements and specifications including, but not limited to:
 - .1 Section 26 31 00 - Solar PV
 - .2 Section 26 32 13.02 - Power Generation to 50 kW.
 - .3 Section 26 32 13.03 - Installation of Electric Power Generation Equipment
 - .4 Section 26 33 16 - Batteries and Battery Racks.
 - .5 Section 26 33 43 - Battery Chargers.

1.4 PRODUCT DATA

- .1 Provide product data in accordance with Section 26 05 00 - Common Work Results for Electrical.

Part 2 Products

2.1 SYSTEM DESCRIPTION - GENERAL

- .1 The Solar PV renewable energy system supplies AC power to its loads and is supported by storage batteries and a generator, and shall be supplied to coordinate fully with each component of that system.

2.2 PERFORMANCE REQUIREMENTS

- .1 Automatically maintain battery in fully charged state while input (solar or generator) power available. Maintain DC float voltage within plus or minus 1% of setting.
- .2 Manual/programmable adjustment of float charge voltage with range plus or minus 5%.
- .3 Manual/programmable adjustment of equalizing charge voltage.

- .4 Automatic current limiting adjustable between 80 and 120% of normal rating.
- .5 Audible noise level not to exceed 65 dBA at 1.5 m.
- .6 All devices, equipment, and systems must be capable of off-season storage in-place without supplemental heat, and without the need to “winterize” any item(s).

2.3 CHARGER CHARACTERISTICS

- .1 Battery charger: to CAN/CSA C22.2 No.107.2.
- .2 Operation in conjunction with inverter and charge controller.

2.4 ACCESSORIES

- .1 DC voltmeter: switchboard type or digital, accuracy plus or minus 2% of full scale, to measure rectifier output voltage.
- .2 DC ammeter: switchboard type or digital, accuracy plus or minus 2% of full scale, to measure rectifier output current.
- .3 LEDs mounted on front to indicate: low DC voltage, high DC voltage.
- .4 Temperature compensation system for voltage output, including remote, battery mounted, temperature sensor.

2.5 ENCLOSURE

- .1 Access from front.
- .2 Convection ventilated.
- .3 Meters, indicating lamps and controls group mounted on front panel.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use size 4 nameplates for major components such as input breakers, output breaker.
- .3 Use size 2 nameplates for mode lights alarms, meters.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install battery charger as indicated.
- .2 Connect input terminals to source(s).
- .3 Connect output terminals to battery and to loads.
- .4 Connect auxiliary and controls terminals to generator, field devices, etc.
- .5 Ensure that input and output terminals will accommodate the quantity and size of conductors to be terminated without the use of adapters.
- .6 Install instruction and data nameplates and warning signs.

3.2 TESTS

- .1 In accordance with Section 26 33 16 Batteries and Battery Racks.
- .2 Continue charging to ensure charger changes from bulk rate to float charge rate.
- .3 Simulate faults to demonstrate that alarm lights and audible alarms are performing as designed.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 ASTM International Inc.
 - .1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .3 Canadian Standards Association (CSA International)
- .4 Underwriters' Laboratories of Canada (ULC)

Part 2 Products

2.1 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule or elsewhere.

2.2 LUMINAIRES

- .1 As indicated in luminaire schedule.
- .2 Luminaire power supplies (drivers shall have a THD not exceeding 10%.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires and control devices as indicated.
- .2 Provide adequate support to suit ceiling system.

3.2 WIRING

- .1 Connect luminaires to lighting circuits.
- .2 Each light fixture is to have a separate fixture drop installed and connected to hard wired junction or outlet box located in ceiling/roof space.
- .3 A maximum of four drops is permitted from any single box, regardless of box size.

3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 ASTM International Inc.
 - .1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .2 Canadian Standards Association (CSA International).
- .3 Underwriters' Laboratories of Canada (ULC).

Part 2 Products

2.1 LUMINAIRES

- .1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated. Install fixture true and plumb, and in accordance with manufacturer's instructions.
- .2 Provide adequate support to suit site conditions.
- .3 Check luminaire orientation, level and tilt.
- .4 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 - Cleaning.
- .3 Section 01 74 19 - Waste Management and Disposal.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM D4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
 - .2 Nova Scotia Department of Transportation (NSTIR) Standard Specifications, latest edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for aggregate materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Allow continual sampling by Departmental Representative during production.
 - .2 Provide Departmental Representative with access to source and processed material for sampling.
 - .3 Install sampling facilities at discharge end of production conveyor, to allow Departmental Representative to obtain representative samples of items being produced. Stop conveyor belt when requested by Departmental Representative to permit full cross section sampling.
 - .4 Provide front end loader or other suitable equipment including trained operator for stockpile sampling as necessary. Move samples to storage place as directed by Departmental Representative.
 - .5 Supply new or clean sample bags or containers according appropriate to aggregate materials.
 - .6 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.
 - .7 Provide water, electric power and propane to Departmental Representative laboratory trailer at production site.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 Storage: store washed materials or materials excavated from underwater 24 hours minimum to allow free water to drain and for materials to attain uniform water content.

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, free from adherent coatings and injurious amounts of disintegrated pieces or other deleterious substances.
- .2 Aggregates in accordance with NSTIR standard specifications.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.
- .3 Advise Departmental Representative 4 weeks minimum 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 EXAMINATION

- .1 Verification of Conditions: verify that conditions are acceptable for topsoil stripping.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with topsoil stripping. only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Topsoil stripping:
 - .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.
 - .2 Begin topsoil stripping of areas as indicated after area has been cleared of weeds, brush and grasses and removed from site.
 - .3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.

- .4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2 m.
- .5 Dispose of topsoil as directed by Departmental Representative.
- .2 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 directed by Departmental Representative.
 - .2 Where clearing is required, leave screen of trees between cleared area and roadways as directed.
 - .3 Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.
 - .4 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.
 - .5 Trim off and dress slopes of waste material piles and leave site in neat condition.
 - .6 Provide silt fence or other means to prevent contamination of existing watercourse or natural wetland features.
- .3 Processing:
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
 - .2 Blend aggregates, as required, including reclaimed materials that meet physical requirements of specification is permitted in order to satisfy gradation requirements for material and, percentage of crushed particles, or particle shapes specified.
 - .1 Use methods and equipment approved in writing by Departmental Representative.
 - .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate gradation.
 - .5 Where necessary, screen, crush, wash, classify and process aggregates with suitable equipment to meet requirements.
 - .1 Use only equipment approved in writing by Departmental Representative.
- .6 Stockpiling:
 - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. 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 Departmental Representative within 48 hours of rejection.
- .7 Stockpile materials in uniform layers of thickness as follows:
 - .1 Maximum 1.5 m for coarse aggregate and base course materials.
 - .2 Maximum 1.5 m for fine aggregate and sub-base materials.
 - .3 Maximum 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 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .4 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.
- .5 Waste Management: separate waste materials for recycling and/or reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .6 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.
- .7 Restrict public access to temporary or permanently abandoned stockpiles by means acceptable to Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 56 20 - Erosion Protection and Sediment Control.
- .2 Section 01 74 00 – Cleaning.
- .3 Section 31 14 13 – Soil Stripping and Stockpiling.

1.2 DEFINITIONS

- .1 Clearing consists of cutting off trees and brush vegetative growth to not more than specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.
- .2 Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps and embedded logs, removing at, or close to, existing grade and disposing of fallen timber and surface debris.
- .3 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees and disposing of felled trees and debris.
- .4 Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 50 mm trunk diameter and disposing of fallen timber and surface debris.
- .5 Grubbing consists of excavation and disposal of stumps, roots, boulders and rock fragments to not less than specified depth below existing ground surface.

1.3 SAFETY

- .1 Safety Requirements: worker protection.
 - .1 Workers must wear gloves, dust masks, long sleeved clothing, and eye protection when applying herbicide materials.
 - .2 Workers must not eat, drink or smoke while applying herbicide material.
 - .3 Clean up spills of preservative materials immediately with absorbent material and safely discard to landfill.

1.4 STORAGE AND PROTECTION

- .1 Prevent damage to trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utilities, and other site appurtenances which are to remain.
 - .1 Repair damaged items to approval of Departmental Representative.

1.5 WASTE MANAGEMENT

- .1 Consider felled timber from which saw logs, pulpwood, posts, poles, ties, or fuel wood can be produced as saleable timber.
 - .1 Stockpile adjacent to site.

Part 2 Products

2.1 MATERIALS

- .1 Bituminous based paint of standard manufacture specially formulated for tree wounds.
- .2 Herbicide: effective for killing annual and perennial weeds, and bamboo grass, by being absorbed through roots and foliage as approved by Departmental Representative.
- .3 Soil Material for Fill:
 - .1 Excavated soil material: free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, deleterious, or objectionable materials.
 - .2 Remove and store soil material for reuse.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENT CONTROL

- .1 Provide temporary erosion and sediment control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PREPARATION

- .1 Inspect site and verify with Departmental Representative, items designated to remain.
- .2 Locate and protect utilities: preserve in operating condition active utilities traversing site.
 - .1 Notify Departmental Representative immediately of damage to or when unknown existing utilities are encountered.
 - .2 When utilities which are to be removed are encountered within area of operations, notify Departmental Representative in ample time to minimize interruption of service.
- .3 Notify utility authorities before starting clearing.
- .4 Keep roads and walks free of dirt and debris.

3.3 CLEARING

- .1 Clearing includes felling, trimming, and cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within cleared areas.
- .2 Clear as directed by Departmental Representative by cutting at height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 1000 mm above ground surface.
- .3 Cut off branches overhanging area cleared as directed by Departmental Representative.

- .4 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.
- .5 Apply herbicide in accordance with manufacturer's label to top surface of stumps designated not to be removed.

3.4 CLOSE CUT CLEARING

- .1 Close cut clearing to ground level to within 100 mm of ground surface.
- .2 Perform close cut clearing by hand so that existing muskeg is not damaged.
- .3 Cut off branches overhanging area cleared as directed by Departmental Representative.
- .4 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.

3.5 ISOLATED TREES

- .1 Cut off isolated trees as directed by Departmental Representative at height of not more than 300 mm above ground surface.
- .2 Grub out isolated tree stumps.
- .3 Prune individual trees as indicated.
- .4 Trim trees designated to be left standing within cleared areas of dead branches 4 cm or more in diameter; and trim branches to heights as indicated.
- .5 Cut limbs and branches to be trimmed close to bole of tree or main branches.
- .6 Paint cuts more than 3 cm in diameter with approved tree wound paint.

3.6 UNDERBRUSH CLEARING

- .1 Clear underbrush from areas as indicated to ground level.

3.7 GRUBBING

- .1 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots, and designated stumps from indicated grubbing areas.
- .2 Grub out stumps and roots to not less than 200 mm below ground surface.
- .3 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m³.
- .4 Fill depressions made by grubbing with suitable material and to make new surface conform to existing adjacent surface of ground.

3.8 REMOVAL AND DISPOSAL

- .1 Remove cleared and grubbed materials to disposal area designated by Departmental Representative.
- .2 Cut timber greater than 125 mm diameter to 3600 mm lengths and stockpile. Stockpiled timber becomes property of Departmental Representative.
- .3 Dispose of cleared and grubbed materials by burying to approval of Departmental Representative.

- .4 Chip, mulch and spread cleared and grubbed vegetative material on site as directed by Departmental Representative.
- .5 Remove diseased trees and dispose to approval of Departmental Representative.

3.9 FINISHED SURFACE

- .1 Leave ground surface in condition suitable for stripping of topsoil to approval of Departmental Representative.

3.10 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 56 20 - Erosion Protection and Sediment Control.
- .2 Section 01 74 00 – Cleaning.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENT CONTROL

- .1 Provide temporary erosion and sediment control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

- .1 Ensure that procedures are conducted in accordance with applicable Provincial requirements.
- .2 Remove topsoil before construction procedures commence to avoid compaction of topsoil.
- .3 Handle topsoil only when it is dry and warm.
- .4 Remove vegetation from targeted areas by non-chemical means and dispose of stripped vegetation by composting.
- .5 Remove brush from targeted area by non-chemical means and dispose of through mulching.
- .6 Strip topsoil to depths as indicated.
 - .1 Avoid mixing topsoil with subsoil.
- .7 Pile topsoil in berms in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2.5 - 3 m.
- .8 Dispose of unused topsoil in location as indicated by Departmental Representative.
- .9 Protect stockpiles from contamination and compaction.

- .10 Cover topsoil that has been piled for long term storage, with trefoil or grass to maintain agricultural potential of soil.

3.3 PREPARATION OF GRADE

- .1 Verify that grades are correct and notify Departmental Representative if discrepancies are present.
 - .1 Grade area only when soil is dry to lessen soil compaction.
 - .2 Grade soil establishing natural contours and eliminating uneven areas and low spots, ensuring positive drainage.

3.4 PLACING OF TOPSOIL

- .1 Place topsoil only after Departmental Representative has accepted subgrade.
- .2 Place topsoil as indicated on drawings.
- .3 Spread topsoil during dry conditions in uniform layers not exceeding 150 mm, over unfrozen subgrade free of standing water.
- .4 Establish traffic patterns for equipment to prevent driving on topsoil after it has been spread to avoid compaction.
- .5 Cultivate soil following spreading procedures.

3.5 SUB-SOILING

- .1 Apply sub-soil, following spreading and cultivating procedures to designated areas to improve drainage and agricultural potential of soil.
- .2 Work sub-soil area following natural grade contour lines, with vibrating sub-soiler to depth of 40 cm.
- .3 Cross sub-soil the area following the first pass.
- .4 Cultivate the soil with a chain harrow to de-clod the soil.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 45 00 – Quality Control.
- .3 Section 31 14 13 – Soil Stripping and Stockpiling.
- .4 Section 31 32 19.16 – Geotextile Soil Stabilization.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C117-04, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D422-63/2002, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D698-00a/1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
 - .5 ASTM D1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700 kN-m/m³).
 - .6 ASTM D4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .4 Nova Scotia Transportation and Infrastructure Renewal (NSTIR) Standard Specification for Highway Construction and Maintenance, latest edition.

1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock : solid material in excess of 1.0 m³ and which cannot be removed by means of heavy-duty mechanical excavating equipment with 0.95 to 1.15 m³ bucket. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .5 Borrow material: material obtained from locations outside area to be graded and required for construction of fill areas or for other portions of Work.
- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .7 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.2.
 - .2 Table:

Sieve Size (mm)	% Passing
2.00	100
0.10	45 - 100
0.02	10 - 80
0.005	0 - 45
 - .3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.
- .8 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Control: in accordance with Section 01 45 00 - Quality Control:
 - .1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.
 - .2 Submit for review by Departmental Representative proposed dewatering methods as described in PART 3 of this Section.
 - .3 Submit to Departmental Representative written notice at least 7 days prior to excavation work.
 - .4 Submit to Departmental Representative written notice when bottom of excavation is reached.

- .5 Submit to Departmental Representative testing results as described in PART 3 of this Section.
- .3 Preconstruction Submittals:
 - .1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
 - .2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field and location plan of relocated and abandoned services, as required.

1.5 QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .3 Design and supporting data submitted to bear stamp and signature of qualified professional Engineer licensed in the Province of Nova Scotia.
- .4 Keep design and supporting data on site.
- .5 Engage services of qualified professional Engineer who is licensed in the Province of Nova Scotia in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning if required for Work.

1.6 EXISTING CONDITIONS

- .1 Examine soil report bound to this specification.
- .2 Buried services:
 - .1 Before commencing work verify or establish location of buried services on and adjacent to site by careful test excavations. Location of services shown on utilities plan is approximate only and not deemed accurate.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
 - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to beginning excavation Work, notify Departmental Representative and establish location and state of use of buried utilities and structures.
 - .6 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
 - .7 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing. Costs for such Work to be paid by Owner.
 - .8 Record location of maintained, re-routed and abandoned underground lines.
 - .9 Confirm locations of recent excavations adjacent to area of excavation.
- .3 Existing buildings and surface features:

- .1 Conduct, with Departmental Representative a condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, pavement, survey bench marks and monuments which may be affected by Work.
- .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Granular Backfill: Type 1 or Type 2 granular in accordance with NSTIR specifications, as follows:

Sieve Size (mm)	Percent Passing	
	Type 1	Type 2
80	-	100
56	-	70 - 100
28	-	50-80
20	100	-
14	50 - 85	35-65
5	20 - 50	20-50
1.25	-	-
0.16	5 - 12	3 - 10
0.080	3-8	0 - 7

- .2 Select (common) Fill: Common material from site which is free of stumps, trees, roots, organics, boulders and masonry larger than 100 mm in any dimension and other deleterious materials as approved by the Departmental Representative.
- .3 Imported Fill: Common material from other (Contractor's own) sources which is free of stumps, trees, roots, organics, boulders and masonry larger than 100 mm in any dimension and other deleterious materials as approved by the Departmental Representative.
- .4 Utility/Pipe Bedding and Surround: 150 mm layer of Type 1 granular in accordance with NSTIR specifications.
- .5 C4 Clear Stone (25mm – 75mm): Crushed and screened, hard, durable stone, free from clay and organic matter, and graded as follows:

Sieve Size (mm)	Percent Passing
112	100
80	90 – 100
28	0 – 10

- .6 C5 Clear Stone (5mm – 20 mm): Crushed and screened, hard, durable stone, free from clay and organic matter, and graded as follows:

Sieve Size (mm)	Percent Passing
28	100
19	90 – 100
9.5	0 – 40
4.75	0 – 10

.7 Disposal Field (Common) Fill:

- .1 Select (common) fill as identified herein and tested to show a required hydraulic conductivity between 20 and 80 x 10⁻⁶ m/sec.

.8 Sand: hard, granular, sharp material, well-graded from coarse to fine, free of impurities, chemicals or organic matter, graded as follows:

Sieve Size (mm)	Percent Passing
5	100
0.16	0 – 5

.9 Unshrinkable fill: proportioned and mixed to provide:

- .1 Maximum compressive strength of 0.4 MPa at 28 days.
.2 Maximum cement content of 25 kg/m³.
.3 Minimum strength of 0.07 MPa at 24 h.
.4 Concrete aggregates: to CSA-A23.1/A23.2.
.5 Cement: Type GU.
.6 Slump: 160 to 200 mm.

.10 Marking Tape: Color coded heavy gauge polyethylene, 150 mm wide indicating the service type buried below.

.11 Geotextiles: to Section 31 32 19.16 – Geotextile Soil Stabilization.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties according to requirements of authorities having jurisdiction.
.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

- .3 The Contractor shall not penetrate the asphalt on the Cabot Trail highway.

3.3 PREPARATION/PROTECTION

- .1 Keep excavations clean, free of standing water, and loose soil.
- .2 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .4 Protect buried services that are required to remain undisturbed.

3.4 STRIPPING OF TOPSOIL AND STOCKPILING

- .1 Do topsoil stripping and stockpiling in accordance with Section 31 14 13 – Soil Stripping and Stockpiling.

3.5 SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with the Provincial Health and Safety Act.
- .2 Obtain permit from authority having jurisdiction for temporary diversion of water course if required.
- .3 Construct temporary Works to depths, heights and locations as approved by Departmental Representative.
- .4 During backfill operation:
 - .1 Unless otherwise indicated or directed Departmental Representative, remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
 - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .5 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .6 Upon completion of substructure construction:
 - .1 Remove shoring and bracing.
 - .2 Remove excess materials from site.

3.6 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Departmental Representative approval the details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .6 Provide flocculation tanks, settling basins, geotubes or other treatment methods and facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.7 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations.
- .2 Excavate to lines, grades, elevations and dimensions as indicated.
- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .5 For trench excavation, do not excavate more than 30 m of trench in advance of installation operations. All excavations shall be filled at end of work day prior to leaving site.
- .6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .7 Restrict vehicle operations directly adjacent to open trenches.
- .8 Dispose of surplus and unsuitable excavated material in approved location.
- .9 Do not obstruct flow of surface drainage or natural watercourses.
- .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .11 Notify Departmental Representative when bottom of excavation is reached.
- .12 Obtain Departmental Representative approval of completed excavation.
- .13 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
- .14 Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with Type 2 granular fill compacted to not less than 100% of SPMDD.
 - .2 Fill under other areas with Type 2 granular or common fill compacted to not less than 95 % of SPMDD.
- .15 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

- .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.
- .16 Install geotextiles in accordance with Section 31 32 19.16 – Geotextile Soil Stabilization.

3.8 FILL TYPES AND COMPACTION

- .1 Use types of fill as indicated or specified below.
 - .1 Exterior side of structure walls: use Type 2 granular fill to subgrade level. Compact to 95% of SPMDD.
 - .2 Under concrete slabs: use Type 2 granular fill to underside of base course for concrete slabs. Compact to 98 % of SPMDD.
 - .3 Under concrete slabs: provide 150 mm compacted thickness base course of Type 1 granular fill to underside of slab. Compact base course to 98 % SPMDD.
 - .4 Place unshrinkable fill in areas as indicated.

3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Hand place material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .2 Place bedding and surround material in unfrozen condition.

3.10 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and approved installations.
 - .2 Departmental Representative has inspected and approved of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
 - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Backfilling around installations:
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 300 mm.
- .6 Place unshrinkable fill in areas as indicated.
- .7 Consolidate and level unshrinkable fill with internal vibrators.

3.11 TESTING

- .1 Quality control testing of bedding, surround and backfill shall be carried out and paid for by the Contractor. Submit satisfactory compaction testing results to Departmental Representative for review and approval as results become available.
- .2 Departmental Representative may conduct quality assurance testing at own cost to verify testing results of contractor.

3.12 RESTORATION

- .1 Replace topsoil as indicated.
- .2 Reinstate lawns to elevation which existed before excavation.
- .3 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .4 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .5 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .6 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 - Cleaning.
- .3 Section 01 74 19 - Waste Management and Disposal.
- .4 Section 32 91 19.13 - Topsoil Placement and Grading.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
- .2 Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR), latest edition.

1.3 DEFINITIONS

- .1 Rock Excavation: excavation of:
 - .1 Material from solid masses of igneous, sedimentary or metamorphic rock which, prior to removal, was integral with parent mass. Material that cannot be ripped with reasonable effort with a Caterpillar D9 crawler bulldozer or equivalent to be considered integral with parent mass.
 - .2 Boulder or rock fragments measuring in volume 1 cubic metre or more.
- .2 Common Excavation: excavation of materials that are not Rock Excavation or Stripping.
- .3 Unclassified Excavation: excavation of whatever character other than stripping encountered in the Work.
- .4 Free Haul: distance that excavated material is hauled without compensation. Free haul distance to be 0.5 km or less.
- .5 Stripping: excavation of organic material covering original ground.
- .6 Over Haul: authorized hauling in excess of free haul distance that excavated material is moved.
- .7 Embankment: material derived from usable excavation and placed above original ground or stripped surface up to top of subgrade.
- .8 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.
- .9 Borrow Material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of work.
- .10 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval and review blasting program including preshear details, powder factors fly-rock control, and vibration monitoring methods.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Adhere to regulations of authority having jurisdiction when blasting is required.
 - .2 Adhere to Provincial and National Environmental requirements when potentially toxic materials are involved.

Part 2 Products

2.1 MATERIALS

- .1 Materials in accordance with NSTIR standard specifications.
- .2 Embankment materials require approval by Departmental Representative.
- .3 Material used for embankment not to contain more than 3% organic matter by mass, frozen lumps, weeds, sod, roots, logs, stumps or other unsuitable material.
- .4 Borrow material:
 - .1 Obtain from sources such as quarry, or borrow pit as approved by Departmental Representative.
 - .1 Earth Embankment materials to consist of acceptable earth material and processed rock material free from objectionable quantities of organic matter, frozen soil, stumps, trees, moss, and other unsuitable materials.
 - .2 Rock Embankment material to consist of fragmented rock produced by drilling and blasting operations, and boulders which cannot be placed in layers as specified for Earth Embankments.

.1 Rock Embankment to conform to gradation as follows:

Sieve Designation	Percent Passing by Weight
150 mm	100
100 mm	85 - 100
75 mm	10 - 50
No. 200	* 0 - 3

- .2 * Gradation is determined by that portion passing 75 mm screen.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that condition of substrate is acceptable for roadway embankment Work:
 - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 COMPACTION EQUIPMENT

- .1 Compaction equipment: vibratory rollers or vibrating plate compactors capable of obtaining required density in materials on project.
 - .1 Demonstrate compaction equipment effectiveness on specified material and lift thickness by documented performance of test-strip before start of Work.
 - .2 Replace or supplement equipment that does not achieve specified densities.
- .2 Operate compaction equipment continuously in each embankment when placing material.

3.3 WATER DISTRIBUTORS

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

3.4 STRIPPING (OF TOPSOIL)

- .1 Place top soil and finish grading in accordance with Section 32 91 19.13 - Topsoil Placement and Grading.
- .2 Commence topsoil stripping of areas as indicated after grasses, brush and weeds have been removed from these areas.
- .3 Strip topsoil to depths as indicated. Do not mix topsoil with subsoil.
- .4 Stockpile in locations as directed by Departmental Representative.
 - .1 Stockpile height: not to exceed 2 m.
- .5 Dispose of unused topsoil off site.
- .6 Remove clearing and grubbing debris from stripping.
- .7 Spread organic stripping, on completion of excavation and embankment construction, on slopes and trim or remove from site if quantity exceeds ability to grade on site.

3.5 EXCAVATING

- .1 General:
 - .1 Notify Departmental Representative when waste materials are encountered and remove to depth and extent directed.
 - .2 Sub-excavate 500 mm below subgrade in cut sections unless otherwise directed by Departmental Representative.
 - .1 Compact top 150 mm below sub-excavate to minimum 95% maximum dry density, to ASTM D698.
 - .2 Replace with approved embankment material and compact to specified embankment density.
 - .3 Treat ground slopes, where subgrade is on transition from excavation to embankment, at grade points as directed by Departmental Representative.

- .4 Treat ground slopes, where subgrade is on transition from excavation to embankment, at grade points as indicated.
- .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 Rock excavation:
 - .1 Notify Departmental Representative, when material appearing to conform to classification for rock is encountered, to enable measurements to be made to determine volume of rock. Provide 12 hour notification.
 - .2 Submit blasting program to Departmental Representative, for approval 48 hours minimum before start of Work.
 - .1 Do not proceed without written approval of blasting program from Departmental Representative.
 - .3 Shatter rock to 300 mm below subgrade elevation as indicated.
 - .4 Reduce overbreak and increase stability of rock faces by using smooth blasting techniques.
 - .5 Use smooth blast and excavate short sections in rock cuts to determine optimum spacing of holes when requested by Departmental Representative.
 - .6 Stem holes as necessary to contain blast.
 - .7 Do not use prilled type ammonium nitrate and fuel oil (ANFO) explosives within 4 m of final cut line.
 - .8 Form back wall by pre-splitting at least 10 m in advance of production blasting.
 - .1 Smooth wall blast just prior to or just after production blast as determined by approved blast program.
 - .9 Scale rock backslopes to achieve smooth, stable face, free of loose rock and overhangs to design backslope.
 - .10 Control blasting to minimize flying particles.
- .4 Borrow Excavation:
 - .1 Completely use in embankments, suitable materials removed from right-of-way excavations before taking material from borrow areas.
 - .2 Obtain embankment materials, in excess of what is available from cut areas, from designated borrow areas.
 - .1 Departmental Representative to designate extent of borrow areas and allowable depth of excavation.
 - .2 Remove waste and stripping material from borrow pits to designated locations.
 - .3 Slope edges of borrow areas to minimum 2:1 and provide drainage as directed.
 - .4 Trim and leave borrow pits in condition to permit accurate measurement of material removed.

3.6 EMBANKMENTS

- .1 Scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces.
 - .1 Method used to be to be pre-approved in writing by Departmental Representative.
- .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 by Departmental Representative.
- .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. Departmental Representative 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.

3.7 COMPACTION

- .1 Break material down to sizes suitable for compaction and mix for uniform moisture to full depth of layer.
- .2 Deposit, spread, and level, embankment material in layers 200 mm maximum thickness before compaction.
 - .1 Compact each layer of embankment until compaction equipment achieves no further significant consolidation.
 - .2 Ensure required compaction for each layer before placing any material for next layer.
- .3 Use specialized compaction equipment supplemented by routing, hauling, and leveling equipment over each layer of fill.
- .4 Obtain written approval from Departmental Representative before using specialized compaction equipment such as tamping rollers, vibratory rollers, or other alternate compaction equipment that produces the required results
- .5 Compact each layer to minimum 95% maximum dry density: ASTM D698 except top 150 mm of subgrade.

- .1 Compact top 150 mm to 100% maximum dry density.
- .6 Add water or dry as required to bring moisture content of materials to level required to achieve specified compaction.
- .7 All existing roadways are to be proof-rolled and verified to be acceptable for roadway construction, under supervision of Departmental Representative. Contractor to assume and account for 6 inch depth of possible material rework, removal or replacement in costing. Any work additional to the scope of work as indicated in drawings and herein will be considered to be paid at a unit rate found in the tender form.

3.8 FINISHING

- .1 Shape entire roadbed to within 50 mm of design elevations.
- .2 Finish slopes, ditch bottoms and borrow pits true to lines, grades and drawings where applicable. Scale slope by removing loose fragments, for cut slopes in bedrock steeper than 1:1.
- .3 Remove rocks over 150 mm in dimension from slopes and ditch bottoms.
- .4 Hand finish slopes that cannot be finished satisfactorily by machine.
- .5 Round top of backslope 1.5 m both sides of top of slope.
- .6 Run tractor tracks over slopes exceeding 3 m in height to leave tracks parallel to centreline of highway.
- .7 Trim between constructed slopes and edge of clearing to provide drainage and free of humps, sags and ruts.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and/or recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.10 PROTECTION

- .1 Maintain finished surfaces in condition conforming to this section until acceptance by Departmental Representative.
- .2 Provide silt fences and erosion protection as required to mitigate and prevent impacts to adjacent properties.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 00 – Cleaning.
- .3 Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .4 Section 31 37 00 – Rip Rap.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM D4491-99a (2009), Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .3 ASTM D4595-09, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - .4 ASTM D4716-08, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
 - .5 ASTM D4751-04, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-4.2 No. 11.2-2004, Textile Test Methods - Bursting Strength - Ball Burst Test (Extension of September 1989).
 - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test and Evaluation Reports:
 - .1 Submit copies of mill test data and certificate at least 4 weeks prior to start of Work.

Part 2 Products

2.1 MATERIAL

- .1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.
- .2 Properties:
 - .1 Weight: Minimum 136 g/m².
 - .2 Grab Tensile Strength: Minimum 445 N.
 - .3 Grab Elongation: 50 %.
 - .4 Tear Resistance: Minimum 222 N.
 - .5 Puncture Resistance: Minimum 289 N.
 - .6 Mullen Burst: Minimum 1481 N.
 - .7 Permittivity: Maximum 2.0 sec⁻¹.
 - .8 Water Flow Rate: Maximum 5700 l/min/m².
 - .9 Apparent Opening Size (AOS): 0.212 mm
 - .10 UV Stability: Minimum 70 % @ 500 hours.
- .3 Securing pins and washers: to CSA G40.21, Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m² to ASTM A123M.
- .4 Factory seams: sewn in accordance with manufacturer's recommendations.
- .5 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

Part 3 Execution

3.1 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated.
- .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 Join successive strips of geotextile by sewing.
- .6 Pin successive strips of geotextile with securing pins at midpoint of lap.
- .7 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .8 After installation, cover with overlying layer within 4 hours of placement.
- .9 Replace damaged or deteriorated geotextile to approval of Departmental Representative.
- .10 Place and compact soil layers in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.3 PROTECTION

- .1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 32 19.16 – Geotextile Soil Stabilization.

Part 2 Products

2.1 STONE

- .1 Hard, dense (with specific gravity not less than 2.65) non-ore bearing, non-toxic to aquatic life, durable quarry stone, free from seems, cracks or other structural defects, to meeting the following size distribution for use untended:
 - .1 Class A Rip-Rap: at least 70% of the rip-rap shall have a minimum dimension of between 150 mm and 200 mm as per NSTIR standard specifications.

Part 3 Execution

3.1 PLACING

- .1 Where rip-rap is to be placed on slopes, excavate trench at toe of slope to dimensions as indicated.
- .2 Fine grade area to be rip-rapped to uniform, even surface. Fill depressions with suitable material and compact to provide firm bed.
- .3 Place geotextile on prepared surface in accordance with Section 31 32 19.16 – Geotextile Soil Stabilization and as indicated. Avoid puncturing geotextile. Vehicular traffic over geotextile not permitted.
- .4 Place rip-rap to thickness and details as indicated.
- .5 Place stones in manner approved by Departmental Representative to secure surface and create a stable mass. Place larger stones at bottom of slopes.
- .6 Hand placing:
 - .1 Use larger stones for lower courses and as headers for subsequent courses.
 - .2 Stagger vertical joints and fill voids with rock spalls or cobbles.
 - .3 Finish surface evenly, free of large openings and neat in appearance.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 11 - Cleaning
- .3 Section 01 74 21 – Construction Demolition Waste Management and Disposal.
- .4 Section 31 53 13 – Timber Cribwork.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C127-15 Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
- .2 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO T85 Coarse Aggregate Specific Gravity and Absorption

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
- .2 Collect and separate paper packaging, plastic and corrugated cardboard in accordance with Waste Management Plan.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Fold up metal banding, flatten and place in designated area for recycling.
- .5 Divert left over aggregate materials from landfill to local facility for reuse.

Part 2 Products

2.1 STONE

- .1 Hard, with relative density (formally specific gravity) not less than 2.65 when tested to ASTM C127 or AASHTO T85, durable crushed quarried rock, free from silt, clay, organic matter and other foreign substances and free from splits, seams, cracks or other structural defects likely to impair its soundness during handling or under action of water.
- .2 Coarse Mattress material will be 50 mm clear stone to facilitate levelling.
- .3 Rock fill shall be well graded 200 mm maximum size, free from fines and suitable for placement of mattress material on top.
- .4 Rip Rap will be free of seams that would affect its durability and shall be sized as follows:
 - .1 100% smaller than 450 mm.
 - .2 20% larger than 350 mm.

- .3 50% larger than 300 mm.
- .4 80% larger than 200 mm.

Part 3 Execution

3.1 PREPARATION

- .1 Prepare and level breakwater core stone material in the area where the coarse crushed rock mattress is to be placed.
- .2 Sound area and record elevation of material on which mattress will be placed before placing mattress material, shoreline filter and/or rip rap.
- .3 Excavate shoreline area and record elevations on which the filter fabric and rockfill / shoreline filter stone will be placed.

3.2 PLACEMENT

- .1 Do not place rock fill or mattress material until bottom area has been accepted by Consultant.
- .2 Place mattress material to avoid segregation of material sizes. Do not drop material through water.
- .3 Do not place material under poor weather conditions. Place immediately prior to planned placement of timber cribs.
- .4 Level top surface of coarse mattress to specified grade. Use a sweep beam suspended from a barge as a screed to level surface of each mattress layer. Other methods of levelling may be employed subject to acceptance by Consultant.

3.3 TOLERANCES

- .1 Surface of bearing layer to be within 50 mm of elevation indicated and variation in elevation over whole area of bearing layer not to exceed 50 mm.
- .2 Other layers to be within 100 mm of lines shown.

3.4 PROTECTION

- .1 Consider anticipated weather conditions and degree of exposure of site in setting requirements for protection.
- .2 Schedule and carry out construction so that each phase of work is not left exposed longer than necessary.
- .3 The Contractor should note that the work site is subject to water level variations.
- .4 The Contractor will be responsible to replace any mattress lost due to storms, or by his own activities.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 11 - Cleaning
- .3 Section 01 74 21 – Construction Demolition Waste Management and Disposal
- .4 Section 31 53 13 – Rock Fill, Rip Rap and Mattress.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - .2 ASTM A123/A123M-17 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .3 ASTM B111/B111M-18a Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
- .2 CSA Group (CSA)
 - .1 CSA-O80 Series- 15, Wood Preservation.
- .3 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2017 edition or most recent at the time of tendering.
- .4 Copper naphthenate containing 2% copper for Brush or Spray Treatment for Field Cuts.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 At least two weeks prior to finalizing timber order, submit drawings, clearly indicating assembly of timber pieces for construction of cribwork wharf. Show splice locations, splice details, ballast floor, binder posts, fastening arrangements.
 - .3 Submit detailed methodology for fields treatment, crib building, launching, setting and ballasting.
 - .4 Indicate Contractor's proposed interim / partial height of crib to be constructed and floated into place and the means to complete the crib at the crib site.

1.4 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Worker protection:
 - .1 Workers must wear protective clothing, gloves, long sleeved clothing, eye protection, respirators when handling, drilling, sawing, cutting or sanding preservative treated wood and applying preservative materials.
 - .2 Workers must not eat, drink or smoke while applying preservative material.
 - .3 Clean up spills of preservative materials immediately with absorbent material. Safely discard of adsorbent material to sanitary landfill.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling and /or reuse in accordance with Section 01 74 21 – Construction Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Ensure emptied containers are sealed and stored safely.
- .4 Do not dispose of preservative treated wood through incineration.
- .5 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.
- .6 Dispose of treated wood, end pieces, wood scraps and sawdust at a sanitary landfill.

Part 2 Products

2.1 MATERIALS

- .1 Timber: use timber graded and stamped in accordance with applicable grading rules and standards of associations or agencies approved to grade lumber by Canadian Lumber Standards Accreditation Board of CSA.
 - .1 Species: Eastern Hemlock, Western Hemlock or Douglas Fir Species, only, will be used.
 - .2 Grade: No. 1.
 - .3 Grading authority: NLGA.
 - .4 Preservative treatment: CCA preservative treatment to CAN/CSA-O80 Series 15 for Marine Construction Coastal Waters. Where assay retentions are not indicated, they are to be taken as 1.5 times the indicated gauge retention. Use one type and color of treatment throughout unless otherwise indicated.
 - .1 Make arrangements for timber inspection:
 - .1 Field inspection: providing same information as above and facilitating the inspection in the field.
 - .2 Filling in and submitting a preprinted form, agreed to by the Consultant containing the above information.
 - .3 The Consultant may test in the field or may choose to not test some charges at the field.

- .4 Timber will be protected during handling, shipping, offloading and field handling, by use of suitable equipment and procedures. Use rope or fabric strap slings on site for moving bundles or individual timbers, rather than metal grabs, chains or cables.
- .2 Miscellaneous hardware:
 - .1 Hardware must meet the following specifications:
 - .1 Machine bolts, lag bolts, drift bolts, anchor bolts, nuts, square cut steel plate washers: to ASTM A307.
 - .2 Spikes: to CSA-B111.
 - .3 Hot dip galvanized hardware, bolts, nuts, washers and spikes to ASTM A123, with minimum zinc coating of 600 g/m².
 - .4 All hardware will be galvanized unless otherwise shown on plans.
- .3 Ballast stone for filling cribs to following requirements:
 - .1 Supply hard durable stone containing no organic material, silt, clay, or foreign substances. Ballast stone to be graded on any side and minimum size not less than 250 mm.
 - .2 Minimum specific gravity: 2.65 kg/m³.

Part 3 Execution

3.1 CRIB CONSTRUCTION

- .1 Timber supplied to be precut to required length, per reviewed drawings prior to preservative treatment.
- .2 Boreholes for drift bolts to be 1.5 mm smaller in diameter than bolt and for full length of bolt. Boreholes for machine bolts to be same diameter as bolts. Boreholes for lag bolts to be same diameter as shank for unthreaded portion and 0.70 times the shank diameter for the threaded portion. Threaded portion of lag bolts will be installed using a wrench, not by driving.
- .3 Construct timber cribwork to height indicated in crib building methodology, prior to placing in work.
- .4 Ballast floor: Place ballast floor, as indicated.
- .5 Longitudinals: secure longitudinals to intersection of cross ties with drift bolts and to intersection of vertical posts with machine bolts, as shown on plans.
- .6 Crossties: secure crossties to intersection of longitudinals with drift bolts and to intersection of vertical posts with machine bolts, as shown on plans.
- .7 Vertical posts: to be in one length from bottom of cribwork, unless splice details are shown on plans. Use maximum length binders in the work (i.e. 4.8 m long typically). Stager splices in binder posts.
- .8 Once the crib foundation is finished and before the backfill operations begin, the three sides of the crib not facing the river shall have their void filled with similar lumber elements to prevent backfill from being washed away.

3.2 HANDLING TREATED TIMBER

- .1 Handle treated material to avoid damage causing timber alteration in original treatment.
- .2 Treat in field, spike holes, boreholes, plugged holes, cuts and any damage to treated material, using Copper naphthenate containing 2% copper for brush or spray treatment for field cuts, regardless of plant treatment type. Fill all unused bored holes and any other holes with tight fitting treated wooden plugs prior to any exposure to water containing marine borers.
- .3 Provide methodology pertaining to heating and application. Apply to dry surfaces, wherever possible.
- .4 Treat boreholes, using a pressurized container with an extension rod, to produce a fine spray in the holes with one application. Alternately a cylindrical brush may be used.
- .5 Treat field cuts and any abrasions with minimum of two liberal applications, using either spray or brush.
- .6 In addition, field cuts and underwater damaged areas will receive a coating of plastic compound, capped with lead flashing secured with galvanized roofing nails. Plastic compound not to be water soluble and is subject to approval.
- .7 Environmental concern: ensure no spillage or excess application of field preservative. Provide workmen with sufficient training and protective gear to properly and safely handle the treated materials and to apply field treatment, so as to prevent undue hazard to themselves, others, or the environment.
- .8 Contain all debris and leachates (films on water surface) within the area of the work by using containment facilities such as floating booms or screens.

3.3 PREPARATION

- .1 Mattress:
 - .1 Level top of course mattress, using a sweep beam capable of sweeping the entire width of the mattress in one operation. Once sweeping is done and elevations taken on a grid consisting of every metre along a crosstie location and the same along lines one half metre each side of and parallel to the cross ties. Touch up, re-sweep and repeat the above procedure until the mattress is within the tolerances specified. If any delay what-so-ever exists between final touch-up and crib setting, repeat the above procedure – starting with elevations – immediately prior to placing crib.
 - .2 Alternate methods of levelling subject to acceptance by Consultant.
- .2 Setting Crib:
 - .1 Prior to setting crib, mark locations on all crib vertical posts of known distances above bottom of lowest crosstie, so that elevations of bottom of crib can be easily determined using the tide or survey equipment. Once the initial section of the partially completed crib bottoms out on the falling tide, and prior to placing any ballast, contractor shall check bearing at each crosstie location. At the same time, determine elevation of bottom of crib at each crosstie location along the perimeter and down the middle. If crib is located within tolerances in all respects, commence ballasting and complete construction of the upper portion of the timber cribwork.

- .3 Ballasting:
 - .1 Place ballast stone in a manner which will not damage timber cribwork. As a minimum, the top courses of timber will be protected with planks. Consultant to accept placing methodology.
 - .2 When placing the crib, ballast the bays containing the ballast floors with sufficient (less than 1 metre) ballast to just start setting of the crib. Have crib rechecked for bearing and elevation. If there is no need to correct deficiencies, then ballast these bays just sufficiently and evenly to prevent floatation. Then ballast the bays containing no ballast floor to L.N.T. unless otherwise shown. Thereafter ballast crib uniformly throughout.
- .4 Tolerances:
 - .1 Construction crib overall dimensions to within tolerance of 1 in 300.
 - .2 Locate crib within 50 mm of location indicated.
 - .3 If Contractor decide to build two smaller crib sections in place of one larger crib section, with approval of the Consultant, the adjoining cribs to line up exactly.
 - .4 Final bottom elevation of fully ballasted crib to be 0 to 50 mm below the elevation indicated on the plans.
 - .5 Refloat a crib out of alignment, not correctly located or at wrong elevation. Repair mattress, prior to resetting.
 - .6 Some settlement of the crib structure is anticipated into the mattress. Prior to installation of the upper courses of timbers, check the elevations and provide any shimming necessary, to ensure that the elevations, as shown on the drawings, are met.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Nova Scotia Transportation & Infrastructure Renewal (NSTIR) Standard Specification for Highway Construction and Maintenance, latest edition.
- .2 Section 32 11 23 - Aggregate Base Courses.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused granular material to local facility as approved by Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Type 2 granular in accordance with NSTIR Specifications, as follows:

Sieve Size (mm)	Percent Passing
	Type 2
80	100
56	70 - 100
28	50-80
20	-
14	35-65
5	20-50
1.25	-
0.16	3 - 10
0.08	0 -7

Part 3 Execution

3.1 PLACING

- .1 Place granular sub-base after subgrade is inspected and approved by Departmental Representative.
- .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 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .6 Place material to full width in uniform layers not exceeding indicated compacted thickness.

- .7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .8 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 Departmental Representative before use.
- .3 Equipped with device that records hours of actual work, not motor running hours.
- .4 Compact to density of not less than 100% SPMDD.
- .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 Departmental Representative.
- .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 45,400 kg gross mass with four pneumatic tires each carrying 11,350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm maximum.
- .2 Obtain approval from Departmental Representative to use non-standard proof rolling equipment.
- .3 Proof roll at level in sub-base as indicated.
- .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 Departmental Representative.
 - .2 Backfill excavated subgrade with Type 2 granular and compact as per 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 TESTING

- .1 Contractor shall conduct quality control testing and provide results to Departmental Representative upon request.

- .2 Submit testing procedure and frequency of tests to Departmental Representative for approval.

3.5 SITE TOLERANCES

- .1 Finished sub-base surface to be within 5 mm of elevation as indicated but not uniformly high or low.

3.6 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 Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Nova Scotia Transportation & Infrastructure Renewal (NSTIR) Standard Specification for Highway Construction and Maintenance, latest edition.
- .2 Section 32 11 16.01 – Granular Sub-base.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused granular material to local facility as approved by Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Type 1 granular in accordance with NSTIR Specifications, as follows:

Sieve Size (mm)	Percent Passing
	Type 1
80	-
56	-
28	-
20	100
14	50 - 85
5	20 - 50
1.25	-
0.16	5 - 12
0.080	3-8

Part 3 Execution

3.1 SEQUENCE OF OPERATION

- .1 Place granular base after sub-base surface is inspected and approved by the Departmental Representative.
- .2 Placing
 - .1 Construct granular base to depth and grade in areas indicated.
 - .2 Ensure no frozen material is placed.
 - .3 Place material only on clean unfrozen surface, free from snow and ice.
 - .4 Place material using methods which do not lead to segregation or degradation of

aggregate.

- .5 Place material to full width in uniform layers not exceeding indicated compacted thickness.
 - .6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
 - .7 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment
- .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 the Departmental Representative before use.
 - .3 Equipped with device that records hours of actual work, not motor running hours.
- .4 Compacting
- .1 Compact to density not less than 100% SPMDD.
 - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - .3 Apply water as necessary during compacting to obtain specified density.
 - .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by the Departmental Representative.
 - .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- .5 Proof rolling
- .1 For proof rolling use standard roller of 45,400 kg gross mass with four pneumatic tires each carrying 11,350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm
 - .2 Proof roll at level in granular base as indicated.
 - .3 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
 - .4 Where proof rolling reveals areas of defective subgrade:
 - .1 Remove base, sub-base and subgrade material to depth and extent as directed by Departmental Representative.
 - .2 Backfill excavated subgrade with Type 2 gravel and compact in accordance with Section 32 11 16.01 - Granular Sub-base.
 - .3 Replace sub-base material and compact in accordance with Section 32 11 16.01 - Granular Sub-base.
 - .4 Replace base material and compact in accordance with this Section.

- .5 Where proof rolling reveals defective base or sub-base, remove defective materials to depth and extent as directed by Departmental Representative and replace with new materials in accordance with Section 32 11 16.01 - Granular Sub-base and this section at no extra cost.

3.2 TESTING

- .1 Contractor shall conduct quality control testing and provide results to Departmental Representative upon request.
- .2 Submit testing procedure and frequency of tests to Departmental Representative for approval.

3.3 SITE TOLERANCES

- .1 Finished base surface to be within plus or minus 5 mm of established grade and cross section but not uniformly high or low.

3.4 PROTECTION

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 - Cleaning.
- .3 Section 01 74 19 - Waste Management and Disposal.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A90/A90M-09, Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - .3 A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM F1664-08, Standard Specification for Poly(Vinyl Chloride) (PVC)-Coated Steel Tension Wire Used with Chain-Link Fence.
 - .5 ASTM A123/A123M-09, Standard Specification for Zinc (Hot Dip Galvanized) coatings on Iron and Steel Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-138.1-96, Fabric for Chain Link Fence.
 - .2 CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence.
 - .3 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
 - .4 CAN/CGSB-138.4-96, Gates for Chain Link Fence.
- .3 CSA Group (CSA)
 - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A3000-08, Cementitious Materials Compendium.
- .4 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes, fences, posts and gates and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect fence and gate materials from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with CSA A23.1.
 - .1 Nominal coarse aggregate size: 20-5.
 - .2 Compressive strength: 30 MPa minimum at 28 days.
 - .3 Additives: fly ash to CSA A3000.
- .2 Chain-link fence fabric: to CAN/CGSB-138.1.
 - .1 True No.9 gauge (0.144mm minimum), 50mm mesh with black PVC coating.
 - .2 Height of fabric: as indicated.
- .3 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe. Dimensions as indicated.
- .4 Tension wire: to CAN/CGSB-138.2, single strand, vinyl coated steel wire.
- .5 Tie wire fasteners: steel wire, double twisted, vinyl coated.
- .6 Tension bar: to ASTM A653/A653M, 6 x 22 mm minimum galvanized steel.
- .7 Gates: to CAN/CGSB-138.4.
- .8 Gate frames: to ASTM A53/A53M, galvanized steel pipe, standard weight 114 mm outside diameter pipe for outside frame, 43 mm outside diameter pipe for interior bracing.
 - .1 Fabricate gates as indicated with electrically welded joints.
 - .2 Fasten fence fabric to gate with twisted selvage at top.
 - .3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.
- .9 Fittings and hardware: to CAN/CGSB-138.2, galvanized steel.
 - .1 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.
 - .2 Turnbuckles to be drop forged.

2.2 FINISHES

- .1 Galvanizing:
 - .1 For chain link fabric: to CAN/CGSB-138.1.
 - .2 For pipe: 550 g/m² minimum to ASTM A90.
 - .3 For other fittings: to ASTM A123/A123M.
- .2 Vinyl coating: to ASTM F1664.
 - .1 0.045 mm dry film thickness minimum.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for fence and gate installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Grading:
 - .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.
 - .1 Provide clearance between bottom of fence and ground surface of 30 mm to 50 mm.

3.3 ERECTION OF FENCE

- .1 Erect fence along lines as indicated.
- .2 Excavate post holes to dimensions indicated.
- .3 Space line posts 3 m apart, measured parallel to ground surface.

- .4 Space straining posts at equal intervals not to exceed 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade, is greater than 150 m.
- .5 Install additional straining posts at sharp changes in grade and where directed by Departmental Representative.
- .6 Install corner post where change in alignment exceeds 10 degrees.
- .7 Install end posts at end of fence and at buildings.
 - .1 Install gate posts on both sides of gate openings.
- .8 Place concrete in post holes then embed posts into concrete to depths indicated.
 - .1 Extend concrete 50 mm above ground level and slope to drain away from posts.
 - .2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .9 Install fence fabric after concrete has cured, minimum of 5 days.
- .10 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface.
 - .1 Install braces on both sides of corner and straining posts in similar manner.
- .11 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.
- .12 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.
- .13 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals.
 - .1 Knuckled selvedge at bottom.
 - .2 Twisted selvedge at top.
- .14 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals.
 - .1 Give tie wires minimum two twists.

3.4 INSTALLATION OF GATES

- .1 Install gates in locations as indicated.
- .2 Level ground between gate posts and set gate bottom approximately 50 mm above ground surface.
- .3 Determine position of centre gate rest for double gate.
 - .1 Cast gate rest in concrete as directed.
 - .2 Dome concrete above ground level to shed water.
- .4 Install gate stops where indicated.

3.5 TOUCH UP

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and/or recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 00 – Cleaning.
- .3 Section 31 14 13 – Soil Stripping and Stockpiling.

1.2 REFERENCES

- .1 Agriculture and Agri-Food Canada
 - .1 The Canadian System of Soil Classification, Third Edition, 1998.
- .2 Canadian Council of Ministers of the Environment
 - .1 PN1340-2005, Guidelines for Compost Quality.

1.3 DEFINITIONS

- .1 Compost:
 - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
 - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
 - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below 50), and contain no toxic or growth inhibiting contaminants.
 - .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category A.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submittals:
 - .1 Soil testing: submit certified test reports showing compliance with specified performance characteristics and physical properties as described in PART 2 - SOURCE QUALITY CONTROL.
 - .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused soil amendments from landfill to official hazardous material collections site approved by Departmental Representative.
- .2 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 TOPSOIL

- .1 Topsoil for seeded areas: mixture of particulates, microorganisms and organic matter which provides suitable medium for supporting intended plant growth.
 - .1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70 % sand, minimum 7 % clay, and contain 2 to 10 % organic matter by weight.
 - .2 Contain no toxic elements or growth inhibiting materials.
 - .3 Finished surface free from:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
 - .4 Consistence: friable when moist.

2.2 SOIL AMENDMENTS

- .1 Fertilizer:
 - .1 Fertility: major soil nutrients present in following amounts:
 - .2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
 - .3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
 - .4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
 - .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
 - .6 Ph value: 6.5 to 8.0.
- .2 Peatmoss:
 - .1 Derived from partially decomposed species of Sphagnum Mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5 mm.
- .3 Sand: washed coarse silica sand, medium to course textured.
- .4 Organic matter: compost Category A in accordance with CCME PN1340, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
- .5 Limestone:
 - .1 Ground agricultural limestone.
 - .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .6 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

Part 3 Execution

3.1 STRIPPING OF TOPSOIL AND STOCKPILING

- .1 In accordance with Section 31 14 13 – Soil Stripping and Stockpiling.

3.2 PREPARATION OF EXISTING GRADE

- .1 Verify that grades are correct.
 - .1 If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.
 - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
 - .2 Remove debris which protrudes more than 75 mm above surface.
 - .3 Dispose of removed material off site.
- .4 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm.
 - .1 Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after Departmental Representative accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.4 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
 - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by Departmental Representative.
 - .1 Leave surfaces smooth, uniform and firm against deep foot printing.

3.5 ACCEPTANCE

- .1 Departmental Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.6 SURPLUS MATERIAL

- .1 Dispose of materials except topsoil not required where directed by Departmental Representative.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 00 – Cleaning.

1.2 SCHEDULING

- .1 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.
- .2 Scheduling:
 - .1 Schedule hydraulic seeding to coincide with preparation of soil surface.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for seed, mulch, tackifier, fertilizer, liquid soil amendments and micronutrients.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Landscape Contractor: to be a Member in Good Standing of Landscape Nova Scotia.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Labelled bags of fertilizer identifying mass in kg, mix components and percentages, date of bagging, supplier's name and lot number.
 - .2 Inoculant containers to be tagged with expiry date.
- .3 Storage and Handling Requirements:
 - .1 Store fertilizer in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.7 WARRANTY

- .1 For seeding, 12 months warranty period is extended to 1 full growing season.
- .2 End-of-warranty inspection will be conducted by Owner.

Part 2 Products

2.1 MATERIALS

- .1 Seed: "Canada Pedigreed Grade" in accordance with Government of Canada *Seeds Act* and Regulations.
 - .1 Grass mixture: "Certified", "Canada No. 1 Lawn Grass Mixture" in accordance with Government of Canada "Seeds Act" and "Seeds Regulations".
 - .1 Mixture composition:
 - .1 40 % Kentucky Blue Grass.
 - .2 40 % Creeping Red Fescue.
 - .3 20% Annual Rye Grass.
 - .2 Mulch: specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors with following properties:
 - .1 Type I mulch:
 - .1 Made from wood cellulose fibre.
 - .2 Organic matter content: 95% plus or minus 0.5%.
 - .3 Value of pH: 6.0.
 - .4 Potential water absorption: 900%.
 - .3 Tackifier: water soluable, liquid dispersion.
 - .4 Water: free of impurities that would inhibit germination and growth.
 - .5 Fertilizer:
 - .1 To Government of Canada *Fertilizers Act* and Regulations.
 - .2 Complete synthetic, slow release with 35% of nitrogen content in water-insoluble form.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for hydraulic seeding.
 - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLERS

- .1 Use installers with a membership in Good Standing with Landscape Nova Scotia.

3.3 PROTECTION OF EXISTING CONDITIONS

- .1 Protect structures, signs, guide rails, fences, plant material, utilities and other surfaces not intended for spray.
- .2 Immediately remove any material sprayed where not intended.

3.4 PREPARATION OF SURFACES

- .1 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, frozen ground or ground covered with snow, ice or standing water.
- .2 Fine grade areas to be seeded free of humps and hollows.
 - .1 Ensure areas are free of deleterious and refuse materials.
- .3 Cultivated areas identified as requiring cultivation to depth of 25 mm.
- .4 Ensure areas to be seeded are moist to depth of 150 mm before seeding.
- .5 Obtain Departmental Representative's approval of grade and topsoil depth before starting to seed.

3.5 FERTILIZING PROGRAM

- .1 Fertilize prior to fine grading, during establishment and warranty period in accordance with manufacturer's recommendations.

3.6 PREPARATION OF SLURRY

- .1 Measure quantities of materials by weight or weight-calibrated volume measurement satisfactory to Departmental Representative.
- .2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.
- .3 After materials are in seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

3.7 SLURRY APPLICATION

- .1 Hydraulic seeding equipment:
 - .1 Slurry tank.
 - .2 Agitation system for slurry to be capable of operating during charging of tank and during seeding, consisting of recirculation of slurry and/or mechanical agitation method.
 - .3 Capable of seeding by 50 m hand operated hoses and appropriate nozzles.

- .4 Tank volume to be certified by certifying authority and identified by authorities "Volume Certification Plate".
- .2 Slurry mixture shall be applied to surface in accordance with manufacturer's instructions and as approved by Departmental Representative.
- .3 Slurry to be applied at a minimum application rate of 100 kg/ha.
- .4 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.
 - .1 Using correct nozzle for application.
 - .2 Using hoses for surfaces difficult to reach and to control application.
- .5 Blend application 300 mm into adjacent grass areas or sodded areas or previous applications to form uniform surfaces.
- .6 Re-apply where application is not uniform.
- .7 Remove slurry from items and areas not designated to be sprayed.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
 - .1 Clean and reinstate areas affected by Work.

3.9 PROTECTION

- .1 Protect seeded areas from trespass until plants are established.
- .2 Remove protection devices as directed by Departmental Representative.

3.10 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following operations from time of seed application until acceptance by Owner.
- .2 Grass Mixture:
 - .1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
 - .2 Mow grass to 50 mm whenever it reaches height of 70 mm. Remove clippings which will smother grass.
 - .3 Fertilize seeded areas after 10 weeks after germination provided plants have mature true leaves in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles.
 - .4 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.
 - .5 Water seeded area to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.

3.11 ACCEPTANCE

- .1 Seeded areas will be accepted by Owner provided that:
 - .1 Plants are uniformly established and seeded areas are free of rutted, eroded, bare or dead spots.
 - .2 Areas have been mown at least twice.
 - .3 Areas have been fertilized.
- .2 Areas seeded in fall will achieve final acceptance in following spring, one month after start of growing season provided acceptance conditions are fulfilled.

3.12 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period:
 - .1 Repair and reseed dead or bare spots to satisfaction of Owner.
 - .2 Mow areas seeded and remove clippings that will smother grassed areas as directed by Owner.
 - .3 Fertilize seeded areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 32 91 19.13 - Topsoil Placement and Grading.

1.2 REFERENCES

- .1 Canadian Nursery Landscape Association (CNLA)
- .1 Canadian Standards for Nursery Stock.

1.3 SOURCE QUALITY CONTROL

- .1 Obtain approval from Owner's Representative of plant material at source prior to digging.
- .2 Notify Owner's Representative of source of material at least seven (7) days in advance of shipment. No work under this section is to proceed without approval.
- .3 Acceptance of plant material at its source does not prevent rejection on site prior to or after planting operations.
- .4 Imported plant material must be accompanied with necessary permits and import licenses. Conform to federal and provincial regulations.

1.4 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificate: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical characteristics.
- .3 Pre-installation meetings: conduct pre-installation meetings to verify project requirements, installation instructions and warranty requirements.

1.5 SHIPMENT AND PRE-PLANTING CARE, STORAGE AND PROTECTION

- .1 Co-ordinate shipping of plants and excavation of holes to ensure minimum time lapse between digging and planting.
- .2 Tie branches of trees and shrubs securely and protect plant material against abrasion, exposure and extreme temperature change during transit. Avoid binding of plant stock with rope or wire which would damage bark, break branches or destroy natural shape of plant. Give full support to root ball of large trees during lifting.

- .3 Remove broken and damaged roots with sharp pruning shears. Make clean cut and cover cuts over 10 mm diameter with wound dressing.
- .4 Keep roots moist and protected from sun and wind. Heel-in trees and shrubs, which cannot be planted immediately, in shaded areas and water well
- .5 Protect plant material from frost, excessive heat, wind and sun during delivery.
- .6 Protect plant material during transportation:
 - .1 When delivery distance is less than 30 km and vehicle travels at speeds under 80 km/hr, tie tarpaulins around plants or over vehicle box.
 - .2 When delivery distance exceeds 30 km or vehicle travels at speeds over 80 km/hr. use enclosed vehicle where practical.
 - .3 Protect foliage and root balls using anti-desiccants and tarpaulins, where use of enclosed vehicle is impractical due to size and weight of plant material.
- .7 Protect stored plant material form frost, wind and sun as follows:
 - .1 For bare root plant material preserve moisture around roots by heeling-in or burying roots in sand or topsoil and watering to full depth of root zone.
 - .2 For pots and containers, maintain moisture level in containers.
 - .3 For balled and burlapped and wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones.

1.6 WARRANTY

- .1 The contractor will warrant that plant material as itemized on the drawings will remain free of defects in accordance with GC31, but for two (2) full growth seasons.
- .2 End-of-warranty inspection will be conducted.
- .3 Owner's Representative reserves the right to extend contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

1.7 SUBMITTALS

- .1 Submit product data for:
 - .1 Fertilizer
 - .2 Anti-desiccant
 - .3 Guying assembly including clamps, collar, guying wire, anchors and wire tightener.
 - .4 Mulch

1.8 REPLACEMENT

- .1 During warranty period, remove from site any plant material that has dried or failed to grow satisfactorily as determined by Owner's Representative.

- .2 Replace plant material in the next planting season.
- .3 Extend warranty for replacement plant material for a period equal to the original warranty period.
- .4 Continue such replacement and warranty until plant material is acceptable.

Part 2 Products

2.1 MATERIALS

- .1 Water: potable and free of minerals and impurities that would inhibit plant growth.
- .2 Stakes: T-bar, steel, 40 x 40 x 5 x 2440 mm, primed with one brush coat of black zinc-rich paint.
- .3 Cables and accessories: factory galvanized cables, wire tighteners, eyebolts and turnbuckles. Use turnbuckles with 150 mm long eyebolts and 100 mm diameter threaded opening for tightening.
- .4 Guy wires: steel wire strand to CSA-G4, at following sizes:
 - .1 Shrubs and trees under 75 mm caliper use 2.5 mm wire.
 - .2 Trees 75 to 150 mm caliper use 3 mm wire.
- .5 Tree Rigs: fabricated from 3 mm galvanized wire encased in two ply reinforced 12 mm diameter rubber garden hose or equivalent.
- .6 Wire Mesh: galvanized, electrically welded.
 - .1 For tree guards use 1.4 mm wire with 25 x 50 mm mesh.
- .7 Reinforcing Rod: 10 mm bars to CSA G30.12.
- .8 Fiberglass Fabric: tight woven, minimum 2.5 kg/m² mass, 1 m wide.
- .9 Root Bull Burlap: 150 g Hessian burlap.
- .10 Tree wrapping material: new, clean, plain burlap strips minimum 2.5 kg/m² mass and 150 mm wide.
- .11 Anchors: T-bar steel stakes 40 x 50 x 50 mm long.

- .12 Mulch:
 - .1 Peatmoss: decomposed plant material, fairly elastic and homogeneous, free of decomposed colloidal residue, wood, sulphur and iron containing 60% organic matter by weight, and moisture content not exceeding 15%. Shredded particles may not exceed 6 mm in size. Minimum pH value of peat 4.5, maximum 6.0.
 - .2 Bark Chip Mulch: chips from bark of coniferous trees varying in size from 25 to 50 mm diameter.
 - .3 Wood Chip Mulch: chips, free of bark, small branches, leaves and varying in size from 50 to 75 mm and 5 mm to 20 mm thick.
 - .4 Shredded wood: varying in size from 25 to 125 mm in lengths with coniferous trees.
- .13 Anti-desiccant: Wax-like emulsion to provide film over plant surfaces reducing evaporation but permeable enough to permit transportation.
- .14 Wound dressing: horticulturally accepted non-toxic, non-hardening emulsion.

2.2 PLANT MATERIAL

- .1 Quality and source: comply with Guide Specifications for Nursery Stock, referring to size and development of plant material and root ball. Measure plants when branches are in their natural position. Height and spread dimensions refer to main body of plant and not from branch tip to branch tip. Use trees and shrubs of No 1 grade.
- .2 Additional plant material qualifications:
 - .1 Plant material obtained from areas with milder climatic conditions from those of site acceptable only when moved to site prior to the braking of buds in their original location, and heeded-in, in a protected area until conditions suitable for planting.
 - .2 Use trees and shrubs with strong fibrous root system free from disease, insects, defects or injuries and structurally sound. Use trees with straight trunks, well and characteristically branched for species. Plants must have been root pruned regularly, but not later than one growing season prior to arrival on site.
 - .3 Large trees must have been half root pruned during each of two successive growing seasons. The latter at least one growing season prior to arrival on site.
 - .4 Plant material that has come out of dormant stage and is too far advanced will not be accepted unless prior approval obtained.
- .3 Cold storage: approval required for plant material which has been held in cold storage.
- .4 Container - Grown Stock: acceptable if containers large enough for root development. Trees and shrubs must have grown in container for minimum of one growing season but not longer than two. Root system must be able to "hold" soil when removed from container. Plants that have become root bound are not acceptable. Container stock must have been fertilized with slow releasing fertilizer.
- .5 Balled and Burlapped: coniferous and broad-leafed evergreens over 500 mm tall must be dug with soil ball. Deciduous trees in excess of 3 m in height must have been dug with

large firm ball. Root balls must include 75% of fibrous and feeder root system. This excludes use of native trees grown in light, sandy or rocky soil. Secure root balls with burlap, heavy twine or rope. For large trees, wrap ball in double layer of burlap and drum lace with minimum 10 mm diameter rope. Protect root balls against sudden changes in temperature and exposure to heavy rainfall.

- .6 Frozen Ball for Large Trees: dig root ball in fall when soil conditions permit good ball formation. Mulch root ball to prevent intermittent freezing.
- .7 Tree Spade Dug Material: dig plant material with mechanized digging equipment of hydraulic space or clam-shell type. Root balls to satisfy CNLA standards. Lift root ball from hole, place in wire basket designed for purpose and line with burlap. Replace root ball and tie basket to ball with heavy rope. Take care not to injure trunk of tree with wire basket ties or rope.
- .8 Collected or Native Plant Material: use only native trees indigenous to area into which they are to be transplanted. Select trees from reasonably open stands. Trees must have well developed crowns and must be characteristically branched. Not more than 40% of overall tree height may be free of branches.
- .9 Substitutions to plant material as indicated on planting plan not permitted unless written approval has been obtained as to type, variety and size. Plant substitutions must be of similar species and of equal size as those originally specified.

Part 3 EXECUTION

3.1 PRE-PLANTING OPERATIONS

- .1 Ensure plant material is acceptable to Owner's Representative.
- .2 Remove damaged roots and branches from plant material
- .3 Apply anti-desiccant to conifers and deciduous trees in leaf in accordance with manufacturer's instructions.
- .4 Stake out locations of trees and planting beds as per planting plan. Obtain approval prior to excavating.
- .5 Coordinate operations. Keep site clean and planting holes drained. Immediately remove soil and debris spilled onto pavement.

3.2 PLANTING TIME

- .1 Plant deciduous plant material during dormant period before buds have broken. Plant material noted for spring planting only, must be planted in dormant period.
- .2 Plant material imported from region with warmer climatic conditions may only be planted in early spring.

- .3 When permission has been obtained to plant deciduous plant material after buds have broken, spray plant with anti-desiccant to slow down transpiration prior to transplanting.
- .4 Plant evergreens in spring before bud break. Planting of such stock with root balls may start after middle of August. Apply anti-desiccant to evergreen before digging.
- .5 When permission has been obtained, trees, shrubs and ground covers growing in containers may be planted throughout growing season.
- .6 Plant only under conditions that are conducive to health and physical conditions of plants.
- .7 Provide planting schedule. Extending planting operations over long period using limited crew will not be accepted.

3.3 EXCAVATION

- .1 Shrub Beds: excavate to minimum depth of 500 mm.
- .2 Individual Shrubs: excavate planting holes 500 mm deep and at least 500 mm wide.
- .3 Small trees (up to 3.0 m): excavate holes 600 mm deep with diameter of 300 mm greater than root spread of root ball.
- .4 Excavate to depth and width as indicated.
- .5 Provide drainage for planting holes in heavy soil if natural drainage does not exist. Have method approved.
- .6 Remove subsoil, rocks, roots, debris and toxic material from excavated material that will be used as planting soil. Dispose of excess material.
- .7 Protect bottom of excavations against freezing.
- .8 Remove water which enters excavations prior to planting. Ensure source of water is not ground water.

3.4 PLANTING

- .1 Loosen bottom of planting hold to depth of 150 mm to 200 mm. Cover bottom of each excavation with minimum of 150 mm of topsoil mixture.
- .2 Plant trees and shrubs vertically with roots placed straight out in hole. Orient plant material to give best appearance in relation to structure roads and walks.
- .3 Place plant material to depth equal to depth they were originally growing in nursery.
- .4 With balled and burlapped root balls, loosen burlap and cut away minimum top 1.3 without disturbing root ball. With container stock, remove entire container without disturbing root ball. Non bio-degradable wrappings must be removed.

- .5 Tree spade Excavated Material:
 - .1 Dig tree pit with same mechanical equipment as used to dig plant material. Ensure hole dug is as upright as possible. Place in hole a mixture of 40 L of planting soil and fertilizer mixed with water to soupy consistency. This will be forced upside of ball as root ball is placed in hole.
 - .2 In heavy clay soil dig planting pit as specified for excavation of large trees. Pit Preparation: Loosen bottom of planting hole to depth of 150 to 200 mm. Cover bottom of each excavation with minimum 150 mm topsoil mixture.
- .6 During planting of bare-rooted stock, first shake backfill of planting soil among the roots.
- .7 Tamp planting soil around root system in layers of 150 mm eliminating air voids. Frozen or saturated planting soil is unacceptable. When 2/3 of planting soil has been placed, fill hole with water. After water has completely penetrated into soil, complete backfilling.
- .8 Build 100 mm deep saucer around outer edge of hole to assist with maintenance watering.
- .9 When planting is completed, give surface of planting saucer dressing or organic 10-6-4 fertilizer at rate of 12 kg/100m² for shrub beds, or 40 to 50g/mm of caliper for trees. Mix fertilizer thoroughly with top layer of planting soil and water in well.

3.5 TREE SUPPORT

- .1 Tree support: minimum to three (3) stakes.
- .2 Staking for trees up to 3 m and evergreen up to 2 m in height: backfill planting hole 2/3, drive T-rail stake 900 mm into bottom of pit, taking care not to damage main roots. Place stake or anchor 150 mm away from trunk on side of prevailing wind. Fasten trunk to stake or anchor with tree-ring. Different methods of fastening tree trunk to stake or anchor are acceptable if no damage to bark of tree will occur. Obtain approval prior to using other methods.
- .3 Tree Stakes and Wire Mesh: Protect trees indicated as requiring tree guards. Encircle staked trees with galvanized wire mesh. Leave space of at least 150 mm between tree trunk and wire mesh. Fasten wire mesh to stake at 4 places using 3 mm wire.
- .4 Guy Wires for Trees up to 150 mm Caliper:
 - .1 For deciduous trees taller than 3 m and evergreens taller than 2 m. Fasten three wires to tree where a branch will prevent skipping down. Use tree rings to prevent abrasion of bark.
 - .2 Fasten guy wires to anchors at distance from tree base equal to height of where wire is attached to trunk. Break wires, install wire tighteners and tighten slightly.
 - .3 Where guy wires are used close to pedestrian traffic ways, paint turnbuckles orange to make them clearly visible.
 - .4 Use sufficient number of guy wires to support large shrubs.

3.6 TRUNK PROTECTION

- .1 Install trunk protection on deciduous trees as indicated.
- .2 Install trunk protection prior to installation of tree supports when used.
- .3 Wrap deciduous trees, whose caliper is 20 to 50 mm spirally from ground up to height of second branches. Treat trunk with paste of long residual insecticide, lindane or equivalent before applying wrapping. Secure burlap with binder twine wound in opposite direction to burlap of 100 mm intervals. Place wrapping neatly and snugly with 40 mm overlap.

3.7 PRUNING

- .1 Prune trees and shrubs after planting as indicated to compensate for loss of roots suffered during transplanting. Postpone pruning of those trees where heavy bleeding may occur, until in full leaf. Employ clean sharp tools and make cuts flush with main branch. Smooth and sloping as to prevent accumulation of water. Remove projecting stumps on trunks or main branches. Remove dead and injured branches and branches that rub causing damage to bark. Trim out crown of trees and shrubs without changing their natural shape. Do not damage lead branches or remove smaller twigs along main branches. Treat cuts in excess of 20 mm dia. and damaged parts with application of wound dressing.

3.8 MULCHING

- .1 Obtain approval of planting before mulching material is applied. Loosen soil in planting beds and pits and remove debris and weeds. Spread mulch to minimum thickness of 50 mm. Mulch material susceptible to blowing must be moistened and mixed with topsoil before applying. When mulching is placed in fall, place immediately after planting. When mulching is placed in spring, wait until soil has warmed up.

3.9 MAINTENANCE

- .1 Water once a week for first four (4) weeks and then sufficiently thereafter to maintain optimum growing conditions. Ensure adequate moisture in root zone at freeze-up.
- .2 Keep soil within confines of planting saucer around trees and planting beds, shallowly cultivated and free from weeds.
- .3 Spray plants to combat pests and diseases. Do not use DDT or sprays prohibited by Agriculture Canada.
- .4 Keep tree guards and guy wires in proper repair.
- .5 Provide adequate protection against winter damage, including damage caused by rodents.

- .6 Maintain plant material from date of planting up to end of warranty period.
- .7 Remove trunk wrapping, tree stakes, guy wires and eyebolts at end of warranty period.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 74 00 - Cleaning.
- .4 Section 01 74 19 - Waste Management and Disposal.
- .5 Section 31 05 16 - Aggregate Materials.
- .6 Section 31 23 33.01 - Excavating Trenching and Backfilling.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A123/A123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM C117-13, Standard Test Method for Materials Finer than 75-mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM C478M-13, Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
 - .5 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA Group
 - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A165 Series-04 (R2009), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for maintenance holes and catch basin structures and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia, Canada.

1.4 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 45 00 - Quality Control.
- .2 Certifications:
 - .1 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work. Include manufacturer's drawings, information and shop drawings where pertinent.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect maintenance holes and catch basin structures from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Precast maintenance hole units: to ASTM C478M, circular or oval.
 - .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
- .2 Joints: made watertight using rubber rings, bituminous compound, epoxy resin cement or cement mortar.
- .3 Mortar:
 - .1 Masonry Cement: to CAN/CSA-A3002.
- .4 Ladder rungs: to CSA G30.18, No.25M billet steel deformed bars, hot dipped galvanized to ASTM A123/A123M.
 - .1 Rungs to be safety pattern (drop step type).
- .5 Adjusting rings: to ASTM C478M.
- .6 Concrete Brick: to CAN/CSA-A165 Series.
- .7 Drop maintenance hole pipe: same as sewer pipe.

- .8 Galvanized iron sheet: approximately 2 mm thick.
- .9 Steel gratings, I-beams and fasteners: as indicated.
- .10 Frames, gratings, covers to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames.
 - .1 Frame with grating or cover to constitute one unit.
 - .2 Assemble and mark unit components before shipment.
 - .2 Maintenance hole frames and covers: heavy duty municipal type for road service; light duty for landscape service.
 - .3 Size: 762 mm clear diameter.
- .11 Granular bedding and backfill: in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 As indicated and in accordance with NSTIR standard specifications.
- .12 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for maintenance holes and catch basin structures installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling and as indicated.
- .2 Obtain approval of Departmental Representative before installing outfall structures, maintenance holes or catch basins.

3.3 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Complete units as pipe laying progresses.
 - .1 Maximum of 3 units behind point of pipe laying will be allowed.
- .3 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.

- .4 Cast bottom slabs directly on undisturbed ground.
- .5 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% maximum density to ASTM D698.
- .6 Precast units:
 - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.
 - .2 Make each successive joint watertight with Departmental Representative's approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.
 - .3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 - .4 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
- .7 Compact granular backfill to 95% maximum density to ASTM D698.
- .8 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .9 Installing units in existing systems:
 - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
 - .2 Make joints watertight between new unit and existing pipe.
 - .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
- .10 Place frame and cover on top section to elevation as indicated.
 - .1 If adjustment required use concrete ring.
- .11 Clean units of debris and foreign materials.
 - .1 Remove fins and sharp projections.
 - .2 Prevent debris from entering system.
- .12 Install safety platforms in maintenance holes having depth of 5 m or greater, as indicated.

3.4 ADJUSTING TOPS OF EXISTING UNITS

- .1 Remove existing gratings, frames and store for re-use at locations designated by Departmental Representative.
- .2 Sectional units:
 - .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
 - .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.

- .1 When amount of raise is less than 600 mm use standard maintenance hole brick, modoloc or grade rings.

3.5 FIELD QUALITY CONTROL

- .1 Leakage Test:
 - .1 Install watertight plugs or seals on inlets and outlets of each new sanitary sewer maintenance hole and fill maintenance hole with water.
 - .2 Leakage not to exceed 0.3% per hour of volume of maintenance hole.
 - .3 If permissible leakage is exceeded, correct defects.
 - .4 Repeat until approved by Departmental Representative.
- .2 Departmental Representative will issue Test Certificate for each maintenance hole passing test.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and/or reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 00 – Cleaning.
- .3 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA B301-10, Standard for Liquid Chlorine.
 - .2 ANSI/AWWA C651-05, Standard for Disinfecting Water Mains.
- .2 ASTM International (ASTM)
 - .1 ASTM B88-16, Standard Specification for Seamless Copper Water Tube.
 - .2 ASTM F714-10, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certification: to be marked on pipe.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PIPE, JOINTS AND FITTINGS

- .1 Polyethylene pressure pipe:
 - .1 NPS 1/2 to NPS 6: to CAN/CSA-B137.1, PE 4801, DR 17
 - .2 Polyethylene to polyethylene joints: to be fit using compression joints.
 - .3 Polyethylene fittings: to CAN/CSA-B137.1, for pipe sizes NPS 4 and less.

2.2 VALVES AND VALVE BOXES

- .1 Valves to open counter clockwise.
- .2 Gate valve (below ground) to be HDPE with adjustable service box with stem to suit depth of bury.
- .3 Ball valves to be HDPE with socket joints.

2.3 VALVE CHAMBERS

- .1 Precast concrete sections to ASTM C478M.
- .2 Valve chamber frames and covers: grey iron castings, minimum tensile strength 200 MPa, with two coats, shop applied, approved asphalt coating.
 - .1 Design and dimensions as indicated.
 - .2 Cover to be marked "WATER"/"EAU".

2.4 SERVICE CONNECTIONS

- .1 Pipe:
 - .1 Copper tubing: to ASTM B 88, type K annealed, minimum pressure rating of 1035 kPa.
- .2 Joints: compression type, minimum pressure rating of 1035 kPa.
- .3 Brass curb stops and drain: to ASTM B584, NSF 61-G, compression type joints. Minimum pressure rating of 1035 kPa.
 - .1 Curb stops to have adjustable cast iron service box with stem to suit depth of bury.
 - .2 Top of cast iron box marked "WATER"/"EAU".
- .4 Service saddle: bronze body, confined O-ring seal cemented in place, double stainless steel strap type and straps suitable for connecting to a main. Outlet tapped and threaded to ANSI/AWWA C800.

2.5 GRANULAR BEDDING AND BACKFILL

- .1 As indicated on drawings and to Section 31 23 33.01 – Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Clean pipes, fittings, valves, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects to approval of Departmental Representative.
 - .2 Remove defective materials from site as directed by Departmental Representative.

3.3 SERVICE CONNECTIONS

- .1 Terminate building water service 1 m outside building wall.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker in the form of a red stake to locate pipe end.
- .2 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops as indicated.
- .3 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .4 Leave corporation stop valves fully open.
- .5 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .6 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.
- .7 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.

3.4 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Ensure trench depth allows coverage over pipe of 1.2 m minimum from finished grade unless indicated otherwise
- .3 Trench alignment and depth require Departmental Representative's approval prior to placing bedding material and pipe.

3.5 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 98% SPMDD to ASTM D698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling with compacted bedding material.

3.6 PIPE INSTALLATION

- .1 Lay pipes to manufacturer's standard instructions and specifications.
- .2 Join pipes in accordance with manufacturer's recommendations.
- .3 Handle pipe by methods recommended by pipe manufacturer and approved by Departmental Representative.
- .4 Lay pipes on prepared bed, true to line and grade.
- .5 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
- .6 Position and join pipes with equipment and methods approved by Departmental Representative.
- .7 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .8 Align pipes before jointing.
- .9 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .10 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes.
- .11 Do not lay pipe on frozen bedding.
- .12 Backfill remainder of trench.

3.7 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of bedding same as adjacent pipe. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.

3.8 VALVE CHAMBERS

- .1 Use precast units as approved by the Departmental Representative.
- .2 Construct units as indicated, plumb and centred over valve nut, true to alignment and grade, and not resting on pipe.
- .3 Set bottom section of precast unit in bed of drainage stone, compacted to 90% SPMDD.
 - .1 Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.
- .4 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.
- .5 Plug lifting holes with mastic compound or mortar.
- .6 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring.

3.9 HYDROSTATIC TESTING

- .1 Do tests in accordance with ANSI/AWWA C600.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Departmental Representative at least 24 hours in advance of proposed tests.
 - .1 Perform tests in presence of Departmental Representative.
- .4 Test in sections not exceeding 365 m in length.
- .5 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated.
- .6 Leave valves, joints and fittings exposed.
- .7 Open valves.
- .8 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .9 Thoroughly examine exposed parts and correct for leakage as necessary.
- .10 Apply leakage test pressure of 1035 kPa minimum after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.

- .11 No leakage is permitted by the test.
- .12 Locate and repair defects if leakage is observed.
- .13 Repeat test until defects have been corrected.
- .14 As part of work in this contract, Contractor is to complete testing and commissioning for all existing water distribution infrastructure. Any underground pipe breaks or repairs to existing undergrounds as a result of this testing will have to be paid at a unit rate found in the tender form.

3.10 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated on drawings.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 98% SPMDD to ASTM D698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 98% SPMDD to ASTM D698.

3.11 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated on drawings.
- .2 Do not place backfill in frozen condition.
- .3 Under roadways and walkways, compact backfill to at least 98% SPMDD.
 - .1 In other areas, compact to at least 95% SPMDD to ASTM D698.

3.12 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: to be carried out by the Contractor.
 - .1 Notify Departmental Representative at least 2 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 0.8 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.
- .3 Flushing flows as follows:

Pipe Size NPS	Flow (L/s) Minimum
6 and below	38
8	75
10	115
12	150

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hose bibbs and service connections to ensure thorough flushing.
- .6 When flushing has been completed, introduce strong solution of chlorine as approved by Departmental Representative into water main and ensure that it is distributed throughout entire system.
- .7 Disinfect water mains.
- .8 Rate of chlorine application to be proportional to rate of water entering pipe.
- .9 Chlorine application to be close to point of filling water main and to occur at same time.
- .10 Operate valves, hose bibbs and appurtenances while main contains chlorine solution.
- .11 Flush line to remove chlorine solution after 24 hours. Chlorinated water shall not be allowed to enter waterways, wetlands or other natural water bodies during flushing.
- .12 Measure chlorine residuals at extreme end of pipe-line being tested.
- .13 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of 2 days.
 - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.

3.13 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface as indicated.

3.14 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .2 CSA International
 - .1 CSA B1800-11, Thermoplastic Non-pressure Pipe Compendium.
 - .1 CSA B182.2-11, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.
 - .2 CSA B182.11-11, Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certification: to be marked on pipe.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PLASTIC PIPE

- .1 Type PSM Polyvinyl Chloride (PVC): to CAN/CSA B1800 unless otherwise noted.

- .1 Standard Dimensional Ratio (SDR): 35 for pipes 150mm or larger.
- .2 Locked-in gasket and integral bell system.

2.2 GRANULAR BEDDING AND BACKFILL

- .1 As indicated and to Section 31 23 33.01 – Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewer pipe installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .2 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Clean pipes and fittings of debris and water before installation and remove defective materials from site to approval of Departmental Representative.
- .3 Clean and dry pipes and fittings before installation.
- .4 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.3 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer or sewer connection.
- .3 Trench alignment and depth require approval of Departmental Representative prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.

- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 98 % SPMDD.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

3.5 INSTALLATION

- .1 Lay and join pipes to: CSA B1800.
- .2 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .3 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Joint deflection permitted within limits recommended by pipe manufacturer.
- .7 Water to flow through pipe during construction, only as permitted by Departmental Representative.
- .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Install plastic pipe and fittings in accordance with CSA B1800.
- .10 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's written recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.

- .8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
- .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .11 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .12 Plug lifting holes with pre-fabricated plugs approved by Departmental Representative.
- .13 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .14 Make watertight connections to manholes.
- .15 Use prefabricated saddles for connecting pipes to existing sewer pipes.
- .1 Joints to be structurally sound and watertight.

3.6 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 98 % SPMDD to ASTM D698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 98 % SPMDD.
- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.
- .3 Under roadways and walkways, compact backfill to at least 98 % SPMDD to ASTM D698.
 - .1 In other areas, compact to at least 95% SPMDD to ASTM D698.
- .4 Place unshrinkable fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.8 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.

- .2 As part of work in this contract, Contractor is to complete testing and commissioning for all existing sanitary infrastructure. Any underground pipe breaks or repairs to existing undergrounds as a result of this testing will have to be paid at a unit rate found in the tender form.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by video camera.
 - .2 Provide the Departmental Representative with a copy of the inspection video.

3.9 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33.01 – Excavation, Trenching and Backfilling.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-B1800-11, Thermoplastic Non-Pressure Piping Compendium. (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .1 CAN/CSA-B182.2-11 PVC Sewer Pipe and Fittings (PSM Type).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for drainage field materials and include product characteristics, performance criteria, physical size, finish and limitations
- .3 Certificates.
 - .1 Submit one copy of certification or license of approved installers.

1.4 QUALITY ASSURANCE

- .1 Use licensed installers who comply with local authority having jurisdiction.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: delivery materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect drainage field materials from nicks, scratches and blemishing.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GRANULAR BEDDING AND BACKFILL

- .1 As indicated and to Section 31 23 33.01 – Excavating, Trenching and Backfilling.

2.2 PIPE

- .1 75mm diameter DR35 solvent weld PVC pipe and fittings to CAN/CSA-B182.2, non-perforated.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for drainage field installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Department Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INFILTRATION TRENCH TYPE DISPOSAL FIELD INSTALLATION

- .1 Excavate to lines and depths as indicated and in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.
- .2 Scarify trench base and walls under dry conditions.
- .3 Do not operate construction equipment across disposal field.
- .4 Place 75mm minimum filter sand in trench bottom.
- .5 Install header and alternating gravity dosing box between septic tank and absorption trenches. Installation to be water-tight construction.
- .6 Set dosing box and header level as indicated.
 - .1 Provide access with removable cover for inspection of dosing box.
- .7 Connect lengths of infiltration pipe as per Manufacturer's specifications and place infiltration pipe on filter sand material.
- .8 Connect each distribution pipe stub individually to header and to infiltration pipe as per Manufacturer's specifications.
- .9 Maintain pipe elevations within 5 mm of inverts indicated.
- .10 Do not backfill trenches until pipe grade and alignment have been approved by Departmental Representative.
- .11 Backfill trenching with material as indicated.
 - .1 Do not compact.
 - .2 Overfill to allow for settlement.

3.3 FINAL CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 31 05 16 - Aggregate Materials.
- .3 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C117-04, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
 - .4 ASTM F405-05, Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.
 - .5 ASTM F667-06, Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA Group (CSA)
 - .1 CAN/CSA-B1800-06, Thermoplastic Non-pressure Pipe Compendium - B1800 Series.

1.3 SCHEDULING

- .1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.
- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Shop drawings to indicate proposed method for installing carrier pipe for undercrossings.

- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia, Canada.
- .4 Samples:
 - .1 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
 - .2 Submit to Departmental Representative for testing, at least 2 weeks prior to beginning Work.
- .5 Certification to be marked on pipe.
- .6 Test and Evaluation Reports: submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.
- .7 Manufacturer's Instructions: submit to Departmental Representative 1 copy of manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PLASTIC PIPE

- .1 Corrugated polyethylene pipe: high density to ASTM F405.

2.2 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 As indicated and in accordance with NSTIR standard specifications.

2.3 BACKFILL MATERIAL

- .1 As indicated.
- .2 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.

3.2 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer.
- .3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipes.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% maximum density to ASTM D698.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

3.4 INSTALLATION

- .1 Lay and join pipes to: ASTM C12.
- .2 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .3 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

- .4 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Joint deflection permitted within limits recommended by pipe manufacturer.
- .7 Water to flow through pipes during construction only as permitted by Departmental Representative.
- .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Install plastic pipe and fittings in accordance with CAN/CSA-B1800.
- .10 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.
- .11 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.
- .12 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes and catch basins.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .14 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.
 - .1 Joint to be structurally sound and watertight.
- .15 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.5 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum density to ASTM D698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90% maximum density to ASTM D698.

- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.6 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill to at least 95% maximum density to ASTM D698. In other areas, compact backfill to at least 90% maximum density to ASTM D698.
- .4 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.7 FIELD TESTS AND INSPECTIONS

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 Draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction directed by Departmental Representative.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.
 - .2 Provide means of access to permit Departmental Representative to do inspections.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and/or reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 - Cleaning.
- .3 Section 01 74 19 - Waste Management and Disposal.
- .4 Section 31 05 16 - Aggregate Materials.
- .5 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .6 Section 31 32 19.16 - Geotextile soil stabilization.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM D698-10, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA Group (CSA)
 - .1 CAN/CSA-B1800-06, Thermoplastic Non-pressure Pipe Compendium.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Inform Departmental Representative of proposed source of bedding and filter materials and provide access for sampling at least 4 weeks prior to commencing work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, pipe fittings, tiles, and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit for testing, following samples of materials proposed for use.
- .4 Certificates:
 - .1 Submit manufacturer's certification that drain pipe materials meet requirements of this Section.
 - .2 Certification to be marked on pipe.

- .5 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data that drain pipe materials meet requirements of this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes and tiles from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Perforated plastic pipe and fittings: to CAN/CSA-B1800. Nominal pipe sizes 150 mm.
- .2 Bedding gravel or crushed stone; hard, durable particles, graded evenly in size from 16 to 8 mm.
- .3 Granular filter material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 As indicated and in accordance with NSTIR standard specifications.
- .4 Geotextile filter: In accordance with Section 31 32 19.16 - Geotextile soil stabilization.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sub-drainage piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TRENCHING

- .1 Do excavating/trenching and backfilling in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.4 BEDDING

- .1 Place 100 mm layer of bedding material as indicated and compact to minimum 95% of maximum density to ASTM D698.

3.5 INSTALLATION OF FRENCH DRAINS

- .1 Install French drains as indicated.
- .2 Backfill remainder of trench as indicated.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and/or recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 00 – Cleaning.
- .3 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA B1800 Series-11, Thermoplastic Non-Pressure Piping Compendium.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certification: to be marked on pipe.
- .4 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 HDPE PIPE

- .1 Double walled HDPE: to CAN/CSA B1800 with smooth interior surface.
- .2 Fittings: bell and spigot.

2.2 GRANULAR BEDDING AND BACKFILL

- .1 Granular bedding and backfill material to Section 31 23 33.01 – Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for pipe culvert installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Department Representative.
 - .2 Inform Department Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Obtain Department Representative's approval of trench line and depth prior to placing bedding material or pipe.

3.4 BEDDING

- .1 Dewater excavation, if necessary, to allow placement of culvert bedding in dry condition.
- .2 Place 150 mm minimum thickness of approved granular material on bottom of excavation and compact to 98% SPMDD 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 Department Representative, free from sags or high points.
- .4 Place bedding in unfrozen condition.

3.5 LAYING PIPE CULVERTS

- .1 Begin at downstream end of culvert with flanged end of first pipe section facing upstream.
- .2 Ensure barrel of each pipe is in contact with shaped bed throughout its length.

3.6 PIPE JOINTS

- .1 Joints may be made with rubber gaskets.
 - .1 Rubber gasket joints:
 - .1 Install in accordance with manufacturer's written recommendations.
 - .2 Ensure that tapered ends are fully entered into flanged ends.

3.7 BACKFILLING

- .1 Backfill around and over culverts as indicated.
- .2 Place granular backfill material 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 98% SPMDD to ASTM D698 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.
- .5 Place backfill in unfrozen condition.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 211.2-06(R2016), Rigid PVC (Unplasticized) Conduit.

Part 2 Products

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC conduit. Refer to section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .1 Nominal length: 3 m plus or minus 12 mm.
- .2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make a complete installation.
- .3 Rigid PVC 90 degrees, 45 degrees bends and 5 degrees angle couplings as required.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent cement for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 CABLE DUCT PROTECTION

- .1 38 x 140 mm (trade size 2 in. x 6 in.) wood planks, pressure treated.

2.5 CABLE DUCT IDENTIFICATION

- .1 Mesh-type, detectable, marker system. The mesh shall have the following minimum specifications:
 - .1 Colour: red.
 - .2 Central longitudinal cord to provide visible element indicating the presence of the buried hazard.
 - .3 Integrated stainless-steel tracer wire, 0.8mm diameter, coated in black polypropylene. 1.3mm overall diameter.
 - .4 Mesh: five support elements,
 - .5 Exterior tapes: two, longitudinal.

- .6 Overall width: 200mm minimum.
- .7 Standard of acceptance: TechnoConsort Plyage HzD, or equivalent.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install duct in accordance with manufacturer's instructions and at elevations as indicated.
- .2 Clean inside of ducts before laying.
- .3 Install plastic duct spacers and ensure full, even support every 1.5 m and smooth transition throughout duct length.
- .4 Slope ducts with 1 to 400 minimum slope.
- .5 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.
- .6 Pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign material.
 - .1 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 Install a pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 Notify the Departmental Representative for field review upon completion of direct buried ducts and obtain acceptance prior to backfill.

3.3 CABLE DUCT PROTECTION

- .1 For ducts in vehicular traffic areas and elsewhere as shown on the drawings install continuous row of pressure treated wood planks to cover length of run.
 - .1 The wood planks shall extend no less than 50 mm beyond the edge of the outermost cable on each side of the trench. Additional wood planks shall be installed as required.
 - .2 The wood planks shall be located no less than 300 mm below the surface of the trench (as measured from the underside of the planks to the surface of the land immediately surrounding the trench) and in accordance with CSA 22.1.

3.4 CABLE DUCT IDENTIFICATION

- .1 Install mesh-type, detectable, marker system above the wood planks to extend the entire length of the duct run.

END OF SECTION

