



SPECIFICATION 30 August 2018

Parks Canada Agency (PCA)
Waterton Lakes National Park
Alpine Stables Reconstruction – Foundations & Underground Civil Work

Project No. R.096286.001

Waterton, Alberta

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Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises general construction of building foundations, underground civil work, and associated mechanical and electrical work, located at Waterton Lakes National Park Alpine Stables site.

1.2 CONTRACT METHOD

- .1 Construct Work under single stipulated price contract.

1.3 LAWS, NOTICES, PERMITS AND FEES

- .1 Obtain and pay for the building permit, permanent easements and rights of servitude.
- .2 Obtain and pay for permits, licenses, and certificates necessary for the performance of the Work that were in force at the date of executing the Agreement.

1.4 SUPPLEMENTARY INFORMATION FOR PROGRESS PAYMENTS

- .1 Successful Contractor will be required to submit a detailed breakdown of costs for each elemental section into three funding accountabilities within 5 business days of Contract Award and with every change to the project. The funding accountability will be detailed as directed, and on a form provided by the Departmental Representative, for parts of Work, aggregating total amount of Contract Price, to facilitate evaluation of application for payments. After review by Departmental Representative, cost breakdown will be used as basis for progress payment.

1.5 WORK BY OTHERS

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.
- .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 Departmental Representative, in writing, any defects which may interfere with proper execution of Work.
- .3 Work of Project executed during Work of this Contract, and which is specifically excluded from this Contract:
 - .1 Alpine Cottage and Bunkhouse: Built off-site and moved on to foundations.
 - .2 Saddling Barn, Boarding Barn, and site work including weather shelter, fences and corrals, landscaping, and parking lot.

1.6 FUTURE WORK

- .1 Project is designed for future buildings. Provide foundations and site services for future installation.
- .2 Insure that Work avoids encroachment into areas required for future work.

1.7 CONTRACTOR USE OF PREMISES

- .1 Unrestricted use of site until Substantial Performance.
- .2 Co-ordinate use of premises under direction of Departmental Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

1.8 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 72 hours' notice for necessary interruption of mechanical or electrical service. Minimize duration of interruptions. Carry out work at times as directed by authorities having jurisdiction with minimum disturbance to residents and businesses.
- .3 Provide alternative routes for pedestrian and vehicular traffic. Supply and maintain signage for detours and road closures.
- .4 Submit schedule to and obtain approval from Departmental Representative for shutdown or closure of active service or facility including water, sewer, power, and communications services. Adhere to approved schedule and provide notice to affected parties.
- .5 Provide adequate bridging over trenches that cross sidewalks or roads to permit normal traffic.
- .6 Where unknown services are encountered, immediately advise Departmental Representative 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.

1.9 DOCUMENTS REQUIRED

- .1 Successful bidding Contractor is to obtain required sets of Contract Documents for construction purposes, which includes two (2) sets for "as-built" and record purposes.
 - .1 Contractor is responsible for costs of printing, handling, and shipping of Contract Documents.
- .2 Maintain at job site, one copy of each document as follows:
 - .1 Contract Drawings.

- .2 Specifications.
- .3 Addenda.
- .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 specified.

END OF SECTION

Part 1 General

1.1 ACCESS AND EGRESS

- .1 Design, construct, and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps, ladders, and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial, and other regulations.

1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work, provide temporary means to maintain security.
- .4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .5 Closures: Protect work temporarily until permanent enclosures are completed.

1.3 WORKING TIMES

- .1 Operation of construction equipment is permitted only between 8:00 am and 7:00 pm on weekends, and between 8:00 am and 8:00 pm on weekdays to minimize disturbance to residents and businesses.
 - .1 Application may be made to Departmental Representative for extended work hours under special circumstances.
- .2 Construction is not permitted on long weekends.
 - .1 Thanksgiving Day 2018
 - .1 Friday October 5th to Monday October 8th
 - .2 Remembrance Day 2018
 - .1 Friday November 9th to Monday November 12th

1.4 NATIONAL PARK REGULATIONS

- .1 Ensure that all work is performed in accordance with ordinances, laws, rules and regulations set out in the Canada National Parks Act.
- .2 Ensure personnel comply with National Park Regulations.
- .3 Obtain business licenses from Parks Canada Administration Office prior to commencement of work.
- .4 Comply with laws and government regulations applicable to work under this contract.

- .5 Obtain vehicle passes from Parks Canada Administration Office for business and private vehicles.
- .6 Equip all service vehicles and supervisory vehicles with Emergency Spill Kit DOT-E-10102 or equivalent.

1.5 SPECIAL REQUIREMENTS

- .1 Submit schedule in accordance with Section 01 32 16 - Construction Progress Schedule - Bar (GANTT) Chart.
- .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic, and security regulations.
- .3 Keep within limits of work and avenues of ingress and egress.
- .4 Ingress and egress of Contractor vehicles at site is limited to existing road and driveway areas to the Alpine Stables site.
- .5 Take precautions to protect the endangered Half-moon Hairstreak butterfly habitat located on the east side of the site. Refer to drawings for location.

1.6 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions.

END OF SECTION

Part 1 General

1.1 SCHEDULE OF UNIT PRICE ITEMS

- .1 Submit a separate price table of unit price items of Work using the form provided by Departmental Representative.
- .2 Make form of submittal parallel to Schedule of Values, with each line item identified same as line item in Schedule of Values. Include in unit prices only:
 - .1 Cost of material.
 - .2 Delivery and unloading at site.
 - .3 Sales taxes.
 - .4 Installation, overhead and profit.
- .3 Ensure unit prices multiplied by quantities given equal material cost of that item in Schedule of Values.

1.2 MEASUREMENT OF QUANTITIES

- .1 Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- .2 Measurement by Area: Measured by square dimension using mean length and width.

1.3 MEASUREMENT AND PAYMENT - UNIT PRICES

- .1 Authority for Changed Conditions: Measurement methods are determined by the Departmental Representative.
- .2 Take measurements and compute quantities. Departmental Representative will verify measurements and quantities.
- .3 If the actual Work requires a 10% or greater change in quantity than those quantities indicated, the Contractor may claim for a Contract Price adjustment.
- .4 Unit Quantities: Quantities and measurements indicated in the Bid Form are for bid and contract purposes only. Quantities and measurements actually supplied or placed in the Work shall determine payment.
- .5 Unit Price Payment Includes: Full compensation for required labour, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.
- .6 Unit Prices shall remain open for acceptance until Substantial Performance.
- .7 All Unit Price changes to the Contract must be approved by the Departmental Representative prior to initiating the work and quantities site verified by the Departmental Representative.

1.4 NON-PAYMENT FOR REJECTED PRODUCTS

- .1 Payment will not be made for any of the following:
 - .1 Products wasted or disposed of in a manner that is not acceptable.
 - .2 Products determined as unacceptable before or after placement.

- .3 Products not completely unloaded from the transporting vehicle.
- .4 Products placed beyond the lines and levels of the required Work.
- .5 Products remaining on hand after completion of the Work.
- .6 Loading, hauling, and disposing of rejected Products.

1.5 UNIT PRICE SCHEDULE

- .1 Item: 50 mm diameter HDPE DR11 200 psi pipe, Section 33 11 16.
 - .1 Description: installation of water line including: tie in to existing watermain, temporary water services (if required), supply and delivery of pipe, excavation and trenching to the required depth, directional drilling and associated materials and accessories, pipe fusing, unions, supply and placement of granular bedding material, pipe installation to the specified line and grade, fittings, connections, tracer wire, thrust blocks, mechanical thrust protection, bends, reducers, tees, couplings, plugs, supply and install 1 x 3 m long clay plug for every 300 m of pipe, connection to maintenance holes, backfilling to roadway subgrade elevation, compaction, soil conditioning, dewatering, care of water, disposal of excess material off site, pressure testing, flushing, chlorinating and all other work incidental to completing the Work.
 - .2 Measurement: Pipe to be measured horizontally, along the top of the pipe, from centreline of connection to centreline of connection.
- .2 Item: 25 mm diameter raw water HDPE DR11 200 psi pipe, Section 33 11 16.
 - .1 Description: Installation of water line including: temporary water services (if required), supply and delivery of pipe, excavation and trenching to the required depth, directional drilling and associated materials and accessories, pipe fusing, unions, supply and placement of granular bedding material, pipe installation to the specified line and grade, fittings, connections, tracer wire, thrust blocks, mechanical thrust protection, bends, reducers, tees, couplings, plugs, connection to maintenance holes, backfilling to subgrade elevation, compaction, soil conditioning, dewatering, care of water, disposal of excess material off site, pressure testing, flushing, chlorinating and all other work necessary to complete the Work.
 - .2 Measurement: Pipe will be measured horizontally, along the top of the pipe, from centreline of connection to centreline of connection.
- .3 Item: Water Line Service 25 mm HDPE DR11 200 PSI pipe, Section 33 11 16.
 - .1 Description: tie-ins of new 25 mm HDPE water lines to new buildings including: digging, trenching, placing, backfilling to subgrade elevation, compacting, disposal of excess material off site, new connection directly to subject Infrastructure, supply and installation of new curb stops, supply and install pipe, supply and install union or riser and connect to existing, supply and install of saddle and connection to the new 50 mm watermain, flushing, testing, chlorination and all work incidental to the completed tie-in. Unit rate includes supply and install of bedding a minimum of 300 mm above the top of pipe and 100 mm below invert of pipe. Include the supply and installation of up to 50 m of pipe per service.

- .2 Measurement: Per building tie-in.
- .4 Item: 50 mm Pressure Reducing Valve.
 - .1 Description: Pressure reducing valve within the maintenance hole at the entrance to the site as indicated.
 - .2 Measurement: Per each valve.
- .5 Item: Type 1 Maintenance Hole, Section 33 05 16.
 - .1 Description: Type 1 maintenance holes, including: excavation, disposal of waste excavation off-site, supply and install granular material, maintenance hole base, maintenance hole barrel, slab top, collars, frame & cover, grouting, backfilling, associated cleanup and all items incidental to complete the work.
 - .2 Measurement: Vertical metres of installed maintenance holes, measured from top of cover to lowest pipe invert.
- .6 Item: 50 mm diameter valve, Section 33 11 16.
 - .1 Description: Gate valves, including supply of valves, supports, operating rods, valve boxes and cathodic protection, excavation and trenching to the required depth, supply and placement of granular bedding material, valve insertion to the specified line and grade, connections, thrust blocking, mechanical thrust protection, backfilling to plan subgrade, compaction, soil conditioning, dewatering, care of water, testing, flushing, chlorination, and all work incidental to the completed valve installation.
 - .2 Measurement: Per each valve.
- .7 Item: 25 mm Standpipe Installation on raw water line, Section 33 11 16.
 - .1 Description: Standpipes as indicated and at locations determined by Departmental Representative, including excavating and trenching to the required depth, supply and placement of granular bedding material, standpipe installation to the specified line and grade, saddle connection to water main, connections, mechanical thrust protection, cathodic protection, supply and install tee with two 19 mm hose bibs, supply and install curb stop and copper lead, supply and install irrigation box, treated post, gravel sump, steel grate, valves, supply and installation of drain rock backfilling, compaction, soil conditioning, dewatering, care of water, testing, flushing, and all work incidental to the completed drain valve chamber installation, removal and disposal of existing standpipe.
 - .2 Measurement: Per each standpipe.
- .8 Item: 25 mm Standpipe Installation on waterline, Section 33 11 16.
 - .1 Description: Standpipes as indicated and at locations determined by Departmental Representative, including excavating and trenching to the required depth, supply and placement of granular bedding material, standpipe installation to the specified line and grade, saddle connection to water main, connections, mechanical thrust protection, cathodic protection, supply and install tee with two 19 mm hose bibs, supply and install curb stop and copper lead, supply and install irrigation box, treated

- post, gravel sump, steel grate, valves, supply and installation of drain rock backfilling, compaction, soil conditioning, dewatering, care of water, testing, flushing, and all work incidental to the completed drain valve chamber installation, removal and disposal of existing standpipe.
- .2 Measurement: Per each standpipe.
- .9 Item: 150 mm diameter SDR 35 PVC pipe, Section 33 31 13.
 - .1 Description: Sanitary sewer line including supply and delivery of pipe, trenching to the required depth, supply and placement of granular bedding material, pipe installation to the specified line and grade, backfilling to subgrade elevation, trench compaction, disposal of excess materials off site, flushing, cleaning, CCTV inspection, and all work incidental to the completed installation of sanitary sewer line.
 - .2 Measurement: Pipe will be measured horizontally, per linear metre, along the top of the pipe, from centreline of connection to centreline of connection.
- .10 Item: 150 mm diameter SDR 26 PVC Cleanout, Section 33 31 13.
 - .1 Description: Sanitary sewer cleanout including supply and delivery of pipe, trenching to the required depth, supply and placement of granular bedding material, supply and install valve box, supply and install 150 mm wye and plugs, pipe installation to the specified line and grade, backfilling to subgrade elevation, trench compaction, disposal of excess materials off site, connection to maintenance holes, flushing, cleaning, CCTV inspection, and all work incidental to the completed installation of sanitary sewer line.
 - .2 Measurement: Pipe will be measured horizontally, per linear metre, along the top of the pipe, from centreline of connection to centreline of connection.
- .11 Item: Type 1 Sanitary Maintenance Holes, Section 33 05 16.
 - .1 Description: Type 1 maintenance holes, including: excavation, disposal of waste excavation off-site, supply and install granular material, maintenance hole base, maintenance hole barrel, slab top, collars, frame & cover, grouting, backfilling, associated cleanup and all items incidental to complete the work.
 - .2 Measurement: Vertical metres of installed maintenance holes, measured from top of cover to lowest pipe invert.
- .12 Item: Sanitary Sewer Service – 150 mm, Section 33 31 13.
 - .1 Description: Tie-ins of new sanitary sewer lines to existing buildings including: up to 15 m of sanitary sewer pipe, digging, trenching, supply and install of bedding material, placing, backfilling to subgrade, compacting, disposal of excess material off site, coordination and notification required for sanitary sewer service interruption, supply and install of all required pipe up to the new foundation location, including riser, supply and install saddle or tee and connection to the sewer main, , flushing, testing, and all work incidental to the completed tie-in. Bedding

- should be installed from 100 mm below invert and 300 mm above top of pipe. Each foundation tie-in will be counted
- .2 Measurement: Per completed connection to new foundation.
- .13 Item: Decommissioning/Removal of Existing Holding Tank, Section 02 65 00.
- .1 Description: Removal and disposal of existing holding tank, including: disposal of waste and surplus material off-site, rehabilitation of disturbed area to match immediate surrounding terrain, cleaning and all work incidental to the removal and disposal of an existing manhole or cesspool.
- .2 Measurement: Per holding tank removed.
- .14 Item: Subgrade preparation.
- .1 Description: preparing the subgrade surface for surfacing to 300 mm depth below the footings and imported gravel under footings, including scarifying, placing, blading, mixing, shaping, grading, moisture conditioning, compacting (150 mm max lifts), maintaining, proof rolling, associated clean up and all work incidental to complete the work. This shall include the undercut and subsequent prep of minor "soft spots" to ensure an approved subgrade surface. The unit price shall include excavation to subgrade elevation, loading, hauling to and stockpiling the excess material at the Red Rock compound (5km from Townsite).
- .2 Measurement: Each area of approved prepared subgrade to be measured by length and average width to produce an area in square metres.
- .15 Item: 19 mm minus – Type 1 Crushed Gravel, 300 mm depth.
- .1 Description: Supply, placement, and compaction to 98% Modified Proctor of granular base course in accordance with limit lines, compacted depths, densities, moisture content and grades specified, including: procurement, loading, processing, hauling, placing, shaping, grading, compacting, moisture conditioning, proof rolling, maintaining, interim lane marking, material certification, quality control, associated clean up and all items incidental to complete the work.
- .2 Measurement: Each area of approved granular base course to be measured by length and average width to give area in square metres.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Schedule and administer project meetings throughout the progress of the work.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting four days in advance of meeting date to Departmental Representative.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within three days after meetings; transmit to Departmental Representative, meeting participants, and affected parties not in attendance.
- .8 Representatives of Contractor, Subcontractor, and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Departmental Representative, Contractor, major Subcontractors, field inspectors, and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum five days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
 - .6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

- .7 Departmental Representative-provided products.
- .8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Monthly progress claims, administrative procedures, photographs, hold backs.
- .12 Appointment of inspection and testing agencies or firms.
- .13 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of Work, schedule progress meetings weekly.
- .2 Contractor, major Subcontractors involved in Work, and Departmental Representative are to be in attendance.
- .3 Notify parties minimum three days prior to meetings.
- .4 Record minutes of meetings; circulate to attending parties and affected parties not in attendance within three days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems that impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules and expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for effect on construction schedule and on completion date.
 - .12 Other business.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Activity: Element of Work performed during course of Project. Activity normally has expected duration, expected cost, and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): Graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally, Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: Original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five-day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: Number of work periods (not including holidays or other nonworking periods) required to complete activity or project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: Summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: Significant event in project, usually completion of major deliverable.
- .8 Project Schedule: Planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision-making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: Overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 Ensure it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative, within 10 working days of Award of Contract, Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Departmental Representative within 5 working days of receipt of acceptance of Master Plan.

1.4 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 Departmental Representative will review and return revised schedules within 5 working days.
- .3 Revise impractical schedule and re-submit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.5 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes, at minimum, milestone and activity types as follows:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .5 Excavation.
 - .6 Backfill.
 - .7 Water main installation.
 - .8 Waste water works.
 - .9 Building footings.
 - .10 Slabs on grade.
 - .11 Civil works.
 - .12 Water main extension.
 - .13 Plumbing.
 - .14 Electrical.
 - .15 Piping.

1.6 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule on weekly basis, reflecting activity changes and completions, as well as activities in progress.

- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impacts, with possible mitigation.

1.7 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings. Identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays and remedial measures will be discussed and negotiated.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Provide submittals listed for review to Departmental Representative. 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 for such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples, and mock-ups in SI Metric units.
- .4 Where items or information are 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 at time of submission, in writing, identifying deviations from requirements of Contract Documents, stating reasons for deviations.
- .7 Allow 10 working days for Departmental Representative's review of each submission.
- .8 Verify field measurements and affected adjacent Work are co-ordinated.
- .9 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .11 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data that 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 Province of Alberta.
- .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 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.
- .5 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.
- .6 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .7 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .8 After Departmental Representative's review, distribute copies.
- .9 Submit electronic copy of shop drawings for each requirement requested in specification Sections, and as Departmental Representative may reasonably request.
- .10 Submit electronic copies 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.
- .11 Submit electronic copies of test reports for requirements requested in specification Sections, and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory, indicating 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 performed within 3 years of date of contract award for project.
 - .12 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
 - .13 Submit electronic copies of manufacturers' 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 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative:
 - .1 Documentation of testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
 - .15 Submit electronic copies 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 Supplement standard information to provide details applicable to project.
 - .18 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned, and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
 - .19 The review of shop drawings by Public Services and Procurement Canada (PSPC) is for sole purpose of ascertaining general conformance with design intent.

- .1 This review shall not mean that PSPC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 SAMPLES

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

1.4 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of colour digital photography in jpg format, standard resolution, as directed by Departmental Representative.
- .2 Project identification: Name and number of project and date of exposure indicated.
- .3 Viewpoints and locations: As determined by Departmental Representative.
- .4 Frequency of photographic documentation: As directed by Departmental Representative.
- .5 Take photographs before, during, and after construction.
- .6 Submit photographs on CD or DVD. Label with meaningful titles.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Province of Alberta
 - .1 Occupational Health and Safety Act, SA 2017, Chapter O-2.1- Updated 2018.
- .2 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation.
- .3 Submit 1 copy of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets to Departmental Representative.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 3 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 3 days after receipt of comments from Departmental Representative.
- .8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.
 - .1 Emergencies: In event of emergency, call 411.

- .2 All other inquiries: Parks Canada Switchboard (403) 859-2224.

1.3 FILING OF NOTICE

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

1.4 SAFETY ASSESSMENT

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

1.5 MEETINGS

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

1.6 REGULATORY REQUIREMENTS

- .1 Perform Work in accordance with Section 01 41 00 - Regulatory Requirements.

1.7 GENERAL REQUIREMENTS

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

1.8 RESPONSIBILITY

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

1.9 COMPLIANCE REQUIREMENTS

- .1 Comply with Province of Alberta Occupational Health and Safety Act and its regulations.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.10 UNFORESEEN HAZARDS

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

1.11 WHMIS

- .1 Ensure that products used in project comply with Workplace Hazardous Materials Information System (WHMIS) Regulations and Chemical Substances of the OH&S Act and Regulations regarding use, handling, labelling, storage, and disposal of hazardous materials.
- .2 Deliver copies of relevant Material Safety Data Sheets (MSDS) to job site and Departmental Representative. MSDS to be acceptable to Labour Canada and Health and Welfare Canada for controlled products that will be used in performance of this work. Locate MSDS in accessible locations for workers and visitors throughout the site, bound and organized in binders.
- .3 Train workers required to use or to work in close proximity to controlled products in accordance with OH&S Act and Regulations.
- .4 Label controlled products at jobsite in accordance with OH&S and Regulations and WHMIS.
- .5 Provide appropriate emergency facilities as specified in the MSDS where workers might be exposed to contact with chemicals, including eye-wash facilities, emergency shower.
 - .1 Workers are to be trained in use of such emergency equipment.
- .6 Provide appropriate personal protective equipment as specified in the MSDS where workers are required to use controlled products.
 - .1 Properly fit workers for personal protective equipment
 - .2 Train workers in care, use, and maintenance of personal protective equipment.
- .7 No controlled products are to be brought on-site without prior approved MSDS.
- .8 MSDS are to remain on site at all times.

1.12 POSTING OF DOCUMENTS

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

1.13 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 may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 BLASTING

- .1 Blasting or other use of explosives is not permitted.

1.15 POWDER ACTUATED DEVICES

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

1.16 WORK STOPPAGE

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.
 - .3 Surveillance Officer: Parks Canada-assigned personnel responsible to monitor compliance with environmental mitigation measures.

1.2 COMPLIANCE REQUIREMENTS

- .1 Perform work in accordance with the ordinances and laws set out in the Canada National Parks Act and Regulations.
- .2 Read, understand, and comply with Parks Canada Development Permit and all stipulations provided.
- .3 Execute Work in compliance with the Canadian Environmental Assessment Act, 2012.
- .4 Comply with mitigation measures as defined in Best Management Practices document.
- .5 Failure to comply with or observe environmental protection measures, as identified in these specifications and those outlined in the Impact Assessment, may result in work being suspended pending rectification of measures.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit Environmental Protection Plan to Departmental Representative for review.

1.4 CONTRACTOR'S EMPLOYEE BRIEFING

- .1 Conduct briefing sessions for employees and sub-contractor employees, highlighting requirements of this section, including operation of equipment.
- .2 Initial site meeting with Contractor, Departmental Representative, Park Project Manager and Surveillance Officer will take place prior to commencement of construction.
- .3 Contract documents have been developed in accordance with Canadian Environmental Assessment Act, 2012 Impact Assessment requirements. Construction methods that are directly affected by CEAA, 2012 Impact

Assessment will be reviewed at initial site meeting. Comply with and ensure construction practices meet mitigation measures outlined in the Impact Assessment. Failure to comply may lead to cessation of work.

1.5 NOTIFICATION

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

1.6 ENVIRONMENTAL PROTECTION PLAN

- .1 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review by Departmental Representative.
- .2 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .3 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .4 Include in Environmental Protection Plan:
 - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
 - .3 Names and qualifications of persons responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring, and reporting requirements to assure that control measures comply with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
 - .6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.

- .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.
 - .1 Include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
 - .1 Include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste Water Management Plan identifying methods and procedures for management and discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.

1.7 EROSION AND SEDIMENTATION CONTROL

- .1 Develop and submit Erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Include monitoring and reporting requirements to assure that control measures comply with erosion and sediment control plan, Parks Canada requirements, and Federal, Provincial, and Municipal laws and regulations.
 - .1 ESC Plan is to be developed by a qualified professional.
 - .2 Refer to Best Management Practices document for ESC Plan minimum requirements.
- .2 Obtain permit for dewatering of construction site.
- .3 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .4 Ensure water pumped into sewer or drainage systems is free of suspended materials.

- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Parks Canada requirements, and in conformance with the Environmental Contaminants Act and applicable provincial regulations, while observing the Code of Good Practice for Management of Hazardous and Toxic Wastes at Federal Establishments.
- .6 Exercise control of erosion caused by wind, using measures in compliance with Best Management Practices document.

1.8 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 metres minimum.
- .3 Where necessary to work adjacent to existing trees and shrubs, exercise all possible care to avoid injury to vegetation. Where roots or limbs over 25 mm in diameter and bark are damaged during operations, trim damaged portion and immediately inform Departmental Representative for inspection and approval.
- .4 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .5 Obtain permits as required from Impact Assessment Office if a tree is to be removed. Contact Impact Assessment Office at (403) 859-5185. Municipal Officer may also give permission for a dead tree to be removed without the consent of Impact Assessment Office. Plant three young trees, from Waterton's native species, for each tree removed.
- .6 Minimize stripping of topsoil and vegetation.
- .7 Obtain list from Impact Assessment Office for native grasses, shrubs, flowers and trees acceptable for revegetation.

1.9 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
 - .1 Provide temporary enclosures where directed by Departmental Representative.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.10 WILDLIFE

- .1 Avoid or terminate activities on site that attract or harass wildlife.
- .2 Immediately notify Departmental Representative who will notify WLNP Resource Conservation Duty Officers (1-888-WARDENS) of bear activity or encounters on or around site. Report other wildlife encounters within 24 hours.
- .3 Take precautions to protect the endangered Half-moon Hairstreak butterfly habitat located on the east side of the site. Refer to drawings for location.

1.11 FIRES

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

1.12 HISTORICAL/ARCHAEOLOGICAL CONTROL

- .1 Provide historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site: and identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in area are discovered during construction.
- .2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.
- .3 Give immediate notice to the Departmental Representative if evidence of archaeological finds is encountered during construction and await Departmental Representative's written instructions before proceeding with work in this area.
- .4 Relics, antiquities, items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tablets, and similar objects found on site remain the Department's property. Protect such articles and request directives from Departmental Representative.
- .5 Provide 48 hours' notice to Departmental Representative prior to commencing work that may interfere with or affect an identified historical or archaeological site. Commence work only upon written instructions from Departmental Representative.

Part 2 Products

NOT USED

Part 3 Execution

3.1 CONTRACTOR'S OPERATIONS

- .1 Confine operations to work limits as indicated on drawings. No activities of any kind may be carried out beyond work limits without Departmental Representative's written permission.
- .2 Do not store or stockpile construction materials in trees bordering or being preserved on site. Do not unreasonably encumber site with products.
- .3 Perform equipment maintenance in designated areas or as approved by Departmental Representative and Impact Assessment Office. Use of turnouts, campgrounds, picnic areas, or work camps for equipment oil changes and other servicing is not permitted.
- .4 Collect and dispose used oil, filter and grease cartridges, lubrication containers, and other products of equipment maintenance at nearest industrial waste facility.
- .5 Provide sufficient sanitary facilities and maintain in a clean condition.
- .6 Obtain permit from Impact Assessment Office for storage of fuel or other inflammable liquids. Observe all restrictions and conditions imposed by permit regarding special protection and berming to control spills and tank damage; fire protection considerations; provisions for disposal of fouled material and used petroleum products
- .7 Conduct operations to preserve natural features and vegetation in area. Cut and fill slopes to blend with adjoining topography. Do not permit material from fill slopes to slough or roll into surrounding tree cover or to bury plant material designated to be retained.
- .8 When, in opinion of Departmental Representative, negligence on part of Contractor results in damage or destruction of vegetation, or other environmental or aesthetic features beyond staked or designated work areas, Contractor shall be responsible, at their expense, for complete restoration of trees including replacement of trees, shrubs, topsoil, grass, and other vegetation to Departmental Representative's satisfaction.
- .9 As no non-native vegetation is allowed in Park, thoroughly wash construction equipment for inspection and approval by the Surveillance Officer before entering Waterton Lakes National Park.

3.2 DISPOSAL OF WASTE

- .1 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Store and handle garbage in conformance with National Parks of Canada Garbage Regulations.

- .3 Store domestic garbage over the short term in wildlife-proof dumpsters. Put domestic recycling in appropriate facilities. Remove contaminated materials out of the Park.
- .4 Do not bury rubbish and waste materials on site.
- .5 Maintain site in tidy condition, free of waste material, debris and litter.
- .6 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

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.

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with 2015 National Building Code of Canada (NBC) including amendments up to tender closing date, and other codes of provincial or local application; in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes, and referenced documents.

1.2 WHMIS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada and Health and Welfare Canada.

1.3 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.

1.4 CANADA NATIONAL PARKS ACT

- .1 Perform Work in accordance with the Canada National Parks Act for projects located within boundaries of a National Park.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 The Contractor is totally responsible for quality of Materials and Products provided for the Work.
- .2 Perform quality control, including inspections and tests as necessary to ensure that the Work conforms to requirements of the Contract Documents.
- .3 During the progress of the Work, perform sufficient number of tests to determine that Material, Products, and installation meet specified requirements.
- .4 Minimum requirements regarding quality control are specified in various sections of the specifications; perform as many inspections and tests as are necessary to ensure that the Work conforms to the requirements of the Contract Documents.
- .5 Testing: In accordance with pertinent codes and regulations and with selected standards of the ASTM International (ASTM) and Canadian Standards Association (CSA).
- .6 Product testing, mill tests, and laboratory reports to demonstrate that Product and Material supplied meet the specifications are identified in various sections of the Contract Documents.

1.2 QUALITY CONTROL TESTING BY THE CONTRACTOR

- .1 Retain the services of an independent testing agency under supervision of a registered professional Engineer, and pay for the cost of testing services for quality control including, but not limited to, the following:
 - .1 Sieve analysis of sands and aggregates to be supplied to the Work.
 - .2 Concrete testing.
 - .3 Backfill compaction testing, subgrade, base course.
- .2 Promptly process and distribute required copies of test reports and test information and related instructions to all Subcontractors and Suppliers to ensure that necessary re-testing and replacement of construction can proceed without delay.

1.3 QUALITY ASSURANCE TESTING BY DEPARTMENTAL REPRESENTATIVE

- .1 The Departmental Representative will retain and pay for services of an independent testing agency for testing for quality assurance, for the Departmental Representative's purposes.
- .2 The Departmental Representative's testing agency and the Departmental Representative will inspect and test Materials, Products and the Work for conformance with the test requirements of the Contract Documents; however, they do not undertake to check the quality of the Work on behalf of the Contractor nor to provide quality control.

- .3 Inspections and test by the Departmental Representative's testing agency and by the Departmental Representative do not relieve the Contractor of responsibility to supply Materials and Products and to perform the Work in accordance with the requirements of the Contract Documents.
- .4 Departmental Representative, at their discretion, may order or perform additional inspections and test for their own purposes or for purposes of the Departmental Representative.
- .5 Coordinate with the Departmental Representative for scheduling of testing and inspection by the Departmental Representative's testing agencies or by the Departmental Representative, to enable testing to be done as necessary, without delay, and the Contractor shall notify the Departmental Representative sufficiently in advance of operations to allow for such inspection and test by the Departmental Representative's or the Departmental Representative's testing agency.

1.4 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 wherever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections, or approvals whether by Departmental Representative instructions, or by law of Place of Work.
- .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 Work and pay cost of examination and correction. If Work is found in accordance with Contract Documents, cost of examination and replacement will be borne by Departmental Representative.

1.5 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.

1.6 PROCEDURES

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples or 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 samples and materials on site. Provide sufficient space to store and cure test samples.

1.7 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 opinion of Departmental Representative, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental Representative will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

1.8 REPORTS

- .1 Submit one copy of inspection and test reports to Departmental Representative.

1.9 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.2 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.3 DEWATERING

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water as approved by the Surveillance Officer and as stated on the RAP.

1.4 WATER SUPPLY

- .1 Provide continuous supply of potable water for construction use.
- .2 Provide continuous supply of potable water to homes, businesses, and facilities disrupted by construction activities.
- .3 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.
- .4 Costs for temporary water services and considered incidental to the work and no separate or additional payment will be made.

1.5 SANITARY SEWER

- .1 Provide continuous sanitary sewer to homes, businesses and facilities disrupted by construction activities.
- .2 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.
- .3 Costs for temporary sanitary sewer services and considered incidental to the work and no separate or additional payment will be made.

1.6 TEMPORARY POWER AND LIGHT

- .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools.
- .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance, and removal.
- .3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.

1.7 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations, and bylaws.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.2 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas that have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.3 SITE STORAGE/LOADING

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.4 CONSTRUCTION PARKING

- .1 Parking will be permitted on site provided it does not disrupt performance of Work or normal operations of the National Park. Parking areas must be approved by Departmental Representative
- .2 Provide and maintain adequate access to project site.

1.5 SECURITY

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

1.6 OFFICES

- .1 If required by Contractor, provide office of sufficient size to accommodate required work activities of Contractor and sub-contractors. Departmental Representative to approve location of trailer.
- .2 Deal directly with utility companies for utility hook-ups required for site office.
- .3 Provide marked and fully stocked first-aid case in a readily available location.

1.7 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.8 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.9 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor is responsible for repair of damage to roads caused by construction operations.
- .7 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .8 Dust control: Adequate to ensure safe operation at all times.
- .9 Provide snow removal during period of Work.

1.10 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

- .1 Provide temporary controls to execute Work expeditiously.
- .2 Remove from site all such work after use.

1.2 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around deep excavations.

1.3 ACCESS TO SITE

- .1 Provide and maintain access roads, sidewalk crossings, ramps, and construction runways as may be required for access to Work.

1.4 PUBLIC TRAFFIC FLOW

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, and lanterns as required to perform Work and protect public.

1.5 FIRE ROUTES

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.6 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Within text of each specifications section, reference may be made to reference standards. Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .3 Cost for such testing will be borne by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment, and articles incorporated in Work are to be new, not damaged nor defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source, and quality of products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .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.

1.3 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Departmental Representative at commencement of Work, and should it subsequently appear that Work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING, AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration, and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

1.5 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.8 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

1.9 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as

required. Perform in a manner to neither damage nor put at risk any portion of Work.

- .2 For remedial work, employ specialists familiar with materials affected.

1.10 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate, or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Departmental Representative's identification of existing survey control points and property limits.

1.2 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practice in Alberta.

1.3 SURVEY REFERENCE POINTS

- .1 Departmental Representative will supply horizontal reference control points benchmark elevations.
- .2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Departmental Representative.
- .4 Report to Departmental Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.4 SURVEY REQUIREMENTS

- .1 Perform survey work required to layout construction.
- .2 Set grades and layout work in detail from control points established by Departmental Representative.
- .3 Establish lines and levels, locate and lay out, by instrumentation.
- .4 Stake for grading, fill and topsoil placement and landscaping features.
- .5 Stake slopes and berms.
- .6 Establish pipe invert elevations.
- .7 Stake batter boards for foundations.
- .8 Establish foundation and column locations and floor elevations.
- .9 Establish lines and levels for mechanical and electrical work.

1.5 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2 Remove abandoned service lines within 2 metres of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

1.6 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.7 RECORDS

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

1.8 SUBMITTALS

- .1 Submit name and address of Surveyor to Departmental Representative.
- .2 On request of Departmental Representative, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.
- .4 Submit as-built survey to Departmental Representative in accordance with Section 01 78 00 – Closeout Submittals.
 - .1 Provide in electronic form in CAD .dwg format, on CD or DVD.

1.9 SUBSURFACE CONDITIONS

- .1 Promptly notify Departmental Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2 After prompt investigation, should Departmental Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .3 Clear snow and ice as required. Pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris. Equip containers with covers to prevent spread of waste by wind, and entry into container by unauthorized persons.
- .6 Dispose of waste materials and debris outside of Waterton Lakes National Park.

1.2 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery, and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris and leave Work clean and suitable for occupancy.
- .3 Prior to final review, remove surplus products, tools, construction machinery, and equipment.
- .4 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .5 Remove dirt and other disfiguration from exterior surfaces.
- .6 Sweep and wash clean paved areas.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT GOALS

- .1 Accomplish maximum control of solid construction waste.
- .2 Preserve environment and prevent pollution and environment damage.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.3 STORAGE, HANDLING, AND PROTECTION

- .1 Store materials to be disposed and recycled in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Remove waste and recyclables from the Park and transport to acceptable waste processing facilities.
- .4 Protect surface drainage, mechanical and electrical from damage and blockage.
- .5 Prevent contamination of materials to be recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 Remove co-mingled materials to off-site processing facility for separation.

1.4 DISPOSAL OF WASTES

- .1 Do not bury rubbish and waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, or paint thinner into waterways, storm, or sanitary sewers.

Part 2 Products

Not used.

Part 3 Execution

3.1 APPLICATION

- .1 Handle waste materials not recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.

- .3 Source separate materials to be reused/recycled into specified sort areas.

3.3 DIVERSION OF MATERIALS

- .1 On-site sale of reusable or recyclable material is not permitted.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Procedures for Acceptance of Work:
 - .1 Contractor's Inspection:
 - .1 Contractor: Conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .2 Notify Departmental Representative, in writing, of satisfactory completion of Contractor's inspection; submit verification that corrections have been made.
 - .3 Request Departmental Representative inspection.
 - .2 Departmental Representative 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 English, indicating 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 Certificates required by Utility companies: Submitted.
 - .5 Operation of systems: Demonstrated to designated personnel.
 - .6 Work: Complete and ready for final inspection.
 - .4 Final Inspection:
 - .1 When completion tasks have been completed, 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.

1.2 FINAL CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting one week prior to contract completion with Contractor's Representative and Departmental Representative, in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify Project requirements.
 - .2 Review warranty requirements.
 - .2 Departmental Representative to establish communication procedures for:
 - .1 Notifying construction warranty defects.
 - .2 Determine priorities for type of defects.
 - .3 Determine reasonable response time.
 - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
 - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, three print and three electronic final copies of operating and maintenance manuals in English.
 - .1 Provide electronic O & M manuals on CD or DVD.
- .3 Provide spare parts, maintenance materials, and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source, and quality of products supplied.

1.3 MECHANICAL AND ELECTRICAL SUBMITTALS

- .1 For submittals related to Mechanical work, refer to Section 21 05 01.
- .2 For submittals related to Electrical work, refer to Section 26 05 00.

1.4 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: Vinyl, hard covered, 3 'D' ring, with spine and face pockets.
 - .1 When multiple binders are used, correlate data into related consistent groupings.

- .3 Text: Manufacturer's printed data, or typewritten data.

1.5 CONTENTS – O&M MANUALS

- .1 Binder Cover and Binder Edge
 - .1 Include: Building Name, address, project name, project number, completed date.
- .2 Title Page
 - .1 O&M Manual for... Building name, address, date, general contractor information: name address, phone number.
 - .2 Consultant name address, phone number.
 - .3 Table of contents indicates each binder's contents.
- .3 Index and tabs
 - .1 Dividers with permanently marked tabs separate each section and sub section.
 - .2 Tab labels typed, not hand written.
 - .3 Main tab for each specification section.
- .4 Tab A: Signed Letter of Warranty, to include:
 - .1 Date.
 - .2 Project name.
 - .3 Project number.
 - .4 Building Location.
 - .5 Warranty start date and end, to be from date of substantial, declared by Consultant.
 - .6 Organization, names and phone numbers of persons to call for warranty services.
 - .7 All warranties to be included from all contractors in this section and extended warranties.
- .5 Tab B: Contact Information for all Subcontractors and Suppliers, including:
 - .1 Name, address, telephone number of manufacturer, installing contractor.
 - .2 24-hour number for emergency service for all equipment in this section identified by equipment.
- .6 Tab C: All Reports and Permits:
 - .1 TAB reports.
 - .2 Pre-functional tests.
 - .3 Start up reports.
 - .4 Completed performance verification forms (found in the Tender Documents).
 - .5 Cabling verifications.
 - .6 ESA certification.

- .7 TSSA certification.
- .8 Fire alarm certification.
- .9 Seismic certification.
- .10 All permits, including electrical, building, plumbing.
- .7 Tab D: As-Built Drawings:
 - .1 Marked-up by contractor, changes marked in red to also be given to Consultant.
- .8 Tab E: Operation and Shutdown:
 - .1 Sequence of Operation-outline how the systems installed were designed to work.
 - .2 Accurate Sequence of Operation, with detailed instruction in proper sequence, for each mode of operation.
 - .3 Emergency Operation: Functions of equipment that can be operated while other functions disabled. Included only for alternate abnormal operations that can follow when there is a partial failure, malfunctioning of components, or other unusual condition.
 - .4 Shutdown Procedure: Instructions for stopping and securing the equipment after operation. If a particular sequence is required, step-by-step instructions given in that order.
- .9 Tab F: CMMS Data Sheets:
 - .1 All equipment that is to be deleted, removed, added, or replaced is to have a CMMS inventory sheet completed and included in the O&M Manual.
- .10 Tab G: Shop Drawings:
 - .1 Copy of all reviewed "by the Consultant" shop drawings.
- .11 Tab H: Maintenance
 - .1 Copy of specific service and maintenance manuals.
 - .2 Preventative and corrective maintenance, with service procedures and schedules.
 - .3 Schedule for preventive maintenance in a printed format and electronic format compatible with Departmental Representative's system.
 - .4 Recommended frequency of performance for each preventive maintenance task, cleaning, inspection and scheduled overhauls or reconditioning.
 - .5 Cleaning: Instructions and schedules for all routine cleaning and inspection recommended, including recommended cleaners and lubricants.
 - .6 Inspection: Periodic inspection of equipment required for operation, cleaning or other reasons, with items to be inspected indicated and inspection criteria given for motors, controls, filters, and any other maintenance items.

- .7 Instructions for minor repairs or adjustments required for preventive maintenance routines.
- .8 Listing of any special tools required to service or maintain the equipment.
- .12 Last Tab: Miscellaneous Items
 - .1 Health and Safety submittals including: site specific hazard assessment, safety manual TOC and company safety policy, MSDS sheets (if applicable) signed site orientations for worker, copy of first aid certificate, copy of emergency plan and muster location.
 - .2 Special requirements for equipment, not to be used for reports.

1.6 AS-BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store as-built documents and samples in field office apart from documents used for construction.
 - .1 Provide files, racks, and secure storage.
- .3 Label as-built documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "AS-BUILT DOCUMENTS" in neat, large, printed letters.
- .4 Maintain as-built documents in clean, dry and legible condition.
 - .1 Do not use as-built documents for construction purposes.
- .5 Keep as-built documents and samples available for inspection by Departmental Representative.
- .6 Record as-built information on drawings and in designated copy of Project Manual provided by Departmental Representative.
- .7 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .8 Maintain information during construction on project site drawings and accurately record deviations of newly installed or existing works from Contract documents.
- .9 Use red felt tip marking pens for recording information.

- .10 Mark on one set of prints and at completion of project and prior to final inspection; neatly transfer notations to second set.
- .11 Ensure but do not limit recording of following information on as-built drawings:
 - .1 Locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
 - .2 Changes made by Change Order.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Details not on original Contract Drawings.
 - .6 References to related shop drawings and modifications.
- .12 Incorporate as-built information into CAD drawings.
- .13 Submit as-built drawings to Departmental Representative.
 - .1 Provide in electronic form as CAD .dwg format, on CD or DVD.
- .14 Specifications: Mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.

1.7 RECORD DOCUMENTS

- .1 Prior to Substantial Performance of the Work, provide on CD or DVD the marked-up information from the as-built documents to a master set of drawing files provided by the Departmental Representative:
- .2 Mark revised documents as "RECORD DOCUMENTS". Include all revisions.
- .3 Indicate changes on the electronic set of record drawings. Provide updated record drawings in .dwg format.
- .4 Submit completed record documents to Departmental Representative on CD or DVD.

1.8 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

- .2 Panel board circuit directories: Provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 91 13 - General Commissioning (Cx) Requirements.
- .15 Additional requirements: as specified in individual specification sections.

1.10 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

1.11 MAINTENANCE MATERIALS

- .1 Spare Parts:

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to site; place and store.
- .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.

1.12 DELIVERY, STORAGE, AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.13 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.

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

- .7 Cross-reference to warranty certificates as applicable.
- .8 Starting point and duration of warranty period.
- .9 Summary of maintenance procedures required to continue warranty in force.
- .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
- .11 Organization, names and phone numbers of persons to call for warranty service.
- .12 Typical response time and repair time expected for various warranted equipment.
- .3 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
- .4 Procedure and status of tagging of equipment covered by extended warranties.
- .5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.14 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water-resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.
 - .6 Inspector's signature.
 - .7 Construction Contractor.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for removal of underground sewage storage tanks, solids, liquid, and associated work, including soil removal as indicated on Drawings; restoration of excavated area with new materials to match adjacent (existing) surfaces including the following:
 - .1 Underground sewage storage tank removal including removal and disposal of tank contents, and disposal.
 - .2 Underground sewage storage tank cleaning and disposal including excavation of tank, evacuation of vapours, tank cleaning, disassembling of tank, and certification for proper disposal of tank.
- .2 Departmental Representative has not monitored effluent levels and there may be exfiltration of sewage liquids into the surrounding ground in the area of the tanks.

1.2 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00– Submittal Procedures.
- .2 Submit a written report describing in detail the procedures to be used to remove liquid from the underground sewage storage tank, cleaning and removing of underground storage tank, and disposal of liquid and solid residues; provide verification that materials were disposed of in an environmentally responsible waste disposal facility; provide photographic documentation of the work, and receipts from the disposal sites for tank and liquid residue.
- .3 Submit a written contingency plan for actions to be taken in the event of a release / encounter with noxious gases or emergency including the following:
 - .1 Emergency contact numbers;
 - .2 Classification of the site land use;
 - .3 Plans for disposal of sewage contaminated / softened soil;
 - .4 Plans for site assessment/remediation work; and,
 - .5 Reducing the risk to human health.

1.3 QUALITY ASSURANCE

- .1 Underground sewage storage tank removal and disposal shall comply with the requirements of the authorities having jurisdiction.

1.4 PROJECT SITE CONDITIONS

- .1 Ensure work area is clearly identified to highlight presence of sewage waste materials and need for PPE.

Part 2 Products

2.1 MATERIALS

- .1 Provide necessary materials, equipment and tarps to prevent further contamination of the site, and for safe handling and containment of any sewage liquid or solid waste and removed contaminated soils.

Part 3 Execution

3.1 PREPARATION

- .1 Provide all necessary personal protective equipment and purging of noxious gases before starting work of this Section.

3.2 UNDERGROUND SEWAGE STORAGE TANK REMOVAL

- .1 Liquid Removal:
 - .1 Provide samples of liquids from the underground fuel storage tank to a certified hazardous waste testing facility for laboratory analysis and approval for the liquid disposal and disposal location.
 - .2 Remove the liquid from the tank for disposal prior to removing the tank from the ground.
 - .3 Obtain disposal facility receipts noting proper liquid disposal.
- .2 Sewage Storage Tank Cleaning:
 - .1 Remove the tank from the ground, place it on the ground adjacent to removal location, and secure it prior to cleaning. If it cannot be removed, remove cover slabs or access covers to provide access.
 - .2 Measure levels of noxious gases and ventilate tank if required to normalise oxygen levels to safe limits:
 - .1 Ventilate tank using a small air mover until air within the tank is normalised.
 - .2 Oxygen content shall range from 19.5 to 23.5%.
 - .3 Cut access ports for cleaning into tank after vapour and oxygen concentrations are at a safe level.
 - .3 Clean tank by high pressure water jet cleaning the interior of the tank.
 - .4 Collect and contain residuals into a sewage vacuum truck for transporting and disposal at a site acceptable to the authorities having jurisdiction.
 - .5 Obtain disposal facility receipts noting proper effluent disposal.
- .3 Sewage Storage Tank Disposal:
 - .1 Verify that final oxygen concentrations are within requirements noted above before proceeding to cut and dismantle the tank for its disposal.
 - .2 Remove dismantled tank to a disposal facility acceptable to the authorities having jurisdiction.

- .3 Obtain disposal facility receipts noting proper tank disposal.

3.3 REMOVED TANK AREA ASSESSMENT

- .1 Collect five soil samples from the removed underground storage tank area as follows:
 - .1 One sample from each of the sidewalls.
 - .2 One sample from the base.
- .2 Place samples in glass sample jars and seal with Teflon coated lids, and place the jar on ice.
- .3 Deliver samples with completed chain of custody documentation to the laboratory.
- .4 Laboratory shall analyze each sample for presence of sewage contamination.
- .5 Site Restoration: Refer to Section 31 05 00 for requirements for backfill and compaction for non contaminated remediation work.

3.4 CONTAMINATED SOIL REMEDIATION

- .1 Collect additional soil samples beyond the boundaries of the original tank location. When soil assessments reveal evidence of leakage or spillage of sewage at levels above those established by the authorities having jurisdiction relating to environmental management for underground storage tank closures.
- .2 Boundary of tank shall not to exceed 75 m³ of soil removed; any work beyond this boundary will be considered as an extra to the Contract and shall be based on unit pricing.
- .3 Continue soil removal and soil contamination assessment testing around the tank until contamination levels are within acceptable levels.
- .4 Remove contaminated soil from the site and haul it to an approved sanitary landfill for proper disposal.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1-09/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA O121-2008, Douglas Fir Plywood.
 - .3 CSA O151-09, Canadian Softwood Plywood.
 - .4 CSA O153-13, Poplar Plywood.
 - .5 CSA-O325-07, Construction Sheathing.
 - .6 CSA O437 Series-93, Standards for OSB and Waferboard.
 - .7 CSA-O86-14, Engineering Design in Wood.
 - .8 CSA S269.1-1975, Falsework for Construction Purposes.
 - .9 CAN/CSA-S269.3-M92, Concrete Formwork, National Standard of Canada

1.2 MEASUREMENT PROCEDURES

- .1 No measurement will be made under this Section. Include costs in items of work for which concrete formwork and falsework is required.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Upon request, indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings. Comply with CAN/CSA-S269.3 for formwork drawings.
- .3 Upon request, indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

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, CAN/CSA-O86, and CSA-O153.
 - .2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.
- .2 Tubular column forms: round, internally treated with release material.

- .1 Spiral pattern may show in hardened concrete, except where column is designated architectural finish, where it shall not show in hardened concrete.
- .3 Form ties:
 - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
 - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
- .4 Form liner:
 - .1 Plywood: high density overlay.
- .5 Form release agent: non-toxic, biodegradable, low VOC.
- .6 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene.
- .7 Falsework materials: to CSA-S269.1.

PART 3 EXECUTION

3.1 FABRICATION AND ERECTION

- .1 Fabricate and erect falsework in accordance with CSA S269.1.
- .2 Refer to drawings for concrete members requiring architectural exposed finishes.
- .3 Do not place shores and mud sills on frozen ground.
- .4 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .5 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.
- .6 Align form joints and make watertight. Keep form joints to minimum.
- .7 Locate horizontal form joints for exposed columns 2400 mm above finished floor elevation.
- .8 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .9 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .10 Construct forms for architectural concrete, and place ties as indicated and as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.

- .11 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .12 Line forms for following surfaces:
 - .1 Surfaces designated as architectural finish.
 - .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 Notify Consultant 24 hours in advance prior to removing formwork.
- .2 Do not remove forms and bracing until concrete has gained sufficient strength to carry its own weight, construction loads, design loads that are liable to be imposed upon it. Verify strength of concrete by compressive test results.
- .3 Leave formwork in place for following minimum periods of time after placing concrete:

LOCATION	TEMPERATURE IN °C		
	21-35	15-21	10-15
Walls	2 days	3 days	4 days
Grade Beams	2 days	3 days	4 days
Side Forms	2 days	3 days	4 days
Slabs *	7 days	7 days	14 days
Beams *	7 days	7 days	14 days
Structural Shoring *	7 days	7 days	14 days

* formwork below/supporting these elements shall remain in place for the minimums stated above and then replaced with shoring posts until concrete is 28 days old. Formwork can be removed and replaced with shoring posts earlier, if concrete test cylinders show a strength of 75% of the required 28-day strength.

- .4 Reshore structural members where required due to design requirements or construction conditions and as required to permit progressive construction.

- .5 Remove formwork progressively and in accordance with Building and Safety Code requirements and so that no shock loads or unbalanced loads are imposed on structure.
- .6 Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- .7 Store removed forms, for exposed concrete, so surfaces in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.
- .8 Re-use formwork subject to requirements of CAN/CSA-A23.1.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA-A23.1-09/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement, A National Standard of Canada.
 - .3 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .4 CAN/CSA-G164-M92(R2003)(withdrawn), Hot Dip Galvanizing of Irregularly Shaped Articles, A National Standard of Canada.
 - .5 CSA W186-M1990(R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A82-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .3 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.2 MEASUREMENT PROCEDURES

- .1 Reinforcing steel will be measured in kilograms of steel incorporated into work, computed from theoretical unit mass specified in CAN/CSA G30.18 for lengths and sizes of bars as indicated.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
- .3 Submit shop drawings including placing of reinforcement and indicate:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
- .4 Detail lap lengths and bar development lengths to CSA-A23.3, unless otherwise indicated.

- .1 Provide class B tension lap splices unless otherwise indicated.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: All reinforcing steel to be CAN/CSA-G30.18M grade 400R deformed bars except column ties and beam stirrups which shall be grade 400W.
- .3 Cold drawn annealed steel wire ties: to ASTM A82.
- .4 Galvanizing of non-prestressed reinforcement: to CAN/CSA-G164, minimum zinc coating 610 g/m².
- .5 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .6 Mechanical splices: subject to approval of Departmental Representative.
- .7 Plain round bars: to CSA-G40.20/G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 All reinforcing is to be detailed in accordance with the latest edition of the Reinforcing Steel Institute of Canada - Manual of Standard Practice, except otherwise noted
- .3 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .4 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .5 Ship bundles of bar reinforcement clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.
- .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

PART 3 EXECUTION

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars, which develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated below and in accordance with CSA-A23.1/A23.2.
 - .1 Foundation walls/piers:
Exposure class: F-2 40 mm outside face 20 mm inside face.
 - .2 Grade Beams:
Exposure class: F-2 50mm bottom to ties 40mm sides and top to ties.
 - .3 Footings/Pile Caps:
Exposure class: S-2 75mm to ties
 - .4 Interior Slabs-on-grade:
Exposure class: N 40mm top 20mm bottom
 - .5 Exterior Slabs-on-grade:
Exposure class: F-2 40mm top 40mm bottom
- .2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.

3.3 DOWELING PROCEDURES

- .1 For bars that are indicated as being dowelled in, drill in and epoxy grout bars as follows:
 - .1 10M bars, 200 mm
 - .2 15M bars, 250 mm
 - .3 20M bars, 350 mm
 - .4 25M bars, 400 mm
- .2 Use only approved adhesive to manufacturer's instructions. Submit proposed adhesive product to Departmental Representative for the approval prior to commencing construction.

- .3 Clean hole thoroughly prior to application of epoxy. Use injection or caulking gun to ensure that the epoxy fills the bottom of the hole prior to embedment of bar.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C260/C250M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C330/C330M-17a, Standard Specification for Lightweight Aggregates for Structural Concrete.
 - .4 ASTM C494/C494M-17, Standard Specification for Chemical Admixtures for Concrete.
 - .5 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .6 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .7 ASTM D624-00(2012), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
 - .8 ASTM D1751-04(2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .9 ASTM D1752-04a(2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
 - .2 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283-06(R2016), Qualification Code for Concrete Testing Laboratories.
 - .3 CAN/CSA-A3000-13, Cementitious Materials.
- .4 International Concrete Repair Institute (ICRI)
 - .1 ICRI Guideline No. 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Certificates:
 - .1 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA-A23.1. Certification letter to be sealed by an engineer registered in the Province of Alberta.
 - .2 Upon request, provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1. Certification letter to be sealed by an engineer registered in the Province of Alberta.
- .3 Concrete pours: submit 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.
- .4 Concrete hauling time: submit for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.3 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Upon request submit to Departmental Representative, minimum 4 weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
 - .1 When plant does not hold valid certification, provide test data and certification by qualified independent inspection and testing laboratory that materials used in concrete mixture will meet specified requirements.
- .3 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for review by Departmental Representative on following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.
 - .1 Modifications to maximum time limit must be agreed to Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by Departmental Representative.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

1.5 MATERIALS

- .1 The concrete constituents shall comply with the following standards:
 - .1 Cement: to CAN/CSA-A3001.
 - .2 Blended hydraulic cement: to CAN/CSA-A3001.
 - .3 Water: to CSA-A23.1.
 - .4 Aggregates: to CAN/CSA-A23.1/A23.2.
 - .5 Admixtures:
 - .1 Air entraining admixture: to ASTM C260.
 - .2 Chemical admixture: to ASTM C494 and ASTM C1017.
Departmental Representative to approve accelerating or set
retarding admixtures during cold and hot weather placing.

1.6 CONCRETE MIX REQUIREMENTS

- .1 Provide the following concrete mix requirements.

Footings/Pile Caps:	35 MPa min. at 56 days Class of exposure: S-2 Entrained air/category: 2 (4% to 7%) Cement type: HS Aggregate: max. 20 mm Curing type: type 2 - additional
Foundation walls/piers:	25 MPa min. at 28 days Class of exposure: F-2 Entrained air/category: 2 (4% to 7%) Aggregate max. 20 mm Curing type: type 2 - additional
Exterior slabs-on-grade:	32 MPa min. at 28 days Class of exposure: C-2 Entrained air/category: 2 (4% to 7%) Aggregate max. 20 mm Curing type: type 2 - additional
Interior grade beams:	25 MPa min. at 28 days Class of exposure: N Entrained air/category: none (less than 3%) Aggregate max. 20 mm Curing type: type 2 - additional
Interior slabs-on-grade:	25 MPa min. at 28 days Class of exposure: N Entrained air/category: none Aggregate max. 20 mm Curing type: type 1 - basic

Unless indicated otherwise the contractor shall specify concrete slump appropriate with placement methods and site conditions. The contractor specified slump must be shown on the certification letter and concrete delivery ticket.

1.7 ACCESSORIES

- .1 Vapour Barrier: 10 mil polyethylene film to CAN/CGSB-51.34 unless otherwise noted on Drawings.
- .2 Grout: Portland Cement based non-shrink, non-metallic composition and shall meet the following requirements:
 - .1 The grout shall not exhibit bleeding or segregation at pumpable consistency.
 - .2 Compressive Strength: 25 MPa @ 1 day.
 - .3 Bond Strength (ASTM C882) 13 MPa @ 28 days.
 - .4 Positive expansion confirmed by ASTM C827.
 - .5 The grout shall not produce a vapour barrier.
- .3 Non-premixed dry pack grout: composition of non metallic aggregate Type GU cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 25 MPa at 28 days.
- .4 Pre-moulded joint fillers:
 - .1 Bituminous impregnated fiber board: to ASTM D1751.
 - .2 Sponge rubber: to ASTM D1752, Type I, flexible grade.

PART 2 EXECUTION

2.1 PREPARATION

- .1 Obtain Departmental Representative's approval before placing concrete.
 - .1 Provide minimum 48 hours 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 facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .5 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .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, air temperature and test samples taken.
- .9 Do not place load upon new concrete until authorized by Departmental Representative.

2.2 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CSA-A23.1/A23.2.
- .2 Sleeves and inserts:
 - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through beams, column capitals or columns, except where indicated or approved by Departmental Representative.
 - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
 - .3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.
 - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.
 - .5 Check locations and sizes of sleeves and openings shown on drawings.
- .3 Anchor bolts:
 - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
 - .2 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
 - .3 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .4 Drainage holes and weep holes:
 - .1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.
 - .2 Install weep hole tubes and drains as indicated.
- .5 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .6 Finishing:
 - .1 Finish concrete in accordance with CSA-A23.1/A23.2.
 - .1 Concrete tolerance in accordance with CSA-A23.1/A23.2 straightedge method Floor Flatness (FF) = 20 : Floor Levelness (FL) = 15.
 - .2 Use curing methods compatible with applied finish on concrete surfaces.

- .7 Curing:
 - .1 Cure and protect concrete in accordance with requirements CSA A23.1.
 - .2 Unless noted otherwise the curing regime shall be consistent with the Class of Exposure. See General Notes on structural drawing for Class of Exposure.
- .8 Waterstops:
 - .1 Install waterstops to provide continuous water seal.
 - .2 Do not distort or pierce waterstop in way as to hamper performance.
 - .3 Do not displace reinforcement when installing waterstops.
 - .4 Use equipment to manufacturer's requirements to field splice waterstops.
 - .5 Tie waterstops rigidly in place.
 - .6 Use only straight heat-sealed butt joints in field.
 - .7 Use factory welded corners and intersections unless otherwise approved by Departmental Representative.
- .9 Joint fillers:
 - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.
 - .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .3 Locate and form joints as indicated.
 - .4 Install joint filler.
 - .5 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

2.3 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by contractor for review in accordance with CSA-A23.1/A23.2.
 - .1 Ensure testing laboratory is certified in accordance with CSA A283.
- .2 Frequency and Number of Tests:
 - .1 Concrete Tests:
 - .1 Not less than one strength test per 50 cubic metres of concrete placed and not less than one test for each class of concrete placed on any one day.
 - .2 Minimum 3 test cylinders required for each sample, for 3, 7 and 28 day compressive testing.
 - .3 Air measurements will be completed on each of the initial 3 loads of concrete per day of casting to ensure satisfactory control of the air content is established. If adequate control of air content is not established within the first 3 loads of concrete or if a test falls outside the specified limits, the testing frequency shall revert to one test per load until satisfactory control is re-established. Costs

for additional testing will be the responsibility of the concrete supplier.

- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.
- .4 Departmental Representative may request 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: in accordance with CSA-A23.1/A23.2.
- .6 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

2.4 VERIFICATION

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established in PART 2 - Products, by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.5 DEFECTIVE CONCRETE

- .1 Defective concrete: cracking, spalling, scaling and concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
- .2 Repair or replacement of defective concrete will be determined by the Departmental Representative, based on the specifications and the above guidelines.
- .3 Do not patch, fill, touch-up, repair or replace exposed concrete except upon express direction of Departmental Representative for each individual use.
- .4 Modify or replace concrete not conforming to lines, detail and elevations indicated on drawings.
- .5 Repair or replace concrete not properly placed, resulting in excessive honeycombing and other defects in critical areas of stress.
- .6 Notify Departmental Representative of proposed methods of repairing or replacing defective concrete. Methods of repairing or replacing defective concrete shall be acceptable to the Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - .2 ASTM D570-98 (2010)e1, Standard Test Method for Water Absorption of Plastics.
 - .3 ASTM D5385/D5385M-93 (2014)e1, Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
 - .4 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
 - .5 ASTM E154/E154M-08a (2013)e1, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, data sheets.
 - .2 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
 - .3 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Handle waterproofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.
- .2 Provide and maintain dry, off-ground weatherproof storage.
- .3 Store rolls of felt and membrane in upright position.
 - .1 Store membrane rolls with selvedge edge up.
- .4 Store sealants at +5°C minimum.

1.4 SITE CONDITIONS

- .1 Ambient Conditions: Install waterproofing when temperature is within manufacturer's recommended range.

Part 2 Products

2.1 MEMBRANE

- .1 Sheet Seal: Self-adhesive bitumen laminated to high-density polyethylene film, nominal total thickness of 1.5 mm.
 - .1 Membrane physical properties:
 - .1 Elongation (ASTM D412): Minimum 300%
 - .2 Tensile Strength (ASTM D412 modified): Minimum 2.24 MPa.
 - .3 Puncture Resistance (ASTM E154): Minimum 222 N/m.
 - .4 Water vapour transmission (ASTM E96): Maximum 1.6 ng/Pa.s.m² (0.02 perms).
 - .5 Moisture Absorption (ASTM D570): 0.2% max.
 - .6 Hydrostatic head (ASTM D5385): 70 m water.

2.2 PRIMER

- .1 Primer: As recommended by waterproofing manufacturer and appropriate to application conditions.

2.3 DRAINAGE BOARD

- .1 Board: Three-dimensional polymeric core drain board, 10 mm thick, with a non-woven geotextile fabric fully bonded to top dimples of board.

Part 3 Execution

3.1 PREPARATION

- .1 Remove loose or foreign matter which may impair adhesion of materials.
- .2 Ensure substrates are clean of oil and dust; free of large voids and sharp protrusions.
- .3 Ensure substrates are free of surface moisture prior to application of membrane and primer.
- .4 Ensure metal closures are free of sharp edges and burrs.

3.2 INSTALLATION

- .1 Install materials in accordance with manufacturer's instructions.
- .2 Perform priming for sheet waterproofing in accordance with manufacturer's written recommendations.
- .3 Apply primer with a roller over properly prepared substrate and allow to dry to tacky surface. Prime only area to be covered in a working day. Re-prime area not covered with membrane within 24 hours.
- .4 After primer has dried, firmly apply membrane using a hand roller onto the primed surface in accordance with membrane manufacturer's written instructions.

- .5 Ensure complete coverage of and adhesion of substrates to receive membrane, including wall penetrations. Co-operate with other trades to ensure continuity of the membrane.
- .6 Overlap membrane 65 mm at sides and ends and carefully smooth out with a roller to ensure full continuous bond throughout overlaps without fissures or fishmouthing.
- .7 Where more than one length of sheet membrane is required, apply in shingled fashion.
- .8 Seal membrane to penetrations as recommended by manufacturer.
- .9 Terminate membrane with manufacturer approved sealant.
- .10 Do not enclose membrane until it has been inspected and approved by Departmental Representative.
- .11 Install drainage board to face of waterproofing membrane.

3.3 PROTECTION OF WORK

- .1 Protect finished work in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Do not permit adjacent work to damage work of this section.
- .3 Ensure finished work is protected from climatic conditions.

3.4 INSPECTION

- .1 Carefully inspect for continuity of waterproofing prior to placement of drainage board.
- .2 Repair deficient membrane areas.
- .3 Repair misaligned or inadequately lapped seams, punctures, or other damage with patch of membrane extending 50 mm in all directions from edge of damaged areas.
- .4 Cover membrane immediately after Departmental Representative's inspection to protect from damage by other trades.

3.5 CLEANING

- .1 Remove markings from finished surfaces.
- .2 Repair or replace defaced or disfigured finishes caused by work of this section.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM C518-10, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .3 ASTM C578-16, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - .4 ASTM D1621-10, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 - .5 ASTM D2842-12, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
 - .6 ASTM E96/E96M-05, Standard Test Methods for Water Vapour Transmission of Materials.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's insulation products and adhesives.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 INSULATION

- .1 Extruded polystyrene (XPS): to ASTM C578.
 - .1 Type: IV.
 - .2 Compressive strength (ASTM D1621): 172 kPa (25 psi).
 - .3 Thermal resistance (ASTM C518): RSI 0.88 per 25 mm (R5 per inch) thickness.
 - .4 Thickness: As indicated.
 - .5 Edges: Square.
- .2 Concrete-faced insulation panels: Polystyrene board insulation with pre-applied concrete facing.
 - .1 Board insulation: CAN/ULC S701, Type 4, extruded polystyrene (XPS), closed cell rigid board.
 - .1 Compressive strength (ASTM D1621): Minimum 240 kPa (35 psi).
 - .2 Thermal resistance (ASTM C518): RSI 0.88/25 mm (R 5.0/inch).
 - .3 Water absorption (ASTM D2842): Maximum 0.7% by volume.
 - .4 Water vapour permeance (ASTM E96): Maximum 45 ng/Pa•s•m² (0.8 perms).
 - .2 Concrete: Latex modified concrete, 8 mm (5/16 inch) thick.
 - .3 Thickness: As indicated on Drawings.
 - .4 Edges: Tongue and groove along longitudinal foam edges, but joints on lateral edges.
 - .5 Surface finish: Textured broom finish, grey.
 - .6 Accessories: Manufacturer-supplied clips, galvanized steel to ASTM A123/A123M, G90 coating designation, complete with corrosion proof masonry fasteners.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 GENERAL

- .1 Offset both vertical and horizontal joints in multiple layer applications.

3.3 EXAMINATION

- .1 Examine substrates and inform Departmental Representative in writing of defects.

- .2 Prior to commencement of work ensure:
 - .1 Substrates are firm, straight, smooth, dry, free of snow, ice and frost.

3.4 PERIMETER FOUNDATION INSULATION

- .1 Exterior application: extend boards as indicated. Install on exterior face of perimeter foundation wall with manufacturer-provided clips.
- .2 Under slab application: extend boards as indicated. Lay boards on level compacted fill.

3.5 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.2 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 window wells. Include product characteristics, performance criteria, physical size, and finish.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 WINDOW WELLS

- .1 Steel sheet, 1.6 mm thick (16 gauge), corrugated; galvanized to ASTM A653, G90 thickness; formed to shape with roll-formed bead or hem at top edge. Complete with flanges with pre-punched holes for attachment to foundation wall.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions are acceptable for window well installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Departmental Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install window well at location indicated.
- .2 Attach solidly to foundation wall with fasteners as recommended by window well manufacturer.
- .3 Install window well square, plumb, and straight without twist or distortion.

3.3 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Leave Work area clean at end of each day.
- .3 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .4 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.2 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .2 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .3 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

- .2 Equipment performance verification test results.
- .3 Special performance data as specified.
- .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .4 Approvals:
 - .1 Submit 3 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .5 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .6 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information daily to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .7 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .8 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:

- .1 One set of packing for each pump.
- .2 One casing joint gasket for each size pump.
- .3 One head gasket set for each heat exchanger.
- .4 One glass for each gauge glass.
- .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .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.

Part 2 Products

2.1 NOT USED.

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 installation in accordance with manufacturer's written instructions.
 - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 10 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Departmental Representative will record these demonstrations on video tape for future reference.

3.5 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.

3.6 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150.
- .2 Cast bronze threaded fittings, Class 125.
 - .1 Cast copper solder joint pressure fittings.
- .3 Copper alloy solder joint pressure fittings.
- .4 Buried copper pipe couplings up to including 50mm (2"):
 - .1 Material: brass, full bore
 - .2 Connection type: compression coupling to AWWA C800
 - .3 NSF 61 complaint
 - .4 Working pressure: 2068 kpa (300 psi).

2.3 JOINTS

- .1 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .2 Copper solder joints: lead free tin & silver solder with minimum melting point of 221°C (430°F). Use water soluble solder fluxes.
- .3 Threaded joints: use Teflon tape or thread sealing compound
- .4 Dielectric connections between dissimilar metals:

- .1 Thermoplastic liner to ASTM F492, or,
- .2 Lead free dielectric unions with copper solder ends with gasket to separate tailpieces to prevent electric current.

2.4 BALL VALVES

- .1 Up to including 50mm (2") 4137 kPa (600 psi) non shock CWP
 - .1 Standard Specification: MSS-SP-110
 - .2 NSF/ANSI 61 compliant
 - .3 Connections: Solder or Thread ends
 - .4 Full port
 - .5 Operator: Removable, plated steel lever handle with plastic cover
 - .6 Body and cap: Forged brass; Cast bronze
 - .7 Stem: Stainless steel
 - .8 Stem seal: Flourocarbon FKM; TFE; PTFE
 - .9 Ball seat: PTFE; TFE
 - .10 Ball: Stainless Steel

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 INSTALLATION

- .1 Install in accordance with local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.3 TRAP PRIMER SYSTEM

- .1 Provide rough-in piping for floor drain trap primer system. Supply piping to be capped off in mechanical room.

3.4 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves.

3.5 PRESSURE TESTS

- .1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.
- .3 Pressure test systems in accordance with local regulations.
- .4 Pressure test buried systems before backfilling.

3.6 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean copper to Provincial potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.7 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.8 START-UP

- .1 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Certificate of static completion has been issued.
 - .3 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 PIPING AND FITTINGS

- .1 Piping, general:
 - .1 38mm to 300mm (1½" to 12") PVC/DWV: to CSA B181.2, CAN/ULC S102.2
 - .2 Flame spread rating: not to exceed 25.

2.2 JOINTS

- .1 Solvent weld for PVC: to ASTM D2564.

2.3 BACKWATER VALVES

- .1 Normally open type.
- .2 Body:
 - .1 Enamel coated cast iron
 - .2 Inlet/Outlet connections: No-hub
 - .3 Gasketed bolt down cover
- .3 Integral Flapper Valve: Bronze with o-ring, adjacent to inlet.
- .4 Integral Gate Valve:
 - .1 Bronze, spade type
 - .2 Stem: non-rising, bronze
 - .3 O-ring seat insert, replaceable
 - .4 Adjacent to outlet
- .5 Handle:
 - .1 Wheel type
- .6 Provide extension as required to suit depth of backwater valve.

2.4 FLOOR DRAINS

- .1 Floor Drains and Trench Drains: to CSA B79.
- .2 Type 1: general duty; cast iron body round, adjustable head, sediment basket nickel bronze strainer, integral seepage pan, and clamping collar.

2.5 CLEANOUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
 - .1 Floor Access: round, cast iron body and frame with adjustable secured nickel bronze top and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: nickel bronze, round, gasket, vandal-proof screws.

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 INSTALLATION

- .1 Install in accordance with local authority having jurisdiction.
- .2 Cleanouts:
 - .1 Install cleanouts:
 - .1 At all changes of direction
 - .2 At base of soil/waste stacks
 - .2 Ensure cleanouts are accessible. Extend cleanouts to face of structure with access cover and frame where located above furred ceilings or in concrete slabs on grade.

3.3 BACKWATER VALVES

- .1 Install in main sewer lines where indicated.

3.4 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.5 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.6 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.7 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section Includes:
 - .1 General requirements that are common to sections found in Division 26 – Electrical.
- .2 This Section covers items common to Section of Division 26. This section supplements requirements of Division 1.
- .3 All drawings and all sections of the specification shall apply to and form an integral part of this section.
- .4 Carefully examine all plans and specifications pertaining to this Contract and become familiar with all details. Visit the site and determine all factors affecting this section of the work and include all costs for same in tender.

1.2 REFERENCES

- .1 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.
- .2 Reference Standards:
 - .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 American National Standards Institute/ International Electrical Testing Association (ANSI/NETA)
 - .1 ANSI/NETA Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
 - .3 The electrical installation shall comply with the requirements of the Electrical Supply Authority, the latest edition of the Canadian Electrical Code, latest edition of referenced standards, with all Provincial and Municipal Laws, Rules and Ordinances, and to the satisfaction of those persons having jurisdiction over same.
 - .4 Notify the Departmental Representative of any discrepancies or conflicts with any regulation seven (7) working days before tenders close. Failing such notification, meet all such requirements without change to the contract price.
 - .5 In no instance shall the standard established by these specifications and drawings be reduced by any of the codes, rules or ordinances.
 - .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

1.3 REQUEST FOR INTERPRETATION PROCESS

- .1 General:
 - .1 Immediately on discovery of the need for interpretation of the Contract Documents, Contractor shall prepare and submit an RFI to the Departmental Representative.
 - .2 Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
 - .3 For RFIs submitted electronically, include project name and RFI number in subject line of email.
- .2 Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - .1 Project name (including building number).
 - .2 Project number.
 - .3 Date.
 - .4 Name of Contractor.
 - .5 Name of Departmental representative.
 - .6 RFI number, numbered sequentially. (eg: RFI-001)
 - .7 RFI subject.
 - .8 Specification Section number, title and related paragraphs, as appropriate.
 - .9 Drawing number and detail references, as appropriate.
 - .10 Field dimensions and conditions, as appropriate.
 - .11 Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Price, Contractor shall state impact in the RFI.
 - .12 Contractor's signature.
 - .13 Attachments: Include sketches, descriptions, measurements, photos, product data, shop drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - .1 Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- .3 RFI Forms: Contractor generated form including all content indicated in this Section.
 - .1 Form and attachments shall be electronic files in Adobe Acrobat PDF format.
- .4 Departmental Representative's Action: Departmental Representative will review each RFI, determine action required, and respond. Allow 10 working days for Departmental Representative's response for each RFI. RFIs received by Departmental Representative after 1:00 p.m. will be considered as received the following working day.

- .1 The following Contractor-generated RFIs will be returned without action:
 - .1 Requests for approval of submittals.
 - .2 Requests for approval of substitutions.
 - .3 Requests for approval of Contractor's means and methods.
 - .4 Requests for approval of corrective actions for deficient work.
 - .5 Requests for coordination information already indicated in the Contract Documents.
 - .6 Requests for adjustments in the Contract Time or the Contract Sum.
 - .7 Requests for interpretation of Departmental Representative's actions on submittals.
 - .8 Incomplete RFIs or inaccurately prepared RFIs.
- .2 Departmental Representative's action may include a request for additional information, in which case Departmental Representative's time for response will date from time of receipt of additional information.
- .3 If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Departmental Representative in writing within 10 days of receipt of the RFI response. Failure to notify will result in the work being included as part of the contract.
- .5 RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log with progress meeting minutes. Include the following:
 - .1 Project name.
 - .2 Name and address of Contractor.
 - .3 Name and address of Departmental representative.
 - .4 RFI number including RFIs that were returned without action or withdrawn.
 - .5 RFI description.
 - .6 Date the RFI was submitted.
 - .7 Date Departmental Representative's response was received.
- .6 On receipt of Departmental Representative action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Departmental Representative within 10 days if Contractor disagrees with response.

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 equipment 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 Alberta, Canada.
- .2 Submit installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to ensure co-ordinated installation.
- .3 Submit copies of drawings and product data to authority having jurisdiction.
- .4 If changes are required, notify Departmental Representative of these changes before they are made.
- .4 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.
 - .3 Permits and fees: in accordance with General Conditions of contract.
 - .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .5 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, as described in PART 3 - FIELD QUALITY CONTROL.

1.5 COORDINATION

- .1 The Contractor is responsible for installing a complete, fully functional and fully operational system, and is responsible for reviewing all other trades' drawings to ensure all electrical requirements are included in the tender price. Inform the Departmental representative of any discrepancies during the tender process. Any discrepancies not identified, shall be incorporated by the Contractor at no cost during construction.
- .2 The Contractor is responsible for coordination with all other trades and Contractors on site.
- .3 Through the General Contractor, coordination shall include regular meetings, exchange of shop drawings and other technical information. Compile working combined systems drawings, where parts of the installation are complex or require input of several trades. Ensure the General Contractor is in attendance and is aware of all coordination. Obtain and exchange schedules with all other trades and Contractors to ensure work which impacts another trade or Contract is completed in sufficient time.
- .4 All work is to be properly phased to enhance coordination. Where it is evident that work outside of phase has inhibited the work of another Contractor, the Departmental representative shall reserve the right to instruct the Contractor to remove said work at the cost of the Contractor.

1.6 DRAWINGS

- .1 Drawings are intended to communicate the general design intent. They are not to be interpreted as a description of means and methods of construction. The Contractor is responsible for reviewing the drawings and specifications of this and all other trades on the project to ensure that they deliver a fully coordinated, complete and fully operational system. Any component or service not described, but reasonably obvious as required for completion shall be included by the Contractor at no cost.
- .2 Carefully examine all drawings and specifications relating to all work (including, but not limited to, all other disciplines' drawings and specs), and all electrical work indicated thereon shall be considered as a part of the work by this section unless indicated otherwise. Prior to the date of the last addendum report at once to the Departmental Representative, any defect, discrepancy, omission or interference affecting the work of this section, or the guarantee of same.
- .3 Install all equipment as shown or as specified and in accordance with manufacturer's approved shop drawings.
- .4 The drawings accompanying these specifications are intended to show the general arrangement and extent of the work to be carried out, but the exact location and arrangement of all parts shall be determined as the work progresses. The location of equipment, outlets, etc., as given on the drawings are approximately correct, but it shall be understood that they are subject to such modifications as may be found necessary or desirable at the time of installation to meet any structural or architectural requirements. Such changes shall be implemented as directed by the Departmental Representative, without additional charge.
- .5 Electrical drawings do not show all structural and other details. Architectural and structural conditions shall govern, and this Section shall make without charge, changes or additions to accommodate these conditions. Check all architectural plans, elevations and details for location of electrical devices, equipment and equipment to be connected.
- .6 Where drawings indicate the general location and route to be followed by conduit, cable, etc., these locations must be governed by job conditions. Where the required conduit, cable, and boxes are not shown on drawings or only shown diagrammatically, they shall be installed to conserve maximum head room and interfere as little as possible with free use of space through which they pass. Maximum clearance above floor shall be maintained under all suspended conduit and equipment, unless otherwise shown on the drawings, or approved by the Departmental representative.
- .7 Submit a complete set of drawings for the proposed installation to the Inspection Department having jurisdiction and receive written approval before installation or fabrication of any equipment. No extra compensation will be allowed for any changes or rearrangement of any electrical apparatus or materials necessary due to failure to receive this approval.

- .8 Provide the Electric Utility with three copies of a drawing showing the main distribution and the proposed method of metering for approval prior to the manufacture of equipment.

1.7 PENETRATIONS IN STRUCTURAL MEMBERS

- .1 Penetrations in new structural members.
 - .1 Coordinate work with structural for penetrations through new structural members.
 - .2 Review structural drawings.
 - .3 Coordinate shop drawings to include for penetrations of electrical services through structural members. Review structural shop drawings prior to submission to Structural Departmental representative for review.
- .2 Installations that deviate from structural drawings are not acceptable.
- .3 Submit proposals for deviations to Departmental representative for review.

1.8 TEMPORARY LIGHTING AND POWER

- .1 All temporary and construction lighting and power work and costs for same are not included as part of the scope of the work of this section. Refer to such clauses in other sections of the specification.

1.9 AS-BUILT DRAWINGS INDICATING CONDUIT/CABLE RUNS & EQUIPMENT LOCATIONS

- .1 Record the horizontal and vertical routing of all electrical cables and conduits installed under this Contract.
- .2 As-built drawing information shall be organized and presented as follows. Each of the following groups of systems shall be recorded on separate As-built drawing sets. Do not 'crowd' drawings with as-built record information. Use additional drawing prints as required.
- .3 Record the location of the following: All electrical duct, pull boxes, junction boxes, access fittings.
- .4 As work progresses, record on one (1) set of contract drawings, installed conduit layout as well as any approved changes and deviations from the original contract and/or working drawings, including outlets, equipment and panel locations. Have these drawings available for reference and observation at all times.

1.10 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 off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect equipment from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse by manufacturer of packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Language operating requirements: provide identification nameplates labels for control items in English and French.
- .3 Use one nameplate label for each language.

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 material and equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.3 EQUIPMENT IDENTIFICATION LABELS, SIGNS AND MARKINGS

- .1 Equipment identification labels, nameplates, signs and markings: in accordance with requirements of authority having jurisdiction and Departmental representative.
- .2 Underground ducts
 - .1 Underground warning tape
 - .1 Identify underground power, communications/ fibre optic ducts with underground warning tape.
 - .1 Polyethylene tape, minimum 76mm wide.
 - .2 Printing on tape shall be permanent and shall not be damaged by burial operations.
 - .3 Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - .2 Power ducts:

- .1 Red tape with black wording: "CAUTION - BURIED
ELECTRIC CABLE BELOW".
- .3 Fibre optic ducts:
 - .1 Orange tape with black wording: "CAUTION - BURIED
FIBRE OPTIC LINE BELOW".

2.4 WARNING SIGNS

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

2.5 WORKMANSHIP AND MATERIALS

- .1 The installation shall consist of material and equipment specified unless as provided herein. Electrical equipment provided under this contract shall be built in accordance with EEMAC standards and shall be C.S.A. certified (or certified by an equivalent recognized certifying agency to meet Canadian Standards) and/or locally approved. All equipment supplied under this contract shall be new and the best of its respective kind and of uniform pattern throughout.
- .2 Any material or equipment ordered or installed without the Departmental Representative's prior approval shall, if so directed by the Departmental Representative, be removed and replaced with approved material or equipment without a change to the contract.
- .3 Replace inferior work if so ordered by Departmental representative without a change to the contract.
- .4 Retain same foreman or superintendent on the job until completed, unless otherwise directed by the Departmental representative.
- .5 All tradesmen shall carry all tools on their person at all times. Any tool not in use shall be under lock and key in an area authorized by the building supervisor.

2.6 CONDUIT AND CABLE INSTALLATION - GENERAL

- .1 Install conduit and sleeves prior to pouring of concrete.
- .2 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .3 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .4 Install conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .5 Redundant, unused or empty conduits, supports, junction, pull boxes and other equipment that was installed under this project but was not used shall be removed from the site unless otherwise noted. Where conduits, junction and pull boxes and other equipment were required to be installed to facilitate construction work, such as temporary feeds, these shall be removed from the site unless otherwise noted.

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 equipment 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 INSTALLATION

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

3.3 NAMEPLATES AND LABELS

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

3.4 FIELD QUALITY CONTROL

- .1 Schedule review of site services by Departmental Representative prior to closing of buried duct and keep detailed documentation with pictures of the uncovered duct install. Provide Departmental Representative with digital images of the duct installation upon request.

3.5 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 The Contractor is responsible for scheduling, arranging, and paying for the new electrical service. Coordinate with the electrical utility as required, and provide required documentation including, but not limited to: Manitoba Hydro Application for Electrical Service. Provide all necessary drawings, specifications, electrical load summaries, etc. as required. Contractor shall coordinate directly with the electrical utility and Departmental Representative for production, payments and signatures of the Electrical Service Agreement (ESA).
- .3 Pay all associated fees for inspection of the work by authorities having jurisdiction.
- .4 Notify Departmental representative of changes required by Electrical Inspection Department prior to making changes.

- .5 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of work to Departmental representative. Copies to be included in Maintenance Manuals.

3.6 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 The Contractor is responsible for scheduling, arranging, and paying for the new electrical service. Coordinate with the electrical utility as required, and provide required documentation including, but not limited to: Hydro Application for Electrical Service. Provide all necessary drawings, specifications, electrical load summaries, etc. as required. Contractor shall coordinate directly with the electrical utility and Departmental Representative for production, payments and signatures of the Electrical Service Agreement (ESA).
- .3 Pay all associated fees for inspection of the work by authorities having jurisdiction.
- .4 Notify Departmental representative of changes required by Electrical Inspection Department prior to making changes.
- .5 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of work to Departmental representative. Copies to be included in Maintenance Manuals.

3.7 RESPONSIBILITY

- .1 Be responsible for any damage caused the Departmental Representatives, or their Contractors due to improperly carrying out this work.
- .2 Install all components of this work promptly and where applicable, in advance of concrete pouring, or similar construction. Provide and set in the proper sequence of construction, all sleeves, hangers, inserts, etc. and arrange for all necessary openings, where required to accommodate the electrical installation.
- .3 Work shall be arranged in co-operation with other Divisions of this specification in such a manner that it doesn't interfere with the progress of the project. In areas where ducts or pipes must be installed along with conduit, co-operate with other divisions so that the finished job will represent the most efficient use of the space.
- .4 In no case proceed with any work in uncertainty. Obtain, from the Departmental Representative, any clarification necessary and thoroughly understand all portions of the work to be performed.

3.8 GUARANTEE

- .1 Guarantee the satisfactory operation of all work and equipment supplied and installed as a part of this section of the specifications.
- .2 Replace forthwith, at no additional material or labour cost, any part which may fail, or prove defective within a period of twelve (12) calendar months after the

final acceptance of the complete installation, provided that such failure is not due to improper usage, or ordinary wear and tear.

- .3 No certificate given, payment made, partial or entire use of the equipment by the Departmental Representative or his representative shall be construed as acceptance of defective workmanship or materials.
- .4 This general guarantee shall not act as a waiver of any specified guarantee or special equipment guarantees covering a greater length of time.

3.9 EXCAVATION AND BACKFILLING

- .1 Excavate and backfill as required for underground electrical services as indicated. Provide protective materials around and over services and be present at all times during excavation and backfilling to supervise work. Backfilling shall restore the excavated area to the original condition and shall include sodding or asphalt repair where required.
- .2 Work to be in accordance with the current CSA Bulletin.
- .3 Include all costs for excavation and backfilling, for any underground electrical installation unless otherwise indicated.
- .4 Ensure adequate compaction to 95% proctor, in 6" lifts. Do not use frozen materials.

3.10 FIREPROOFING

- .1 Where cables or conduits pass through floors, block or concrete walls and fire rated walls, seal openings with ULC rated fireproofing product, to maintain fire rating.
- .2 Seal all holes resulting from removal of cables, conduits and equipment.
- .3 Fireproofing of electrical cables, conduits, trays, etc. passing through fire barriers shall conform to local codes and inspection authorities.

3.11 SYSTEM STARTUP

- .1 Not used

3.12 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 reuse recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 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 hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 hangers and supports from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size and thickness as required, surface mounted, suspended or set in poured concrete walls and ceilings.

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 hangers and supports 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 INSTALLATION

- .1 Secure equipment to poured concrete with expandable inserts.
- .2 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .3 Install fastenings and supports as required for each type conduit, and in accordance with manufacturer's installation recommendations.

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 reuse recycling 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 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 UNDERGROUND ENCLOSURES

- .1 The enclosure shall be rated for incidental traffic (Tier 22).
 - .1 The box dimensions are: 24" x 36"
 - .2 The box shall be open bottom 36" deep.
 - .3 The box, cover, and extension shall be constructed of Polymer Concrete.
 - .4 The cover and box rim shall be green in colour
 - .5 There shall be provision for minimum one-inch keying and a lip on the top rim of box for support of top cover.
 - .6 The box and cover structural requirements shall be in accordance with ANSI/SCTE 77, and be capable of passing ANSI/SCTE 77 Tier 22 loading requirements for Occasional Non-Deliberate *Heavy Traffic*.
 - .7 The box shall have a minimum of two boltholes with selfcleaning, floating style nuts.
 - .8 The cover shall be gasketed.
 - .9 The cover shall have recessed boltholes. The boxes and covers shall be assembled together prior to shipment.

- .10 The boxes may be stacked a maximum of five (5) high and shall be palletized and strapped for ease of handling during shipping and handling.
- .11 Approved Manufacturers:
 - .1 Quazite "PD" style enclosure.

Part 3 Execution

3.1 UNDERGROUND ENCLOSURES

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Install pull boxes clear of all mechanical ductwork and piping.
- .3 Install underground enclosures so as not to exceed 150m of cable or underground duct run between enclosures.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-Z809, Sustainable Forest Management.
- .2 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001, FSC Principle and Criteria for Forest Stewardship.
- .3 Insulated Cable Engineers Association, Inc. (ICEA)

1.2 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 cables and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 cables from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC ducts for direct burial: with expanded flange ends, with minimum wall thickness at any point of 3.0 mm. Nominal length: 3 m plus or minus 12 mm.
- .2 Rigid PVC split ducts.
- .3 Rigid PVC couplings, reducers, caps, adaptors as required to make complete installation.
- .4 Bell ends on all ducts, at each end.
- .5 Rigid PVC 90 deg. and 45 deg. bends as required.

- .6 Rigid PVC 5 deg. angle couplings as required.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent weld compound for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 MARKERS

Concrete type cable markers: as indicated, with words: "cable", "joint" or "conduit" and name of electrical system impressed in top surface, with arrows to indicate change in direction of duct runs.

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 cable 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.
- .2 Provide directional boring for external conduits entry to building.

3.2 DUCT INSTALLATION

- .1 During construction, cap ends of ducts to prevent entrance of foreign materials.
- .2 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 matter. Pull stiff bristle brush through each duct/pipe immediately before pulling-in cables.
- .3 In each duct/pipe install pull rope continuous throughout each duct/pipe run with 3 m spare rope at each end.
- .4 Provide duct plugs on all empty ducts/pipes, at each end.
- .5 Provide seals around conductors inside ducts/pipes at each end.
- .6 Provide markers as required.
- .7 Clearly show locations on Record Drawings c/w dimensions from building, curbs, property lines, etc.
- .8 Provide expansion joints along horizontal and vertical runs, indoors and outdoors, above and below ground, to allow for expansion and contraction of the

duct, due to building expansion joints, temperature changes and soil shrinking or heaving.

- .9 Provide expansion joints at exit from ground to allow for expansion and contraction due to temperature changes and soil shrinking or heaving.
- .10 Account for duct temperature at the time of installation.
- .11 Confirm number of required expansion joints and piston setting with duct manufacturer.
- .12 Install PVC ducts in trenches.
- .13 Install in accordance with manufacturer's instructions.
- .14 Clean inside of ducts before laying.
- .15 Ensure full, even support every 1.5 m throughout duct length.
- .16 Slope ducts with 1 to 400 minimum slope.
- .17 Install ducts on undisturbed ground. If disturbed, excavate back to undisturbed and backfill with $\frac{3}{4}$ " engineered backfill, compacted to 95% proctor in 450mm lifts.
- .18 Ensure trenches are dry and not frozen before installation.
- .19 Backfill under and over ducts with clean, screened, non frozen sand (150mm minimum).

3.3 MARKERS

- .1 Mark duct every 150 m along runs and changes in direction.
- .2 Install cedar post type markers.
- .3 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.4 FIELD QUALITY CONTROL

- .1 Schedule review of site services by Departmental Representative prior to closing of buried duct and keep detailed documentation with pictures of the uncovered duct install. Provide Departmental Representative with digital images of the duct installation upon request.

3.5 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 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 REFERENCES

- .1 ASTM E84: Surface Burning Characteristics of Building Materials
- .2 ASTM E119: Fire Tests of Building Construction and Materials
- .3 ASTM E814: Fire Tests of Through-Penetration Firestops
- .4 NEMA Standard 1-10-79 For Type 1-6p and 11-13 Enclosures
- .5 Underwriters Laboratories of Canada (ULC)
- .6 Underwriters Laboratories Products Certified for Canada (CUL)
- .7 ULC-S115: Fire Test of Through-Penetration Firestops

1.2 SYSTEM REQUIREMENTS

- .1 Technical Considerations:
 - .1 Designs should have a L Rating(CF/FT²) of <1 at Ambient and <1 at 400°
 - .2 Sealing system should be water-tight 1 bar/IP67.
 - .3 Sealing system must be Halogen free.
 - .4 Design should provide cable/pipe retention support of 170 lbs or more per cable or pipe.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results for Electrical
 - .1 Provide dimensioned drawing indicating all selected model numbers of the selected seals for the proposed installation. Include all required seals, parts and accessories.

Part 2 Products

2.1 SEALING PRODUCT

- .1 For sealing cables and ducts in round openings, utilizing peelable modules that are compressed to form a water, gas and dust tight seal.
- .2 Standard of acceptance: Roxtec R and RS seals or equivalent.

Part 3 Execution

3.1 GENERAL

- .1 Provide cable and duct seals to prevent the passage of water, gasses, and rodents.
- .2 Provide seals at all below grade cable, conductor and duct penetrations as follows:
 - .1 Provide inside the duct, to seal around cables and conductors and
 - .2 Provide around duct to seal gap between duct and hole wall.
- .3 Core drill hole or provide sleeve thru exterior wall or floor, size suitable for the sealing system.
- .4 Install sealing system on the inside of the exterior wall or floor.
- .5 After installation of duct and seal, apply grout around duct on outside of wall or floor.
- .6 Installations shall be performed in accordance with manufacturer's detailed installation procedures.
- .7 When conductors enter into the building thru underground ducts, provide pull box inside the building to transition to EMT conduit.

END OF SECTION

Part 1 GENERAL

1.1 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 hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 hangers and supports from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size and thickness as required, surface mounted, suspended or set in poured concrete walls and ceilings.

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 hangers and supports 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 INSTALLATION

- .1 Secure equipment to poured concrete with expandable inserts.
- .2 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .3 Install fastenings and supports as required for each type conduit, and in accordance with manufacturer's installation recommendations.

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 reuse recycling 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 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 UNDERGROUND ENCLOSURES

- .1 The enclosure shall be rated for incidental traffic (Tier 22).
 - .1 The box dimensions are: 24" x 36"
 - .2 The box shall be open bottom 36" deep.
 - .3 The box, cover, and extension shall be constructed of Polymer Concrete.
 - .4 The cover and box rim shall be green in colour
 - .5 There shall be provision for minimum one-inch keying and a lip on the top rim of box for support of top cover.
 - .6 The box and cover structural requirements shall be in accordance with ANSI/SCTE 77, and be capable of passing ANSI/SCTE 77 Tier 22 loading requirements for Occasional Non-Deliberate *Heavy Traffic*.
 - .7 The box shall have a minimum of two boltholes with selfcleaning, floating style nuts.
 - .8 The cover shall be gasketed.
 - .9 The cover shall have recessed boltholes. The boxes and covers shall be assembled together prior to shipment.

- .10 The boxes may be stacked a maximum of five (5) high and shall be palletized and strapped for ease of handling during shipping and handling.
- .11 Approved Manufacturers:
 - .1 Quazite "PD" style enclosure.

Part 3 Execution

3.1 UNDERGROUND ENCLOSURES

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Install pull boxes clear of all mechanical ductwork and piping.
- .3 Install underground enclosures so as not to exceed 150m of cable or underground duct run between enclosures.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-Z809, Sustainable Forest Management.
- .2 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001, FSC Principle and Criteria for Forest Stewardship.
- .3 Insulated Cable Engineers Association, Inc. (ICEA)

1.2 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 cables and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and 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 cables from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC ducts for direct burial: with expanded flange ends, with minimum wall thickness at any point of 3.0 mm. Nominal length: 3 m plus or minus 12 mm.
- .2 Rigid PVC split ducts.
- .3 Rigid PVC couplings, reducers, caps, adaptors as required to make complete installation.
- .4 Bell ends on all ducts, at each end.
- .5 Rigid PVC 90 deg. and 45 deg. bends as required.

- .6 Rigid PVC 5 deg. angle couplings as required.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent weld compound for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 MARKERS

Concrete type cable markers: as indicated, with words: "cable", "joint" or "conduit" and name of electrical system impressed in top surface, with arrows to indicate change in direction of duct runs.

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 cable 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.
- .2 Provide directional boring for external conduits entry to building.

3.2 DUCT INSTALLATION

- .1 During construction, cap ends of ducts to prevent entrance of foreign materials.
- .2 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 matter. Pull stiff bristle brush through each duct/pipe immediately before pulling-in cables.
- .3 In each duct/pipe install pull rope continuous throughout each duct/pipe run with 3 m spare rope at each end.
- .4 Provide duct plugs on all empty ducts/pipes, at each end.
- .5 Provide seals around conductors inside ducts/pipes at each end.
- .6 Provide markers as required.
- .7 Clearly show locations on Record Drawings c/w dimensions from building, curbs, property lines, etc.
- .8 Provide expansion joints along horizontal and vertical runs, indoors and outdoors, above and below ground, to allow for expansion and contraction of the

duct, due to building expansion joints, temperature changes and soil shrinking or heaving.

- .9 Provide expansion joints at exit from ground to allow for expansion and contraction due to temperature changes and soil shrinking or heaving.
- .10 Account for duct temperature at the time of installation.
- .11 Confirm number of required expansion joints and piston setting with duct manufacturer.
- .12 Install PVC ducts in trenches.
- .13 Install in accordance with manufacturer's instructions.
- .14 Clean inside of ducts before laying.
- .15 Ensure full, even support every 1.5 m throughout duct length.
- .16 Slope ducts with 1 to 400 minimum slope.
- .17 Install ducts on undisturbed ground. If disturbed, excavate back to undisturbed and backfill with $\frac{3}{4}$ " engineered backfill, compacted to 95% proctor in 450mm lifts.
- .18 Ensure trenches are dry and not frozen before installation.
- .19 Backfill under and over ducts with clean, screened, non frozen sand (150mm minimum).

3.3 MARKERS

- .1 Mark duct every 150 m along runs and changes in direction.
- .2 Install cedar post type markers.
- .3 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.4 FIELD QUALITY CONTROL

- .1 Schedule review of site services by Departmental Representative prior to closing of buried duct and keep detailed documentation with pictures of the uncovered duct install. Provide Departmental Representative with digital images of the duct installation upon request.

3.5 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 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 REFERENCES

- .1 ASTM E84: Surface Burning Characteristics of Building Materials
- .2 ASTM E119: Fire Tests of Building Construction and Materials
- .3 ASTM E814: Fire Tests of Through-Penetration Firestops
- .4 NEMA Standard 1-10-79 For Type 1-6p and 11-13 Enclosures
- .5 Underwriters Laboratories of Canada (ULC)
- .6 Underwriters Laboratories Products Certified for Canada (CUL)
- .7 ULC-S115: Fire Test of Through-Penetration Firestops

1.2 SYSTEM REQUIREMENTS

- .1 Technical Considerations:
 - .1 Designs should have a L Rating(CF/FT²) of <1 at Ambient and <1 at 400°
 - .2 Sealing system should be water-tight 1 bar/IP67.
 - .3 Sealing system must be Halogen free.
 - .4 Design should provide cable/pipe retention support of 170 lbs or more per cable or pipe.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results for Electrical
 - .1 Provide dimensioned drawing indicating all selected model numbers of the selected seals for the proposed installation. Include all required seals, parts and accessories.

Part 2 Products

2.1 SEALING PRODUCT

- .1 For sealing cables and ducts in round openings, utilizing peelable modules that are compressed to form a water, gas and dust tight seal.
- .2 Standard of acceptance: Roxtec R and RS seals or equivalent.

Part 3 Execution

3.1 GENERAL

- .1 Provide cable and duct seals to prevent the passage of water, gasses, and rodents.
- .2 Provide seals at all below grade cable, conductor and duct penetrations as follows:
 - .1 Provide inside the duct, to seal around cables and conductors and
 - .2 Provide around duct to seal gap between duct and hole wall.
- .3 Core drill hole or provide sleeve thru exterior wall or floor, size suitable for the sealing system.
- .4 Install sealing system on the inside of the exterior wall or floor.
- .5 After installation of duct and seal, apply grout around duct on outside of wall or floor.
- .6 Installations shall be performed in accordance with manufacturer's detailed installation procedures.
- .7 When conductors enter into the building thru underground ducts, provide pull box inside the building to transition to EMT conduit.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - .2 ASTM D1557-02e1, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - .3 ASTM D4253-00, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

1.2 DEFINITIONS

- .1 Corrected maximum dry density is defined as:
 - .1 $D = (F1 \times D1) + (0.9 \times D2 \times F2)$
 - .2 Where: D = corrected maximum dry density kg/m³.
 - .1 F1 = fraction (decimal) of total field sample passing ASTM 4.75 mm sieve
 - .2 F2 = fraction (decimal) of total field sample retained on ASTM 4.75 mm sieve (equal to 1.00 - F1)
 - .3 D1 = maximum dry density, kg/m³ of material passing ASTM 4.75 mm sieve determined in accordance with Method A of ASTM D 1557-91 (regardless of % oversize fraction F2) for granular base, subbase and backfill materials and to ASTM D 698-00a for clay subgrades and backfill materials.
 - .4 D2 = bulk density, kg/m³, of material retained on ASTM 4.75 mm sieve, equal to 1000G where G is bulk specific gravity (dry basis) of material when tested to ASTM C127-88 (1993)e1.
 - .3 For free draining aggregates, determine D1 (maximum dry density) to ASTM D4253 dry method when directed by Departmental Representative.

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 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM D4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.2 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.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .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 Flat and elongated particles of coarse aggregate: to ASTM D4791.
 - .1 Greatest dimension exceeds 5 times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
 - .2 Reclaimed asphalt pavement.
 - .3 Reclaimed concrete material.

- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
 - .3 Reclaimed asphalt pavement.
 - .4 Reclaimed concrete material.

2.2 SOURCE QUALITY CONTROL

- .1 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.
- .2 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.

2.3 TESTING

- .1 Inspection and testing of aggregate materials will be carried out by certified testing laboratory approved by Departmental Representative. Costs of tests will be paid by Contractor.
- .2 Submit testing procedure, frequency of tests, testing laboratory or certified testing personnel to Departmental Representative for approval.
- .3 For each material specified in the following sections, one test will be required for every 500 tonnes of material placed unless otherwise specified in the relevant section.

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.

3.2 PREPARATION

- .1 Topsoil stripping:
 - .1 Stockpile within 50 m of stripped area where possible as directed by Departmental Representative or otherwise as directed by Departmental Representative. Stockpile height not to exceed 2m.

- .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 approved by authority having jurisdiction.
 - .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.
- .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.
- .6 Stockpiling:
 - .1 Stockpile aggregates on site in locations as directed 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 300mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300mm 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 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 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 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 Department Representative .
- .5 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.
- .6 Restrict public access to temporary or permanently abandoned stockpiles by means acceptable to Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM D698-07e1, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).

1.2 EXISTING CONDITIONS

- .1 Known underground and surface utility lines and buried objects are as indicated on site plan. Verify locations of utilities and objects prior to excavation.
- .2 Refer to dewatering in Section 31 23 33.01- Excavating, Trenching and Backfilling.

Part 2 Products

2.1 MATERIALS

- .1 Fill material: Type 3 to Section 31 23 33.01- Excavating, Trenching and Backfilling
- .2 Excavated or graded material existing on site suitable to use as fill for grading work if material meets requirements of Type 3 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 rough grading 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 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Rough grade to depths below finish grades as indicated on drawings.

- .3 Slope rough grade away from buildings at minimum 2% grade and as shown on drawings.
- .4 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .5 Compact filled and disturbed areas to corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density, as follows:
 - .1 90% under landscaped areas.
 - .2 95% under paved and walk areas.
- .6 Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 TESTING

- .1 Inspection and testing of soil compaction will be carried out by certified testing laboratory approved by Departmental Representative. Costs of tests will be paid by Contractor.
- .2 Submit testing procedure, frequency of tests, testing laboratory or certified testing personnel to Departmental Representative for approval.
- .3 Testing frequency will be one test for every 500 m² and one test every 500 m² of 150 mm of fill material placed.

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 PROTECTION

- .1 Protect existing trees, natural features, bench marks, buildings, surface or underground utility lines which are to remain as directed by Departmental Representative. If damaged, restore to original or better condition unless directed otherwise.
- .2 Maintain access roads to prevent accumulation of construction related debris on roads.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C117-17, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136/C136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D422-63(2007)e2, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ;) (600 kN-m/m).
 - .5 ASTM D1557-12e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft) (2,700 kN-m/m).
 - .6 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-13, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.2 SITE CONDITIONS

- .1 The complete Geotechnical Investigation report, including sub-surface soil boring logs is appended to this project manual.

1.3 UTILITY LINES

- .1 Before commencing work, establish location and extent of underground utility lines in areas of excavation. Notify Departmental Representative of findings.
- .2 Remove abandoned utility lines to distance of 1800 mm from foundations. Cap or otherwise seal lines at cut-off points.
- .3 Record locations of maintained, re-routed and abandoned underground utility lines.
- .4 Make good and pay for damage to existing utility lines resulting from work.

1.4 PROTECTION

- .1 Protect bottoms of excavations from softening. Should softening occur, remove softened soil and replace with fill as per Appendix C of the Geotechnical Evaluation report.
- .2 Protect bottoms of excavations from freezing.
- .3 Construct banks in accordance with local by laws.
- .4 Provide adequate protection around bench marks, and geodetic monuments.
- .5 Provide protection to ensure no damage to existing facilities and equipment situated on site.
- .6 Effect approved measures to minimize dust as result of work.
- .7 Do not stockpile excavated material to interfere with site operation or drainage.
- .8 Provide shoring as required to protect adjacent property and structures. All shoring design and drawings to be submitted under seal for review and approval.

1.5 COMPACTION DENSITIES

- .1 Compaction densities are percentages of maximum densities obtainable from ASTM D698 and correct as noted.

1.6 UNSATISFACTORY SOIL CONDITIONS

- .1 Any unsatisfactory or questionable soil conditions revealed during excavation shall be reported immediately to the Departmental Representative.
- .2 All foundation and sub-structural work shall cease until the condition has been examined and approval to proceed has been issued by the Departmental Representative.

1.7 MATERIAL UNSUITABLE FOR BACKFILL

- .1 The Contractor shall be responsible for all costs associated with the excavation and removal of all materials unsuitable for backfill.

1.8 WATER

- .1 Keep excavation free from water at all times. Provide drainage trenches and sumps as necessary and pump water well away from excavation. Do not discharge water onto private property.

1.9 INSPECTION AND TESTING

- .1 Testing of materials and compaction will be carried out by testing laboratory designated by Departmental Representative and as described in Division 0.
- .2 Sieve analysis: Proposed granular materials will be tested to confirm suitability for intended use and conformity with 2.1. Conduct one test per 500 tonnes of material used.
- .3 Frequency of Tests

- .1 Excavated surfaces: When undisturbed excavated surface is being prepared, make a series of 3 test of surface for each 500m2 area.
- .2 Fills under floor or other slabs on grade: Make 3 tests for every 2 lifts of compacted fill.

PART 2 MATERIALS

2.1 GRANULAR MATERIALS:

- .1 Compacted Granular: Clean, angular crusher run natural stone, free from shale clay, friable materials, roots and vegetable matter and graded within the following limits:

<u>Screen Size:</u>	<u>% Passing:</u>
20 mm	100
16 mm	84 – 94
10 mm	63 – 86
5 mm	40 – 67
1.25 mm	20 – 43
630 um	14 – 34
315 um	9 – 26
160 um	5 – 18
80 um	2 – 10
 % Fracture by Weight (2 faces) (All +5mm Particle Sizes)	 60+
 Plasticity Index (PI)	 Non-plastic – 6
 L.A. Abrasion Loss Percent Max.	 50

- .2 General Engineered Fill: Native soils free of organics, debris, frozen or wet soils, and particles greater than 75mm can be used as general engineered fill. All soils intended to be used as general engineered fill must be approved for use by the Departmental Representative.

2.2 STOCKPILING

- .1 If required stockpile fill materials in areas designated by Departmental Representative. Stockpile granular materials in manner to prevent segregation. Protect stockpile fill materials from freezing.
- .2 Protect fill materials from contamination.

PART 3 EXECUTION

3.1 REMOVAL OF TOPSOIL

- .1 Remove topsoil of horticulture value from areas to be excavated.
- .2 Strip topsoil when dry enough to prevent contamination of sub-grade material.
- .3 Stockpile topsoil on site where directed.

3.2 EXCAVATING (FOUNDATION FOOTINGS)

- .1 Excavate to elevations and dimensions indicated on the construction drawings for installation, construction and inspection of work specified.
- .2 Excavate to well defined lines to minimize quantity of fill material required.
- .3 Ensure depth of subgrade excavation to accommodate a minimum 150mm leveling course of compacted granular below all footings and pads.
- .4 Earth bottoms of excavations to be compact to dense gravel, dry, level, free from loose or organic matter.
- .5 Subgrade bearing surface to be inspected and approved by the Geotechnical Engineer.
- .6 Hand trim, make firm and remove loose material and debris from excavations. Under the direction of the Departmental Representative, any soft, loose or unsuitable soils encountered at the footing bearing elevation should be over-excavated and backfilled with lean concrete or compacted granular. Compacted granular shall be placed in maximum 150mm lifts, compacted to 100% of Standard Proctor Maximum Dry Density (corrected, if required) within +/- 2% of the optimum moisture content.
- .7 Overtop of approved subgrade excavation, place the minimum 150mm leveling course of compacted granular. Granular leveling course to be compacted to 100% of Standard Proctor Maximum Dry Density (corrected, if required) within +/- 2% of the optimum moisture content.
- .8 Excavation must not interfere with normal 45-degree splay of bearing from bottom of any footing, unless as directed by the Departmental Representative.
- .9 Dispose of surplus and unsuitable excavated material off site.
- .10 Do not obstruct flow of surface drainage or natural watercourses.
- .11 Notify Departmental Representative when soil at bottom of excavation appears unsuitable and proceed as directed by Departmental Representative.
- .12 Obtain Departmental Representative approval of completed leveling course prior to commencing footing form work.
- .13 Remove unsuitable material from trench bottom to extent and depth directed by Departmental Representative.
- .14 Correct unauthorized excavation at no extra cost as follows:
 - .1 Fill with compacted granular or mud slab concrete as directed by the Departmental Representative.
- .15 Remove concrete, masonry, paving, walks, demolished foundations, and rubble and other obstructions encountered in the course of excavation.

- .16 Provide shoring to Provincial Safety Standards.
- .17 Protect the subgrade from frost, desiccation and inundation prior to, during, and after construction.

3.2 EXCAVATING (CONCRETE SLAB ON GRADE)

- .1 Excavate to elevations and dimensions indicated for installation, construction and inspection of work specified.
- .2 Excavate to well defined lines to minimize quantity of fill material required.
- .3 Once excavation has reached the design subgrade elevation, the subgrade should be inspected and approved by the Geotechnical Engineer.
- .4 Following excavation the subgrade shall be prepared as follows:
 - .1 The exposed native subgrade shall be scarified to a minimum depth of 150mm and moisture conditioned within 2% of the optimum moisture content
 - .2 The scarified and conditioned subgrade shall be compacted to 98% of the Standard Proctor Maximum Dry Density (corrected, if required).
- .5 The prepared subgrade shall be proof-rolled to identify any soft/weak soil pockets. Any weak/soft spots identified during proof-rolling should be over-excavated and replaced with general engineered fill, compacted to 98% of the Standard Proctor Maximum Dry Density (corrected, if required). Prior to final grading, the proof rolled subgrade should be inspected by the Departmental Representative.
- .6 Final grade of the subgrade shall be restored as required by placing general engineered fill in maximum 150mm lifts compacted to 98% of the Standard Proctor Maximum Dry Density (corrected, if required) within 2% of the optimum moisture content.
- .7 A 300mm leveling course of compacted granular shall be placed below the slab and rigid insulation, in maximum 150mm lifts and compacted to 100% of the Standard Proctor Maximum Dry Density (corrected, if required).
- .8 Dispose of surplus and unsuitable excavated material off site.
- .9 Do not obstruct flow of surface drainage or natural watercourses.
- .10 Notify Departmental Representative when soil at bottom of excavation appears unsuitable and proceed as directed by Departmental Representative.
- .11 Obtain Departmental Representative approval of completed excavation.
- .12 Remove unsuitable material from the excavation to extent and depth directed by Departmental Representative.
- .13 Correct unauthorized excavation at no extra cost as follows:
 - .1 Fill with general engineered fill or mud slab concrete as directed by the Departmental Representative.
- .14 Remove concrete, masonry, paving, walks, demolished foundations, and rubble and other obstructions encountered in the course of excavation.
- .15 Provide shoring to Provincial Safety Standards.
- .16 Protect the subgrade from frost, desiccation and inundation prior to, during, and after construction

3.3 BACKFILLING (FOUNDATION FOOTINGS)

- .1 Do not commence backfilling until areas of work to be backfilled have been inspected and approved by Departmental Representative.
- .2 Areas to be backfilled shall be free from debris, snow, ice, water or frozen ground. Backfill and filling material shall not be frozen or contain ice, snow or debris.
- .3 Do not backfill around or over cast-in-place concrete within 7 days of placing.
- .4 Backfill simultaneously each side of walls and other structures to equalize soil pressure.
- .5 The backfill used shall be general engineered fill, placed in maximum 150mm lifts and compacted to 98% of the Standard Proctor Maximum Dry Density (corrected, if required) within +/- 2% of the optimum moisture content. Place and compact fill materials in continuous horizontal layers not exceeding 150 mm loose depth. Use methods to prevent disturbing or damaging buried services, insulation, damp-proofing. Make good any damage.
- .6 On the interior of the Alpine Cottage and Bunk House, do not compact the backfill above the rigid insulation.
- .7 Where temporary unbalanced earth pressures are liable to develop on walls or other structures, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Departmental Representative.
- .8 Do not use frozen material for backfilling or filling.
- .9 Control moisture content of the backfill material by adding water or drying the material, at the Contractor's expense.
- .10 Keep heavy equipment at least 1.5m away from the foundation walls.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .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 D698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
 - .5 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-8.1-88, Sieves, Testing, Woven Wire, Inch Series
 - .2 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.

1.2 DEFINITIONS

- .1 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 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.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

- .6 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 C136 or ASTM D422: Sieve sizes to CAN/CGSB-8.2.
 - .2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 – 100
0.02 mm	10 – 80
0.005 mm	0 – 45
 - .3 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.
- .7 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.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 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, to ensure cross sections are taken.
 - .4 Submit to written notice when bottom of excavation is reached.
 - .5 Submit to Departmental Representative testing results report 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 relocated and abandoned services, as required, location plan of existing utilities as found in field and clearance record from utility authority.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00- Submittal Procedures.
 - .2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.

- .3 Submit 70 kg samples of type of fill specified including representative samples of excavated material.
- .4 Ship samples prepaid to approved testing laboratory, in tightly closed containers to prevent contamination and exposure to elements.

1.4 QUALITY ASSURANCE

- .1 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .2 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Alberta, Canada.
- .3 Keep design and supporting data on site.
- .4 Engage services of qualified professional Engineer who is registered or licensed in Alberta, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .5 Do not use soil material until written report of soil test results are approved by Departmental Representative.

1.5 EXISTING CONDITIONS

- .1 Examine soil report available from Departmental Representative.
- .2 Buried services:
 - .1 Before commencing work verify location of buried services on and adjacent to site.
 - .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 including existing holding tank and well water lines: 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 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

Part 2 Products

2.1 MATERIALS

- .1 Type 1 and Type 2 fill: properties to Section 31 05 16- Aggregate Materials and the following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C117 and ASTM C136. Sieve sizes to CAN/CGSB-8.2.

.3 Table:

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

.2 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

.3 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 fly ash replacement: to CSA-A3001, Type GU.
- .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.

.4 Fracture face: any

.5 Liquid Limit ASTM D4318, maximum 30

.6 Plasticity Index: maximum 10

.7 LA Abrasion: ASTM C131, maximum % loss by weight 100

.8 Shearmat: honeycomb type bio-degradable cardboard 100 mm thick, treated to provide sufficient structural support for poured concrete until concrete cured.

2.2 TESTING

- .1 Inspection and testing of materials will be carried out by certified testing laboratory approved by Departmental Representative. Costs of tests will be paid by Contractor.
- .2 Submit testing procedure, frequency of tests, testing laboratory or certified testing personnel to Departmental Representative for approval.
- .3 For each material used, one test will be required for every 500 tonnes of material placed.

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 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.

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

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 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.5 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Health and Safety Act for the Province of Alberta.
 - .1 Where conditions are unstable, Departmental Representative to verify and advise methods.
- .2 Obtain permit from authority having jurisdiction for temporary diversion of water course.
- .3 Construct temporary Works to depths, heights and locations as indicated.

- .4 During backfill operation:
 - .1 Unless otherwise indicated or directed by 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 cofferdams, shoring and bracing.
 - .2 Remove excess materials from site and restore watercourses as indicated.

3.6 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for approval 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 collection or runoff areas and in a 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.

3.7 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.
- .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, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 120 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

- .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 on site.
- .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 concrete specified for footings.
 - .2 Fill under other areas with Type 2 fill compacted to not less than 95 % of corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.
- .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.

3.8 FILL TYPES AND COMPACTION

- .1 Compaction densities are corrected maximum dry obtained from ASTM D698 and specified in Section 31 05 10.

3.9 TESTING

- .1 Inspection and testing of soil compaction will be carried out by certified testing laboratory approved by Departmental Representative. Costs of tests will be paid by Contractor.
- .2 Submit testing procedure, frequency of tests, testing laboratory or certified testing personnel to Departmental Representative for approval.
- .3 Testing frequency will be one test for every 500 m² and one test every 500 m² of 150 mm lift of fill material placed.

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 150mm 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.
- .6 Place recycled fill in areas as indicated.

3.11 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as indicated or as directed by Departmental Representative.
- .3 Clean and reinstate areas affected by Work as directed by Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO M320-10, Standard Specification for Performance Graded Asphalt Binder.
 - .2 AASHTO R29-08, Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
 - .3 AASHTO T245-97(2008), Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
- .2 Asphalt Institute (AI)
 - .1 AI MS-2-1994, Mix Design Methods for Asphalt Concrete and Other Hot-Mixes.
- .3 ASTM International
 - .1 ASTM C88-05, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .2 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb f/ft³(600 kN-m/m³)).
- .4 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #32, Traffic Marking Paint, Alkyd.

1.2 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 asphalt mixes and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit viscosity-temperature chart for asphalt cement to be supplied showing either Saybolt Furol viscosity in seconds or Kinematic Viscosity in centistokes, temperature range 105 to 175 degrees C 4 weeks prior to beginning Work.
- .3 Samples:
 - .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks prior to beginning Work.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements and with manufacturer's written instructions.
- .2 Deliver and stockpile aggregates in accordance with Section 31 05 16- Aggregate Materials. Stockpile minimum 50% of total amount of aggregate required before beginning asphalt mixing operation.
- .3 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.
- .4 Stockpile fine aggregate separately from coarse aggregate, although separate stockpiles for more than two mix components are permitted.
- .5 Provide approved storage, heating tanks and pumping facilities for asphalt cement.

Part 2 Products

2.1 MATERIALS

- .1 Granular base: as specified in Section 32 11 23 Aggregate Base Courses
- .2 Prime coat: Anionic emulsified asphalt: to CAN/CGSB-16.2, grade: SS-1 or MC-30 as approved by the Departmental Representative.
- .3 Asphalt cement:
 - .1 Asphaltic binder shall not foam when heated to 175°C and shall meet the following specifications:

ASTM Characteristics	ASTM Test Method	Specifications	
		MIN	MAX
Flash Point (Cleveland Open Cup) °C	D92	205	
Thin Film Oven Test Weight Loss, max. %	D1754	-	1.0
Penetration @ 25°C of residue, % of orig.	D5	50	-
Ductility: @ 25°C	D113	100	-
Solubility in Trichloroethylene, min. %	D2042	99.5	-

- .4 Asphalt concrete aggregates:
 - .1 Coarse aggregate is aggregate retained on 5.0 mm sieve and fine aggregate is aggregate passing 5.0 mm sieve when tested to ASTM C117.
 - .2 Aggregate material shall be crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps cementation, organic material, frozen material and any other deleterious materials.

- .3 When dryer drum plant or plant without hot screening is used, process fine aggregate through 5.0 mm sieve and stockpile separately from coarse aggregate.
- .4 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .5 Blended Aggregate: material to Section 31 05 16 - Aggregate Materials and following requirements:

- .1 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.2.

- .2 Table:

Sieve Size	Percent Passing	
	Type III	
	Max	Min
25 mm	-	-
20 mm	-	-
16 mm	-	100
12.5 mm	100	90
10 mm	90	75
5 mm	75	60
2.5 mm	60	45
630 µm	45	30
315 µm	36	22
160 µm	27	15
80 µm	10	4

- .1 Sand equivalent: to ASTM D2419, Minimum 45.
- .2 Crushed particles: at least 80 % of coarse fraction by mass passing 19 mm sieve and retained on 5.00 mm sieve to have at least 2 freshly fractured faces. Material to be divided into ranges using methods of ASTM C136.
- .3 LA Abrasion to C131: maximum 32
- .4 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .5 Flat and Elongated Particles: For coarse fraction (retained on 5.00 mm sieve size) the percentage of flat and elongated particles greater than a 5:1 ratio shall be by mass less than 10%

- .5 Mineral filler for asphalt concrete:

- .1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.
- .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed by Departmental Representative to improve mix properties.

2.2 Mix Design

- .1 An asphalt mix design must be prepared and submitted to the Departmental Representative for review and approval at least one week prior to the Work. The Contractor shall use qualified Departmental Representative and testing services licensed to practice in the Province of Alberta.
- .2 The mix design shall follow the Marshall method of mix design as outlined in the latest edition of the Asphalt Institute Manual Series No. 2 (MS-2), and shall include five separate trial values of asphalt content.

.3 Design of Mix:

- .1 Mix Type III – 50 Blows on each face of test specimens.
- .4 Include the following data with mix design submission:
 - .1 Aggregate specific gravity and asphalt absorption.
 - .2 Sand equivalent, coarse aggregate fracture, flat and elongated particles, and percent manufactured sand values.
 - .3 Asphalt cement supplier/refinery, specific gravity and mixing and compaction temperatures, based on temperature – viscosity properties of asphalt cement.
 - .4 Job mix formula including aggregate gradation and blending proportions, and design asphalt content.
 - .5 Maximum relative density at each trial asphalt content.
 - .6 Where reclaimed asphalt pavement (RAP) is to be incorporated into the mix supply, RAP gradation, RAP asphalt cement content and design recycle percentage.
 - .7 Data to satisfy the requirements of the following:
 - .8 Table:

Property	Requirements Mix Type III
Marshall Stability (kN)	5.4 min.
Marshall Flow (0.25mm Units)	8 – 14
Air Voids (%)	2.8 – 3.2
Voids in Mineral Aggregate (VMA) (%)	14.0 – 16.0
Voids Filled With Asphalt (VFA) (%)	70 – 80
Film Thickness (□m)	7.0 min.

.5 Job Mix Formula:

- .1 Subject to approval by the Departmental Representative, the aggregate proportioning (including RAP), target gradation, asphalt content and air void content from the Mix Design will become the Job Mix Formula for the supply of hot mix asphalt.
- .2 Once established, no alterations to the Job Mix Formula will be permitted unless the Contractor submits a new Job Mix Formula and approved by the Departmental Representative.

- .3 If the sum of any alterations to the Job Mix Formula is in excess of any one of the following limits, a new Mix Design is required.
 - .1 $\pm 5\%$ passing the 5.00 mm sieve size
 - .2 $\pm 1\%$ passing the 80 μm sieve size
 - .3 $\pm 0.30\%$ asphalt content
- .4 Any alteration to the Job Mix Formula shall not result in properties which do not meet the requirements of this Specification.
- .6 Production Tolerances
 - .1 All mixtures shall be supplied to the Job Mix Formula within the range of tolerances specified.
 - .2 Asphalt cement content: $+0.30\%$ of JMF value.
 - .3 Temperature: Mix temperature at point of plant discharge shall not vary from that specified in the job mix formula by more than $+10^{\circ}\text{C}$.
 - .4 Air Voids: $+ 1.0\%$ of the JMF value.
 - .5 Mixture Properties: Marshall Stability, Marshall Flow, Voids Filled with Asphalt, Voids in Mineral Aggregate and Film Thickness as per requirements identified in Table 2.2.4.8.
 - .6 Moisture in Mix: Maximum permissible moisture, at point of plant discharge, is 0.2% by mass of mix.

2.3 Sampling and Testing

- .1 In accordance with Section 31 05 16 Aggregate Materials and as follows:
- .2 Table

Material	Test Standard	Minimum Frequency
Aggregate Gradation analysis and Fracture Content	ASTM C136 ASTM D5821 ASTM C117 ASTM C126	One for every 500 tonne of each class of material processed or placed
Hot Mix Asphalt Analysis (including Asphalt Content, Aggregate Gradation, Marshall Density and Void Properties)	ASTM D 6307 ASTM C 117 ASTM C 136 ASTM D 3203	One for every 500 tonne of each mix type supplied under this specification.
Hot Mix Asphalt Temperature		At least one
Compaction Monitoring (Core or Nuclear Density) following compaction	ASTM D 2726 ASTM D 2950	At least one

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 asphalt paving 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 FOUNDATIONS

- .1 Foundations for roadways comprise:
 - .1 250 mm compacted thickness of granular base according to Section 32 11 23 Granular Base Courses.
- .2 Compaction: compact each lift of granular material to 100% corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density. Maximum lift thickness: 150 mm.

3.3 PAVEMENT THICKNESS

- .1 Pavements for roadways: 90 mm of 16 mm Type III Asphalt Surface Course

3.4 PAVEMENT CONSTRUCTION

- .1 Hot Mix Asphalt Placing Temperature
 - .1 No hot mix asphalt shall be dispatched to the field unless the temperature, as issued by Environment Canada, is rising and meets the following minimum temperature requirements:
 - .1 Thickness less than 50mm - 7°C
 - .2 Thickness greater than 50mm - 2°C
 - .2 A tolerance will be permitted for plant start-up.
 - .3 No surface lift asphalt shall be placed regardless of temperature until the road surface is 5 °C or higher.
- .2 Transportation of Hot Mix Asphalt:
 - .1 Trucks shall be equipped with tarpaulins of sufficient weights and size to cover the entire open area of the truck box. Regardless of weather conditions, tarpaulins shall be used.
 - .2 Vehicles used for the transportation of hot mix asphalt from the plant to the site of work shall have tight metal boxes previously cleaned of all foreign matter. The inside surface may be lightly lubricated with a soap solution just before loading. Excess lubrication will not be permitted.

- .3 Spreading:
 - .1 The spreading machine shall be self-propelled and capable of placing a uniform layer of asphalt mix to the depth and grades as shown on the plans or as indicated by the Departmental Representative.
 - .2 The screed shall include a tamping bar or vibratory strike-off device for use when required. The screed shall strike-off the mix to the depth and cross-section specified and produces a finished surface of uniform texture.
 - .3 Control of the screed shall be by automatic sensing devices. Longitudinal control shall be accomplished by a sensor, which follows a string line, ski, or other reference. The grade sensor shall be moveable and mounts provided so that grade control can be established on either side of the paver. A slope control sensor shall also be provided to maintain the proper transverse slope of the screed. Use automatic grade control for paving operations.
- .4 Placing:
 - .1 The asphalt concrete shall be placed to the design thickness as shown on the contract drawings. On new construction where an established reference is lacking, a string-line reference will be required. Adjacent mats on the same lift are to be controlled by use of the grade sensor. No relaxation of the above procedure will be permitted without written approval of the Departmental Representative.
 - .2 The spreader shall be operated in such a manner as to distribute the asphalt concrete mix to proper cross-section, width and thickness without causing segregation of the mix. Segregated areas, which may occur, shall be corrected immediately. The forward motion of the spreader shall be controlled so that no irregularities in the pavement surface are caused by excessive speed. The rate of placement of the mixture shall be uniform, and shall be co-ordinated with the production rate of the asphalt plant without intermittent operation of the spreader.
 - .3 Any failure of the machine or operation to produce a smooth, uniformly dense mat, free from irregularities, shall be corrected immediately to the satisfaction of the Departmental Representative.
 - .4 Areas that are inaccessible to the paving machine may be paved by other methods, as approved by the Departmental Representative.
 - .5 In small areas or where the use of mechanical equipment is not practical, the mix may be spread and finished by hand. The asphalt mixture shall be dumped on the area and immediately thereafter distributed into place by shovels and spread with lutes in a loose uniform layer of uniform density and correct depth. Material must be handled so as to avoid segregation.
- .5 Compaction: The Contractor shall supply sufficient compaction equipment to:
 - .1 Provide a compaction rate that will equal or exceed the placing rate of the spreader.
 - .2 Ensure the specified compaction is attained before the temperature of the mat falls below 80°C.

- .6 Pavement mat shall be sufficiently cool to resist any deformation or surface scuffing prior to application of an traffic.

3.5 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 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A48/A48M-03(2012), Standard Specification for Grey Iron Castings.
 - .2 ASTM A123/A123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM C117-13, Standard Test Method for Materials Finer than 75-mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM C139-11, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .6 ASTM C478M-13, Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
 - .7 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN-m/m³)).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .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).
 - .3 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .4 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

1.2 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 Alberta, Canada.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .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 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 Cast-in-place concrete:
 - .1 In accordance with Section 03 30 00- Cast-in-Place Concrete.
- .2 Precast maintenance hole units: to ASTM C478M, circular.
 - .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
 - .2 Monolithic bases to be set on concrete slabs cast in place.
- .3 Joints: made watertight using rubber rings, bituminous compound, epoxy resin cement.
- .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 Drop maintenance hole pipe: same as sewer pipe.
- .7 Galvanized iron sheet: approximately 2 mm thick.
- .8 Steel gratings, I-beams and fasteners: as indicated.
- .9 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 Gray iron castings: to ASTM A48/A48M, strength class 20.

- .3 Castings: sand blasted or cleaned and ground to eliminate surface imperfections.
- .4 Maintenance hole frames and covers: heavy duty municipal type for road service; light duty for landscape service.
 - .1 Cover cast without perforations and complete with two 25 mm square lifting holes.
- .5 Size: 600mm clear diameter.
- .10 Granular bedding and backfill: in accordance with Section 31 05 16- Aggregate Materials and following requirements:
 - .1 Crushed stone, gravel and sand.
 - .2 Gradations to be within limits specified when tested to ASTM C136. Sieve sizes to CAN/CGSB-8.1.
 - .3 Table:

Sieve Designation	% Passing
	Gravel/Sand
200 mm	-
75 mm	-
50 mm	-
38.1 mm	-
25 mm	-
19 mm	-
12.5 mm	100
9.5 mm	-
4.75 mm	50-100
2.00 mm	30-90
0.425 mm	10-50
0.180 mm	-
0.075 mm	0-10
 - .4 Fracture face: 0% maximum
 - .5 Liquid Limit ASTM D4318, maximum 25
 - .6 Plasticity Index: maximum 6
 - .7 LA Abrasion: ASTM C131, maximum % loss by weight 40
 - .8 Concrete mixes and materials: in accordance with Section 03 30 00- Cast-in-Place Concrete.
- .11 Unshrinkable fill: in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.

2.2 TESTING

- .1 Inspection and testing of bedding materials will be carried out by certified testing laboratory approved by Departmental Representative. Costs of tests will be paid by Contractor.
- .2 Submit testing procedure, frequency of tests, testing laboratory or certified testing personnel to Departmental Representative for approval.

- .3 For bedding and granular backfill material specified, one test will be required for every 500 tonnes of material placed.

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.

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 CONCRETE WORK

- .1 Do concrete work in accordance with Section 03 30 00- Cast-in-Place Concrete.

3.4 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 For sewers:
 - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
 - .2 Bench to provide smooth U-shaped channel.
 - .1 Side height of channel to be 0.75 times diameter of sewer.
 - .2 Slope adjacent floor at 1 to 20.
 - .3 Curve channels smoothly.
 - .4 Slope invert to establish sewer grade.

- .6 Compact granular backfill to 95% corrected maximum dry density to ASTM D698.
- .7 Place unshrinkable backfill in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.
- .8 Installing units in existing systems:
 - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, 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.
- .9 Place frame and cover on top section to elevation as indicated.
 - .1 If adjustment less than 75mm is required use rubber ring.
 - .2 If adjustment more than 75mm is required use concrete ring.
- .10 Clean units of debris and foreign materials.
 - .1 Remove fins and sharp projections.
 - .2 Prevent debris from entering system.
- .11 Install safety platforms in maintenance holes having depth of 5 m or greater, as indicated.

3.5 ADJUSTING TOPS OF EXISTING UNITS

- .1 Remove existing gratings, and 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 Monolithic units:
 - .1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with cast-in-place concrete.
 - .2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.
 - .3 When monolithic units with tapered upper section are lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.

- .4 Install additional maintenance hole ladder rungs in adjusted portion of units as required.
- .5 Re-use existing gratings, frames.

3.6 SEALING OVER EXISTING UNITS

- .1 Fill with cast-in-place concrete or other material approved by Departmental Representative.

3.7 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.

3.8 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 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA B300-10, Standard for Hypochlorites.
 - .2 ANSI/AWWA B301-10, Standard for Liquid Chlorine.
 - .3 ANSI/AWWA C651-05, Standard for Disinfecting Water Mains.
 - .4 ANSI/AWWA C800-05, Standard for Underground Service Line Valves and Fittings.
- .2 ASTM International
 - .1 ASTM C117-04, Standard Test Methods 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 C478M-11, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.
 - .4 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN-m/m³)).
 - .5 ASTM D2657-07, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - .6 ASTM F714-10, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 - .7 ASTM F2164-02, Standard Practice for Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
 - .3 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.
- .4 CSA International
 - .1 CAN/CSA-B137 Series-09, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - .1 CAN/CSA-B137.1-09, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
- .5 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
- .6 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC-S520-07, Standard for Fire Hydrants.
- .2 CAN/ULC-S543-09, Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.

1.2 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 distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Alberta, Canada for the following products:
 - .1 Valves
 - .2 Curb Stops

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Submit record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.
- .3 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers and hydrants for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .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 water distribution piping from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.5 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Department Representative.
- .3 Notify occupants, Department Representative and occupant minimum of 24 hours in advance of interruption in service.
- .4 Do not interrupt water service for more than 3 hours unless otherwise authorized.
- .5 Notify fire department of planned or accidental interruption of water supply to hydrants.
- .6 Provide and post "Out of Service" sign on hydrant not in use.
- .7 Advise local police department of anticipated interference with movement of traffic.

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 type ASTM F714, type DR 11.
 - .2 Polyethylene to polyethylene joints: to be thermal butt fusion joined, to ASTM D2657.
 - .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 valves: to ANSI/AWWA C500, standard iron body, bronze mounted wedge valves with non-rising stems, suitable for 1000 kPa with joints to suit pipe.
- .3 Pressure reducing valves: to NSF/ANSI 61 & 372, all metal construction with EPDM diaphragm with integral stainless steel strainer. Inlet pressure approximately 95PSI outlet pressure approximately 50PSI.
- .4 Underground type indicator valve where indicated. Indicator post to accurately indicate valve open or closed.
- .5 Cast iron valve boxes: three piece sliding type adjustable over minimum of 450mm complete with valve operating extension rod, 150 mm below cover.
 - .1 Top of box to be marked "WATER"/"EAU".

2.3 SERVICE CONNECTIONS

- .1 Polyethylene pressure pipe:
 - .1 To CAN/CSA-B137.1, type PE, series 160 ASTM F714, Type PE, series DR 11.

- .2 Polyethylene pipe joints: plastic insert type serrated sleeves with four stainless steel screws and band-type clamps per joint or thermal butt fusion welded.
- .3 Brass inverted key-type curb stops: red brass to ASTM B62, compression type with drains.
 - .1 Curb stops to have adjustable bituminous coated cast iron service box with stem to suit depth of bury.
 - .2 Top of cast iron box marked "WATER"/"EAU".
- .4 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.

2.4 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to: Section 31 05 16- Aggregate Materials and following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C136. Sieve sizes to CAN/CGSB-8.2.
 - .3 Table

Sieve Designation	% Passing
	Gravel/Sand
200 mm	-
75 mm	-
50 mm	-
38.1 mm	-
25 mm	-
19 mm	-
12.5 mm	100
9.5 mm	-
4.75 mm	80-100
2.00 mm	50- 90
0.425 mm	10- 50
0.180 mm	-
0.075 mm	0- 10
- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00- Cast-in-Place Concrete.
- .3 Fracture face: 0% for pipe bedding and surround material
- .4 Liquid Limit ASTM D4318, maximum 25
- .5 Plasticity Index: maximum 6
- .6 LA Abrasion: ASTM C131, maximum % loss by weight

2.5 BACKFILL MATERIAL

- .1 Type 3, in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.

2.6 TESTING

- .1 Inspection and testing of granular material will be carried out by certified testing laboratory approved by Departmental Representative. Costs of tests will be paid by Contractor.
- .2 Submit testing procedure, frequency of tests, testing laboratory or certified testing personnel to Departmental Representative for approval.
- .3 Testing frequency will be one test for 500 tonnes of each material placed.

2.7 PIPE DISINFECTION

- .1 Liquid Sodium hypochlorite having 5 to 15 percent available chlorine by volume to ANSI/AWWA B300 or Calcium hypochlorite tablets to ANSI/AWWA B300 to disinfect water mains.
- .2 Disinfect water mains in accordance with ANSI/AWWA C651.

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 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 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, 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 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 2.8 m or as indicated for water service and 0.9 m or as indicated for raw water service.
- .3 Trench alignment and depth require Departmental Representative 's approval prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .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 Install 1 x 3 m long clay plug for every 300 m of pipe as indicated or approved by Departmental Representative.
- .6 Compact each layer full width of bed to 95% corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.
- .7 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.

3.5 PIPE INSTALLATION

- .1 Terminate building water service 1 m outside building wall opposite point of connection to main.
 - .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 to locate pipe end.
- .2 Lay pipes to manufacturer's standard instructions and specifications.
 - .1 Do not use blocks except as specified.
- .3 Join pipes in accordance with manufacturer's recommendations.
- .4 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .5 Lay pipes on prepared bed, true to line and grade.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .2 Take up and replace defective pipe.
 - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10mm in 3m.
- .6 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

- .9 Position and join pipes with equipment and methods approved by Departmental Representative.
- .10 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.
- .11 Align pipes before jointing.
- .12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .13 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
- .14 Complete each joint before laying next length of pipe.
- .15 Minimize deflection after joint has been made.
- .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
- .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .20 Do not lay pipe on frozen bedding.
- .21 Do hydrostatic and leakage test and have results approved by Departmental Representative before surrounding and covering joints and fittings with granular material.
- .22 Backfill remainder of trench.

3.6 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 or support blocks. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.

3.7 UNDERCROSSING

- .1 Excavate working pit to outside facility to be crossed.
- .2 Excavate working pit to not less than 0.6m below lowest invert of pipe.
- .3 Dewater excavation.

- .4 Dewater area of undercrossing.
- .5 Place encasing pipe to exact line and grade indicated. Encasing pipe to cross under obstruction at an angle as indicated.
- .6 Install encasing pipe by tunnelling or boring.
- .7 Ensure encasing pipe is not in tension.
- .8 Joints for encasing pipe: welded type.
- .9 Insert water main into encasing pipe, in end with largest open area, after placement of levelling pad.
- .10 Use approved blocking method to guide water main in true alignment.
- .11 Clearance between blocks and encasing pipe: maximum 15mm when water main is in position.
- .12 Join water main one length at time outside encasing pipe. Push water main into position.
- .13 Couplings of water main shall not rest on levelling pad when water main is in position.

3.8 SERVICE CONNECTIONS

- .1 Terminate building water service 1 m outside building footprint opposite point of connection to main.
 - .1 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops as indicated.
- .4 Tappings for PE pipe: PE tapping tees or multi-saddle tees.
- .5 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .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.
 - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.9 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00- Cast-in-Place Concrete.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Departmental Representative.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by Departmental Representative.

3.10 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C600 or ASTM F 2164.
- .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.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Test pipeline in sections not exceeding 365m in length, unless otherwise authorized by Departmental Representative.
- .6 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 or as directed by Departmental Representative.
- .7 Leave valves, joints and fittings exposed.
- .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .10 Open valves.
- .11 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.
- .12 Thoroughly examine exposed parts and correct for leakage as necessary.

- .13 Apply hydrostatic test pressure of 1.5 times design working pressure or 690 kPa (100 psi), whichever is greater.
- .14 After the initial pressurization of the pipe, to allow for pipe expansion, add sufficient make-up water at hourly intervals for three hours to return the pipe to the original test pressure.
- .15 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .16 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .17 After initial expansion phase, begin the pressure test. Subject the test section to the test pressure for a minimum of 1 hour.
- .18 After test period has elapsed, add and measure the volume of make-up water required to return to the test pressure.
- .19 Expansion allowance for PE pipe in Litres per 100m of pipe is as follows:

Nominal Pipe Diameter (mm)	1 Hour Test	2 Hour Test	3 Hour Test
50	0.8	1.3	2.2
75	1.2	1.7	2.9
100	1.5	2.9	4.6
125	2.4	4.7	7.1
150	3.5	6.9	10.4
200	5.8	11.5	17.3

- .20 Repeat hydrostatic test until defects have been corrected.
- .21 Under no circumstances shall the total time under test pressure exceed 8 hours. If the test is not complete, the test section shall be permitted to "relax" for a period of 8 hours prior to the next test sequence.
- .22 Apply leakage test pressure of 1.5 times design working pressure or 690 kPa (100 psi), whichever is greater.
- .23 Define leakage as amount of water supplied from water storage tank or meter in order to maintain test pressure for 1 hour.
- .24 Do not exceed allowable leakage of zero for HDPE pipes and fittings.
- .25 Locate and repair defects.
- .26 Repeat test until leakage is within specified allowance for full length of water main.

3.11 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150mm compacted thickness as indicated.

- .1 Do not dump material within 150 mm of obvert.
- .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 95 % corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90% corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.

3.12 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact backfill to at least 95% corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.
 - .1 In other areas, compact to at least 90 % corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.

3.13 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by Departmental Representative.
 - .1 Notify Departmental Representative at least 4 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 1.5 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 and service connections to ensure thorough flushing.
- .6 When flushing has been completed to Departmental Representative approval, 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 to the requirements of local authority or to the requirements of AWWA C651, whichever is more stringent.

- .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, hydrants and appurtenances while main contains chlorine solution.
- .11 Measure chlorine residuals at extreme end of pipe-line being tested.
- .12 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
- .13 After adequate chlorine residual not less than 55 ppm as been obtained leave system charged with chlorine solution for 24 hours.
 - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
- .14 Flush line to remove chlorine solution after 24 hours.
- .15 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.

3.14 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by Departmental Representative.

3.15 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 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C117-04, Standard Test Method for Material Finer Than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM C443M-07, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .4 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft⁴-lbf/ft³(600 kN-m/m³)).
 - .5 ASTM D2680-01(2009), Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - .6 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .7 ASTM D3350-10, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA International
 - .1 CSA A3000-08, Cementitious Materials Compendium.
 - .2 CSA A257 Series-09, Standards for Concrete Pipe and Manhole Sections.
 - .3 CSA B1800-11, Thermoplastic Non-pressure Pipe Compendium.
 - .1 CSA B182.1-11, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-11, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.
 - .3 CSA B182.6-11, Profile Polyethylene (PE) Sewer Pipe and Fittings for Leak-Proof Sewer Applications.
 - .4 CSA B182.11-11, Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.

- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
- .3 Notify occupants and Departmental Representative minimum of 24 hours in advance of interruption in service.

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 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Alberta, Canada.
- .4 Certificates:
 - .1 Certification to be marked on pipe.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .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 ASTM D3034 CSA B182.2.
 - .1 Standard Dimensional Ratio (SDR): 35.
 - .2 Separate gasket and integral bell system.
 - .3 Nominal lengths: 6 m.

2.2 SERVICE CONNECTIONS

- .1 Type PSM Poly (Vinyl) Chloride: to CSA B182.2.
- .2 Plastic pipe: to CSA B182.1, with push-on joints.

2.3 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 05 16- Aggregate Materials and following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C136.
 - .1 Sieve sizes to CAN/CGSB-8.2.

- .2 Table:

Sieve Designation	% Passing Gravel/Sand
25 mm	-
19 mm	-
12.5 mm	100
9.5 mm	-
4.75 mm	50-100
2.00 mm	30-90
0.425 mm	10-50
0.180 mm	-
0.075 mm	0-10

- .3 Concrete mixes and materials for cradles, encasement, supports: to Section 03 30 00- Cast-in-Place Concrete.
- .4 Fracture face: 0% for pipe bedding and surround material
- .5 Liquid Limit ASTM D4318, maximum 25
- .6 Plasticity Index: maximum 6
- .7 LA Abrasion: ASTM C131, maximum % loss by weight 40

2.4 BACKFILL MATERIAL

- .1 Type 3, in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.

2.5 TESTING

- .1 Inspection and testing of granular material will be carried out by certified testing laboratory approved by Departmental Representative. Costs of tests will be paid by Contractor.
- .2 Submit testing procedure, frequency of tests, testing laboratory or certified testing personnel to Departmental Representative for approval.
- .3 Testing frequency will be one test for 500 tonnes of each material placed.

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.

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 Clean pipes and fittings of debris and water before installation, and remove defective materials from site.
- .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 granular bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 150mm 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 pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with common backfill.

3.5 INSTALLATION

- .1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .2 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.
- .3 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.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Joint deflection permitted within limits recommended by pipe manufacturer.
- .6 Water to flow through pipe during construction only as permitted by Departmental Representative.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 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.
- .10 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .11 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.
- .12 Make watertight connections to maintenance holes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .13 Use prefabricated saddles or field connections approved by Departmental Representative, 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 150mm compacted thickness as indicated.
 - .1 Do not dump material within 150 mm of obvert.
- .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% corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90% corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.
- .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 150 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill to at least 95% corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.
 - .1 In other areas, compact to at least 90% corrected maximum dry density in accordance with Section 31 05 10 Corrected Maximum Dry Density.

3.8 SERVICE CONNECTIONS

- .1 Install pipe to manufacturer's instructions and specifications.
- .2 Maintain grade for 100 and 125mm diameter sewers at 2% unless directed otherwise by Departmental Representative.
- .3 Service connections to main sewer: Departmental Representative approved saddles.
 - .1 Do not use break-in and mortar patch-type joints.
- .4 Service connection pipe: not to extend into interior of main sewer.
- .5 Plug service laterals with water tight caps or plugs as approved by Departmental Representative.
- .6 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade.
 - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

3.9 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 Remove foreign material from sewers and related appurtenances by flushing with water.
- .3 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .4 Do infiltration and exfiltration testing as specified herein and as directed by Departmental Representative.
 - .1 Perform tests in presence of Departmental Representative.
 - .2 Notify Departmental Representative 24 hours minimum in advance of proposed tests.
- .5 Carry out tests on each section of sewer between successive manholes including service connections.
- .6 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- .7 Exfiltration test:
 - .1 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.
 - .2 Immediately prior to test period add water to pipeline until there is head of 1m over interior crown of pipe measured at highest point of test section or water in manhole is 1 m above static ground water level, whichever is greater.
 - .3 Duration of exfiltration test: 2 hours.

- .4 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.
- .8 Infiltration test:
 - .1 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750mm or more above top of pipe measured at highest point in line to be used.
 - .2 Do not interpolate a head greater than 750mm to obtain an increase in allowable infiltration rate.
 - .3 Install watertight plug at upstream end of pipeline test section.
 - .4 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time, keep thoroughly wet at least one third of pipe invert perimeter.
 - .5 Prevent damage to pipe and bedding material due to flotation and erosion.
 - .6 Place 90 degrees V-notch weir, or other measuring device approved by Departmental Representative in invert of sewer at each manhole.
 - .7 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.
- .9 Leakage: not to exceed following limits in litres per hour per mm of diameter per 100m of sewer including service connections:
 - .1 Exfiltration, based on 600 mm head: 0.175L.
 - .2 Infiltration: 0.150L.
- .10 Repair and retest sewer line as required, until test results are within limits specified.
- .11 Repair visible leaks regardless of test results.
- .12 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by video camera, digital camera or by other related means.
 - .2 Payment for inspection services in accordance with Section 01 29 00 Methods of Measurement and Payment.

3.10 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 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C117-13, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136/C136M-14, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D698-12e2, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft² (600 kN-m/m²)).
 - .4 ASTM D1248-12, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - .5 ASTM D2583-13a, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 CSA Group
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.
 - .2 CSA A23.4-16, Precast Concrete - Materials and Construction.
 - .3 CSA B66-10(R2015), Design, Material and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks.
 - .4 CAN/CSA-B1800-15, Thermoplastic Non-Pressure Piping Compendium (formerly CAN/CSA-B182.4-2002 and CAN/CSA-B182.6-2011).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's installation instructions, printed product literature and data sheets for utility septic tanks 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 Province of Alberta
 - .2 Shop Drawings: to CSA A23.4.
 - .1 Indicate on drawings:
 - .1 Design calculations for items designed by manufacturer.

- .2 Tables and bending diagrams of reinforcing steel.
- .3 Finishing schedules.
- .4 Methods of handling and erection.
- .5 Storage facilities.
- .6 Openings, sleeves, inserts and related enforcement.
- .7 Flotation calculations for tank.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00-Common Product Requirements and 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 utility septic tanks from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Design fibreglass reinforced polyester septic tank in accordance with CSA B66, and to carry handling stresses and indicated service loads.
- .2 Tank to be specified for 3 m of backfill overburden.
- .3 Tank to have minimum total working capacity of **44,100** litres.

2.2 FIBREGLASS REINFORCED POLYESTER TANKS

- .1 Thermosetting resin system reinforced with glass fibres.
- .2 Laminate: combined thickness of interior chemical resistant layer and anti-wicking layer: minimum 2.5mm; Barcol hardness minimum 90% to ASTM D2583
 - .1 Interior chemical resistant layer: 0.13 to 0.30 mm thick.
 - .2 Interior anti-wicking layer:
 - .3 Structural layer:
 - .4 Exterior layer: resin rich flood coat, no chopped glass, 0.13 to 0.30 mm thick.
- .3 Resins, reinforcement and additives to CSA B66.

2.3 MANUFACTURE

- .1 Manufacture units in accordance to CSA A23.4.

2.4 ACCESS

- .1 Include access holes to surface to facilitate cleaning and inspection.

2.5 TANK BEDDING AND SURROUND MATERIAL

- .1 Granular bedding material in accordance with Section 31 05 16- Aggregate Materials and following requirements:
 - .1 Pea Gravel or Crushed stone, clean and free-flowing.
- .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.2.
- .3 Table

Sieve Designation	% Passing	
	Pea Gravel	Crushed stone
50 mm	-	
37.5 mm	-	
25 mm	-	
19 mm	100	
12.5 mm	-	100
9.5 mm	-	-
4.75 mm	0	0
2.00 mm		
0.425 mm		
0.180 mm		
0.075 mm		

- .4 Concrete mixes and materials for cradles, encasement, supports: to Section 03 30 00- Cast-in-Place Concrete.
- .5 Fracture face: 0% for tank bedding and surround material.
- .6 Liquid Limit ASTM D4318, maximum 25
- .7 Plasticity Index: maximum 6
- .8 LA Abrasion: ASTM C131, maximum % loss by weight 40

2.6 BACKFILL MATERIAL

- .1 Type 3, in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.

2.7 TESTING

- .1 Granular material:
 - .1 Inspection and testing of granular material will be carried out by certified testing laboratory approved by Departmental Representative. Costs of tests will be paid by Contractor.
 - .2 Submit testing procedure, frequency of tests, testing laboratory or certified testing personnel to Departmental Representative for approval.
 - .3 Testing frequency will be one test for 500 tonnes of each material placed.

- .2 Tank testing: Complete pre-installation testing according to manufacturer's instructions.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions are acceptable for utility septic tank installation in accordance with manufacturer's written instructions.
 - .1 Prior to unloading tank, visually inspect entire exterior surface to ensure that shipping or handling damage has not occurred. Visually inspect conditions 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 INSTALLATION

- .1 Unload, store and Install tank according to manufacturer's instructions.
- .2 Place bedding and surround material in unfrozen condition.
- .3 Do excavation in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.
- .4 Place tank bedding material in accordance with details as indicated.
 - .1 Compact to 95% corrected maximum dry density Section 31 05 10 Corrected Maximum Dry Density.
- .5 Make inlet and outlet joints of septic tank watertight.
- .6 Conduct leakage test on septic tank in presence of Departmental Representative before backfilling.
 - .1 Fill tank to level of effluent pipe, and allow to stand for 24 hours.
 - .2 Allowable leakage is zero.
 - .3 If leakage occurs, remove seal materials and reseal as directed by Departmental Representative.
- .7 Do backfilling in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.
 - .1 Compact to 90% corrected maximum dry density Section 31 05 10 Corrected Maximum Dry Density.

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.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C117-13, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136/C136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D4491/D4491M-16, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .4 ASTM D4632/D4632M-15a, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - .5 ASTM D4751-16, Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
 - .6 ASTM D4759-11 (2018), Standard Practice for Determining the Specification Conformance of Geosynthetics.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 8.2-88, Sieves, Testing, Woven Wire, Metric.
 - .2 CGSB 41-GP-29Ma, Tubing, Corrugated, Drainage.
 - .3 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Canadian Standards Association (CSA)
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

1.2 SUMMARY

- .1 This section specifies and includes supplying materials, labour, supervision, equipment, and ancillary requirements to complete installation of crawlspace regarding and foundation drainage. This specification shall be read in conjunction with the contract drawings.

1.3 BURIED SERVICES

- .1 Before commencing work verify location of all buried services in crawl spaces.

1.4 PROTECTION

- .1 Keep crawl spaces clean, free of standing water, and loose soil.
- .2 Protect buried services that are required to remain undisturbed.
- .3 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

Part 2 Products

2.1 MATERIALS

- .1 Flexible plastic tubing and fittings: to CGSB 41-GP-29Ma, Type 1 and 2, corrugated, nominal inside diameter 6 inch, perforated top half.
- .2 Filter Sock: Manufacturer's standard filter sock compatible with weeping tile.
- .3 Filter Fabric: Manufacturer's standard non-woven pervious geotextile fabric of polypropylene, nylon or polyester fibres or a combination.
 - .1 Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D4759 and the referenced standard test method in parentheses:
 - .1 Grab Tensile Strength (ASTM D4632): 100 lb.
 - .2 Apparent Opening Size (ASTM D4751): #100 U.S. Standard sieve.
 - .3 Permeability (ASTM D4491): 150 gallons per minute per square foot.
- .4 Sand: to CAN/CSA A23.2, hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
- .5 Drainage Pipe Bedding and Surround Material:
 - .1 Granular material to Section 31 05 16 – Aggregate Materials and the following requirements:
 - .2 Crushed or screened stone, gravel and sand.
 - .3 Graduations to be within limits specified when tested to ASTM C136 and ASTM C117, Sieve sizes to CAN/CGSB-8.2.

Sieve Designation	% Passing – Stone/Gravel	% Passing – Gravel/Sand
25 mm	100 -	
12.5 mm	65-90	100
4.75 mm	35-55	80-100
2.00 mm	25-40	50-90
0.425 mm	10-25	10-50
0.075 mm	0-8	0-10
- .6 Vapour Barrier: 0.38 mm (15 mil) polyethylene sheet to CAN/CGSB-51.34.

Part 3 Execution

3.1 INSPECTION

- .1 Ensure graded subgrade conforms to the required drainage pattern before placing bedding material.

- .2 Ensure improper slopes, unstable areas, areas requiring additional compaction or other unsatisfactory conditions are corrected to approval of Departmental Representative.
- .3 Advise Departmental Representative of timing for inspection of foundation wall waterproofing and drain tile installation before backfilling.

3.2 CRAWLSPACE GRADING

- .1 Remove obstructions from surfaces to being graded.
- .2 Strip existing granular fill materials from within limits of excavation and stockpile. Avoid mixing fill materials with subsoil.
- .3 Carry out grading of the crawlspace to provide drainage away from walls and/or grade beams and towards the sump-pits.

3.3 GRANULAR BEDDING PREPARATION

- .1 Cut trenches in subgrade and place granular bedding materials in uniform layers not exceeding 150 mm (6 inch) compacted thickness to depth as indicated.
- .2 Shape bed true to grade and to provide continuous, uniform bearing surface for tubing.
- .3 Shape transverse depressions, as required, to suit joints.
- .4 Compact each layer full width of bed to at least 95% of Standard Proctor density.
- .5 Fill excavation below design elevation of bottom of specified bedding with compacted bedding material.

3.4 PIPE OR TUBING INSTALLATION

- .1 Ensure tubing interior and coupling surfaces are clean before laying.
- .2 Review condition of filter sock. Do not install weeping tile with ripped or damaged filter sock. Replace all damaged lengths of filter sock.
- .3 Grade bedding to establish tubing slope. Do not use shims to establish slope.
- .4 Lay perforated tubing to slope of minimum 2%. Face perforations and coupling slots downward.
- .5 Lay non-perforated tubing to slope of 2% per foot as indicated, from perforated tubing to disposal area. Use compatible couplings from weeping tile manufacturer. Make joints in non-perforated tubing watertight.
- .6 Install end plugs at ends of collector drains to protect tubing ends from damage and ingress of foreign material.

- .7 Connect non-perforated tubing to sump pit by appropriate adapters manufactured for this purpose.

3.5 PIPE OR TUBING SURROUND MATERIAL

- .1 Upon completion of tubing laying complete with pea gravel material as indicated and geotextile filter, surround and cover tubing as indicated.
- .2 Place surround material manually in uniform layers not exceeding 150 mm (6 inch) compacted thickness, as indicated.
- .3 Place layers uniformly and simultaneously on each side of the tubing.
- .4 Place filter bed by hand in maximum of 150 mm (6 inch) lifts. Consolidate by hand tamping to prevent displacement of pipe

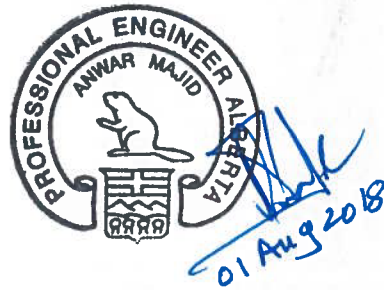
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Authors

Report Prepared By:



Julien Egron, P.Eng.
Geotechnical Engineer
julien.egron@aecom.com



Report Reviewed By:

Anwar Majid, M.A.Sc., P.Eng.
Senior Geotechnical Engineer
Geotechnical Lead – Southern Alberta
anwar.majid@aecom.com

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Appendix B.	Laboratory Test Results

1. Introduction

1.1 General

Public Works and Government Services Canada (PWGSC) is undertaking the design and construction of three new buildings for the Alpine Stables operation at Waterton Lakes National Park in Alberta. The proposed new buildings are single storey, wood frame and/or heavy timber construction, and will have no basements. The new buildings are expected to replace the Saddling Barn, a Bunk House, and an Alpine Cottage that were burnt down in a forest fire in the fall of 2017. PWGSC is also considering paving the existing gravel parking lot adjacent to the new buildings. The site location is shown on **Figure 1** and the new building locations are shown on **Figure 2**.

The main objective of the geotechnical investigation was to determine the subsurface soil and groundwater conditions at the site, and to provide geotechnical recommendations to support the design and construction of geotechnical elements of the project including deep and shallow foundations for the new buildings.

The analyses and recommendations presented in this report are based on the data obtained from six testholes drilled at the site at locations shown on **Figure 2**. The report does not reflect any variations in subsurface conditions that may occur at locations other than the testhole locations. In the performance of subsurface explorations, specific information is obtained at specific locations at specific times; however, it is well known that variations in soil conditions exist on most sites between testhole locations. The nature and extent of variations may not become evident until the course of construction. If variations are then evident, it will be necessary to re-evaluate the recommendations presented in this report after performing on-site observations during the construction period and noting the characteristics of any variations.

This report is subject to the general statement regarding normal variability of subsurface conditions provided at the beginning of the report.

1.2 Scope of Work

The scope of work for the geotechnical investigation consisted of the following tasks:

1. Coordinate with PWGSC to obtain a Restricted Activity Permit to drill testholes within Waterton Lakes National Park.
2. Coordinate with AB One Call to confirm that there are no underground utilities at the proposed drilling locations.
3. Conduct a site investigation by drilling a total of six testholes at the site to a maximum depth of 10 metres (m) below ground surface (mBGS) or refusal. Coring of bedrock was not included in the scope of work.
4. Install standpipe piezometers in select testholes to measure the depth of the groundwater table.
5. Conduct laboratory material testing on select soil samples collected during the site investigation.
6. Prepare a geotechnical evaluation report that documents the findings from the site investigation and laboratory testing, and provides geotechnical recommendations to support the design and construction of geotechnical elements of the project including deep and shallow foundations for the new buildings.

2. Site Investigation

2.1 Site Reconnaissance

A site reconnaissance was conducted by Kristen Tackney, P.Geo., of AECOM on June 11, 2018 to select drilling locations, evaluate site access for the drill rig and meet with a Parks Canada Agency representative (D. Sears) to discuss the drilling program and collect any other information pertinent to the site investigation. It was revealed that the site was previously contaminated and that at some point was remediated and rehabilitated.

2.2 Drilling

Six testholes (TH18-01 to TH18-06) were drilled on June 25th and 26th, 2018 at the locations shown on **Figure 2**. The testholes were drilled at the following locations:

- Testholes TH18-01 to TH18-04 were drilled within or close to the proposed Alpine Cottage and Bunk House footprints
- Testholes TH18-05 and TH18-06 were drilled within or close to the proposed Saddling Barn footprint

The proposed testhole depths were 10 mBGS. Bedrock was encountered at a depth of approximately 10 mBGS as all the testholes terminated at depths between 9.5 and 10.9 mBGS at refusal on bedrock.

The testholes were drilled using a truck-mounted auger rig owned and operated by Earth Drilling Company Ltd. The drill rig was equipped with solid stem augers, ODEX and Standard Penetration Testing (SPT) equipment. Logs of the drilled testholes are presented in **Appendix A**. Locations of the drilled testholes are shown on **Figure 2**.

Testholes were logged by Julien Egron, P.Eng. of AECOM. The testholes were logged based on observations of drill cuttings and drill behaviour. This included visual classification of the soils and interpretation of subsurface moisture and groundwater conditions. The soils were classified according to the modified Unified Soil Classification (mUSC) system. Soil samples were collected at regular intervals and where stratigraphy changed. The samples included disturbed grab samples from the drill cuttings or split spoon sampler. SPTs were performed at 1.5 m intervals, and blow counts per 300 millimetre (mm) penetration (SPT “N” blow counts) were recorded to provide an indication of soil consistency.

25 mm diameter slotted standpipes were installed in testholes TH18-02, TH18-03 and TH18-06 to measure the depth of the groundwater table. The testholes were backfilled after completion of drilling with drill cuttings overlain by a bentonite cap to reduce infiltration. The installation details of the standpipes are shown on the testhole logs in **Appendix A**.

2.3 Laboratory Testing

Soil samples collected during the site investigation were tested in AECOM's Materials Testing Laboratory for soil classification and determination of engineering properties. The laboratory testing included determination of moisture contents, Atterberg Limits, grain size distribution, Standard Proctor Maximum Dry Density (SPMDD), Optimum Moisture Content (OMC), California Bearing Ratio (CBR) and chemical analysis (pH, resistivity, sulphate and chloride content). The test results are shown on the testhole logs in **Appendix A** and are also presented separately in **Appendix B**. A summary of the tests performed on soil samples is provided in **Table 2-1**.

Table 2-1. Summary of Laboratory Testing

Tests	Number	Data Location
Moisture Contents	All Samples	Testhole Logs
Atterberg Limits	1	Testhole Logs & Appendix B
Grain Size Analyses (sieve and hydrometer)	11	Testhole Logs & Appendix B
SPMDD and OMC	1	Testhole Logs & Appendix B
CBR	1	Testhole Logs & Appendix B
pH, Resistivity, Sulphate, and Chloride Content	4	Testhole Logs & Appendix B

3. Subsurface Stratigraphy

3.1 General

The subsurface stratigraphy at the testhole locations was fairly consistent and consisted of topsoil or surface gravel underlain by cohesionless soils (gravel, gravel and sand, sand) underlain by clay underlain by bedrock.

Detailed descriptions of the subsurface conditions encountered at the testhole locations are provided on the testhole logs in **Appendix A**. A description of the terms and symbols used on the logs is also included in **Appendix A**. A summary of the soil units and their index properties are presented in the following sections.

3.2 Topsoil

A layer of topsoil, approximately 50 mm thick, was encountered at surface in testholes TH18-02 and TH18-04.

3.3 Surface Gravel

A layer of road surface gravel, approximately 50 mm thick, was encountered in testholes TH18-01, TH18-05 and TH18-06.

3.4 Gravel

Gravel, gravel and sand or sand and gravel, referred to as gravel in this report, was encountered in all testholes at surface, below the topsoil and below the surface gravel. The gravel layer varied in thickness from 3.9 m to 9.3 m, and was the predominant soil unit encountered at the site. The gravel was sandy with trace to some silt and trace cobbles/boulders. The gravel was brown to grey with trace oxidation and was dry to wet.

The SPT “N” blow counts varied from 6 to 62, with an average of 30, which indicates the gravel is loose to very dense. The low SPT values coincide with the elevation of the groundwater table at the site. SPT “N” refusal was encountered at some locations in the gravel indicating that the gravel contains cobbles and boulders.

The moisture content of the gravel samples ranged from 1.1 % to 27.4 %, with an average of 5.7 %. Particle size distributions, a Standard Proctor and a CBR test were conducted on select gravel samples. A summary of the test results is presented in **Table 3-1**.

Table 3-1. Summary of Test Results – Gravel, Sand and Gravel/Gravel and Sand

Testhole No.	Sample No.	Depth (m)	Moisture Content (%)	Grain Size Distribution (%)			mUSC
				Gravel	Sand	Silt/Clay	
TH18-01	2	1.52	2.1	66	26	8	GW
TH18-02	4	2.13	9.8	41	45	14	SM
TH18-02 & TH18-03	Combined	2.90	3.9	45	44	11	GP
TH18-03	3	2.13	4.6	58	33	9	GP
TH18-04	2	1.52	2.6	63	31	6	GW
TH18-05	2	1.52	1.9	49	40	11	GW
TH18-06	4	3.05	3.6	59	22	7	GW

SPMDD, OMC and CBR tests were conducted on a combined bulk sample collected from testholes TH18-02 and TH18-03. The SPMDD was 2,138 kg/m³, the OMC was 7.2 % and, the un-soaked and soaked CBR values were 54.8 % and 25.3 %, respectively.

Sloughing and seepage were encountered within the gravel layers during drilling and should be expected in excavations during construction.

3.5 Sand

Sand was encountered in testholes TH18-01, TH18-04 and TH18-05 below the gravel, overlying clay or bedrock. The sand layers varied from 1.5 m to 5.2 m in thickness. The sand was gravelly to containing some gravel with some to trace silt and trace clay. The sand layers were brown and moist to wet. The SPT “N” blow counts varied from 6 to 13, with an average of 10, indicating the sand is loose to compact. The low SPT values coincide with the elevation of the groundwater table at the site. SPT “N” refusal was encountered at one sample location within in the sand indicating that the sand may contain cobbles and boulders.

The moisture content of the sand samples ranged from 6.6 % to 23.9 % with an average of 15.2 %. Three grain size distribution tests were conducted on sand samples. The results are summarized in **Table 3-2**.

Table 3-2. Summary of Test Results – Sand

Testhole No.	Sample No.	Depth (m)	Moisture Content (%)	Grain Size Distribution (%)			mUSC
				Gravel	Sand	Silt/Clay	
TH18-01	6	4.57	10.5	22	60	18	SM
TH18-04	9	6.71	19.0	13.6	63.2	15.7 / 7.5	SM
TH18-05	9	6.71	7.0	7	44	39	SM

Seepage was encountered within the sand layers during drilling and should be expected in excavations during construction.

3.6 Clay

Clay layers, approximately 1.7 m to 3.4 m thick, were encountered above the bedrock in testholes TH18-03, TH18-04, TH18-05, and TH18-06. The clay was encountered at depths varying from 6.1 mBGS to 7.6 mBGS. The clay layers were silty and sandy to some sand and contained trace gravel and trace bedrock fragments. The clay was grey with trace oxidation and was humid to wet. The SPT “N” blow counts varied from 6 to 13, with an average of 10, indicating the clay is firm to stiff.

The moisture content of the clay samples varied from 6.2 % to 29.9 %, with an average of 15.6 %. An Atterberg Limits test and grain size distribution test were conducted on a clay sample. The test results are summarized in **Table 3-3**.

Table 3-3. Summary of Test Results – Clay

Testhole No.	Sample No.	Depth (m)	Moisture Content (%)	Atterberg Limits (%)			Grain Size Distribution (%)				mUSC
				Liquid Limit	Plastic Limit	Plastic Index	Gravel	Sand	Silt	Clay	
TH18-06	10	7.62	20.1	22.5	16.1	6.4	4.6	19.2	50.7	25.5	CL-ML

Based on the laboratory test results and our observations during drilling, the clay is classified as low-plastic clay (mUSC = CL, CL-ML).

3.7 Bedrock

Bedrock was encountered in all testholes at depths between 9.1 mBGS and 9.5 mBGS. All testholes terminated in bedrock at depths between 9.3 mBGS and 10.7 mBGS. The bedrock was greyish blue, extremely weak and completely weathered. The bedrock was dry to humid. SPT “N” blow counts recorded in the bedrock ranged from 26 to refusal.

3.8 Groundwater Conditions

Standpipes were installed in testholes TH18-02, TH18-03 and TH18-06 to measure the depth of groundwater. The measured groundwater levels are summarized in **Table 3-4**.

Table 3-4. Groundwater Levels – June 7, 2018

Testhole No.	Ground Elevation (m)	June 7, 2018	
		Groundwater Level (mBGS)	Groundwater Elevation (m)
TH18-02	1299.107	5.74	1293.367
TH18-03	1298.060	5.43	1292.630
TH18-06	1297.518	5.35	1292.168

Groundwater depths should be expected to fluctuate seasonally and in response to precipitation, and may be at different depths when construction commences. Groundwater depths should be measured periodically prior to construction to monitor seasonal fluctuations in the groundwater elevations. Assuming a fluctuation of

approximately 1.5 m in measured groundwater levels, the highest expected groundwater level at this site is approximately 3.85 m.

Sloughing and seepage was encountered during drilling in testholes and should be expected during construction.

3.9 Soil Chemistry

Electrochemical tests were conducted on four soil samples to determine water soluble sulphate concentrations, chloride content, pH, and resistivity. A summary of the test results, expected degree of corrosiveness, and potential for sulphate attack of the subsurface soils on concrete is presented in **Table 3-5**.

Table 3-5. Summary of Electrochemical Testing Results

Testhole No.	Sample No.	Depth (mBGS)	pH	Resistivity (ohm-cm)	Sulphate Content			Chloride Content		Potential for Sulphate Attack	Degree of Corrosiveness	mUSC
					%	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)			
TH18-01	2	1.52	8.51	9,360	< 0.1	51.9	11.5	29	6.5	Low	Moderate	GW
TH18-02	4	2.13	8.19	11,200	< 0.1	26.8	6.0	< 20	< 4.4	Low	Mild	SM
TH18-03	3	2.13	8.01	7,210	< 0.1	63.4	15.5	< 20	< 4.9	Low	Moderate	GP
TH18-04	2	1.52	8.25	7,670	< 0.1	48.5	9.7	45	9.0	Low	Moderate	GW

The degrees of corrosiveness and potential for sulphate attack, as shown in **Table 3-5**, are in accordance with the Handbook of Corrosion Engineering (Roberge, 1999) and the Canadian Standard Association Guidelines.

3.10 Site Seismicity

Seismic loading is required for the design of structures. The level of importance of seismic loading at any site is related to factors such as the subsoil conditions and their behavior during an earthquake, the magnitude, duration, and frequency of strong ground motion, and the probable intensity and likelihood of the occurrence of an earthquake. The seismic loads used in the 2015 National Building Code of Canada (NBCC) are based on a 2 % probability of exceedance in 50 years, i.e., a return period of 2,475 years. This means that within a 50 year period there is a 2 % probability that the ground motions specified in the 2015 NBCC will be exceeded.

Based on the requirements set out in the NBCC, a determination of the soil's relative response to the seismic activity is required. The NBCC deals with the seismic classification of soils based on average properties of the top 30 m of the soil profile. This classification is based on the average standard penetration resistance, shear wave velocity, or undrained shear strength.

The average standard penetration resistance in overburden soils in the four testholes varied from 3 to refusal, with an average of 31 in the upper 10 m. Bedrock was encountered in all testholes below the overburden soils at depths between 9.1 mBGS and 9.5 mBGS; therefore, the soil classification for Site Seismic Response is Class C (very dense soil and soft rock) based on the NBCC (2015).

The Peak Ground Acceleration (PGA) for this site is 0.152g, where g is 9.81 m/s² and Peak Ground Velocity (PGV) is 0.139 m/s (NBCC 2015).

4. Considerations and Recommendations

4.1 General

The proposed buildings to be constructed at the site are single storey, wood frame and/or heavy timber construction with no basements. The new buildings are expected to replace those that were burnt down in wildfires in the fall of 2017. The new buildings will occupy the same footprints previously occupied by the original buildings. Based on the information provided during the preparation of this report, shallow foundations are being considered for the Bunk House and Alpine Cottage and deep foundations are being considered for the Saddling Barn. It is understood that that the Alpine Cottage and Bunk House will be heated whereas the Saddling Barn will be unheated.

The subsurface soils at the site generally consist of gravel, gravel and sand, and sand underlain by clay and/or bedrock. Groundwater was encountered at approximately 5.5 mBGS. Based on SPT “N” blow counts and our observations of the drill cuttings, the overburden soils contain cobbles and occasional boulders (particle size greater than 200 mm); therefore, cobbles and occasional boulders should be expected in excavations and/or pile holes during construction. Seepage and sloughing were encountered in the testholes during drilling and should be expected in excavations and pile holes below a depth of approximately 4.5 mBGS. Based on the subsurface conditions, shallow and deep foundations are considered suitable for the proposed buildings subject to the recommendations provided in this report. Slab-on-grade floors are also considered suitable within the buildings subject to the recommendations provided in this report.

Shallow foundations, if selected, should be founded on compact to dense gravel and sand layers at or below a minimum depth of 1.5 mBGS. Perimeter insulation will be required for shallow foundations located on the perimeter of both heated and unheated buildings. Insulation will also be required for interior foundations of unheated buildings. Insulation is not required for under slab-on-grade floors in heated buildings but will be required under slab-on-grade floors in unheated buildings.

Helical screw piles are used in sands and clay not containing cobbles and boulders and with SPT “N” blow counts less than 30. The overburden soils at the site contain cobbles and occasional boulders and the SPT “N” blow counts varied from 13 to 62 with an average of 34 in the upper 5 to 6 mBGS. Due to the potential presence of cobbles and boulders, high SPT “N” blow counts in the upper 5 m and the potential for damage to the piles, screw piles are not recommended at this site.

Deep foundations consisting of cast-in-place (CIP) concrete piles or driven steel piles are considered suitable for building foundations and other structures subject to the recommendations provided in this report and provided piles are installed into bedrock. Groundwater was encountered at or below a depth of 5.5 mBGS; however, groundwater may fluctuate seasonally and in response to precipitation/snow melt and may be higher than measured during drilling. Seepage and sloughing were encountered in the testholes during drilling and should be expected in pile holes. Controlling seepage and sloughing and maintaining a clean pile hole is the Contractor’s responsibility. The Contractor should select suitable mitigation measures to control seepage and sloughing which may include the use of full depth casing seated into bedrock. CIP concrete piles should be installed at least 1 m into bedrock. The length of full depth casing may vary depending on depth to bedrock; therefore, the Contractor should have provisions for lengthening or shortening the casing and rebar cage, if required, due to variable bedrock depths. The overburden soils contain cobbles and boulders; therefore, equipment selected for pile installation should be capable of installing piles through cobbles and boulders (if encountered at the pile locations), bedrock and seeping and sloughing ground. Selection of suitable equipment for pile and casing installation is the Contractor’s responsibility.

Driven steel H or pipe piles may be considered for the buildings provided these piles are installed into bedrock to practical refusal. Cobbles and boulders are present in the overburden soils; therefore, the Contractor should be prepared for pre-drilling or installation of additional piles (subject to recommendations by a geotechnical engineer) if piles encounter shallow refusal. Piles will not be acceptable if not installed in the bedrock at practical refusal.

We understand that PWGSC are considering paving the existing gravel parking lot adjacent to the new buildings. No traffic information was provided for the design of the pavement structure for the paved parking. Based on observations during the site reconnaissance and the site investigation, traffic on the parking lot consists of visitors driving single axle vehicles (standard sedans, sport utility vehicles, trucks, etc.) and the occasional trailer. Recommendations for the pavement structure of the paved parking lot are provided in the following sections.

4.2 Shallow Foundations

4.2.1 Strip/Spread Footings

Strip/spread footings may be used for the new buildings provided the footings are founded on compact to dense gravel at a depth of approximately 1.5 mBGS. The footings can be sized based on the soil resistances provided below:

Ultimate Limit States (ULS): Footings bearing on compact to dense gravel at a depth of 1.5 mBGS may be designed using an ultimate soil resistance of 500 kPa. For Limit States design a resistance factor of 0.5 should be applied on the ultimate soil resistance to calculate the factored soil resistance.

Serviceability Limit States (SLS): The estimated settlement for an applied load of 250 kPa is estimated to be less than 25 mm; therefore, applied factored loading on the footings should not exceed 250 kPa. The settlement is expected to be elastic and will occur during and shortly after construction.

The ULS and SLS resistances provided above are based on the following assumptions:

- The footings are founded on compact to dense gravel at a minimum depth of 1.5 mBGS.
- Minimum soil cover above footing bases is approximately 1.5 m.
- Footings are protected from seasonal frost heave by providing insulation. Insulation is required to protect exterior footings in heated and unheated building from seasonal frost heave. Insulation is also required for interior footings of unheated buildings.
- The minimum footing width is 900 mm.
- The subgrade below footings is prepared in accordance with the recommendations provided in this report.
- The subgrade is inspected by qualified geotechnical personnel.
- All fill placed above footing bases is compacted to 98 % of the SPMDD within ± 2 % of the OMC.
- The fill placed above footing bases consists of general engineered fill. Native granular soils free of organics, debris, frozen or wet soils or any other suitable soils are considered suitable general engineered fill provided particle sizes greater than 75 mm are removed. A layer of low to medium plastic clay, approximately 600 mm thick, compacted to 98 % of the SPMDD within ± 2 % of the OMC should be placed at surface to reduce the potential of infiltration.

The subgrade below foundations should be prepared by removing all organic soils, soft/wet/loose soils and other unsuitable material such as frozen soils, debris, etc. Inspection of the bearing surface is recommended to confirm that the footings are placed on compact to dense gravel at a depth of 1.5 mBGS. Any soft, loose, or unsuitable soils

encountered at the footing bearing elevation should be over-excavated and backfilled with 20 mm minus crushed gravel compacted to 100 % of the SPMDD within ± 2 % of the OMC or lean concrete. The footings should not be constructed on frozen subgrade or in frozen conditions. The footing subgrade should not be allowed to freeze during or after construction.

Use of a mud slab, approximately 100 mm thick, may be considered below the footings to reduce the risk of disturbing the foundation base due to weather (wetting/drying) or construction equipment. Prior to pouring the mud slab concrete, the prepared subgrade should be inspected by qualified geotechnical personnel to confirm that all soft/loose spots have been removed and prepared subgrade is acceptable. Alternatively, a layer of leveling course (20 mm minus crushed gravel), approximately 150 mm thick, should be placed below the footings. The levelling course should be compacted to 100 % of the SPMDD within ± 2 % of the OMC.

Any surface water or groundwater infiltration into the excavation should be diverted away from the foundation base to avoid softening. In warm, dry weather, care should be taken to prevent soil at the base of the excavation from drying and cracking.

4.2.2 Slab-on-Grade Floors

Concrete slab-on-grade floors may be used within heated and unheated buildings, subject to the recommendations provided below. For heated buildings insulation is not required under the slab-on-grade floors. For unheated buildings insulation is required under the slab-on-grade floors in conjunction with perimeter insulation for exterior shallow foundations, grade beams and foundation walls. Recommendations for insulation are provided in **Section 4.10**.

Any unsuitable soil (organic soil, soft-to-firm and wet soils and soils containing organics, debris, etc.) encountered at or below the slab base elevation should be removed from the slab footprint. The exposed native subgrade, after organic stripping, should be scarified to a minimum depth of 150 mm, moisture conditioned to within 2 % of the OMC and compacted to 98 % of the SPMDD.

The prepared subgrade, after stripping, scarification and re-compaction, should be proof-rolled to identify any soft/weak soil pockets. Any weak/soft spots identified during proof-rolling should be over-excavated and replaced with general engineered fill. The general engineered fill should be compacted to at least 98 % of the SPMDD unless otherwise specified. If seasonally frozen ground is present at the time of slab construction, it should be over-excavated and replaced with general engineered fill. The prepared subgrade should be protected from rain, snow, drying, seasonal frost, and ingress of water. The subgrade should not be allowed to freeze during or after construction to reduce the potential for frost heave movements.

The final grade should be restored by the placement of general engineered fill compacted to 98 % of the SPMDD within 2 % of the OMC. A leveling course of crushed gravel should be provided directly under slab-on-grade floors in heated areas. For slab-on-grade floors in unheated areas, the levelling course should be placed below the rigid insulation. To limit potential stress concentrations, the leveling course should not contain very coarse material. The leveling course should be comprised of a minimum 150 mm thick compacted layer of 20 mm minus crush for slab-on-grade floors in heated premises where insulation under slab-on-grade floor is not required. For slab-on-grade floors in unheated areas, the minimum thickness of leveling course is 300 mm (**Section 4.10.4**). The leveling course should be compacted to 100 % of the SPMDD.

The slab-on-grade floors and walls and columns supported on the foundation system should be structurally independent of each other. Non-load bearing walls placed directly on slab-on-grade floors should also be structurally independent of the walls and columns supported on the foundation system.

The slab-on-grade floors should have maximum floor slab loading of 10 kPa. If the floor slab loading is expected to exceed 10 kPa, supports vibrating equipment, or if the floor slab traffic is expected to be high, AECOM should be given the opportunity to re-evaluate the recommendations for slab-on-grade floors.

The slab-on-grade floors should contain an adequate number of construction joints to control cracking of the slab concrete. The slab-on-grade floors should be adequately reinforced to reduce the possibility of uncontrolled slab cracking.

Some relative movement between slab-on-grade floors and adjacent walls or foundations and differential movements within the slabs is anticipated. Generally, if the recommendations outlined in this report are followed, these movements should be acceptably small. It is possible that some cracking of the slab or distortion of any internal partition walls supported by the slab may occur. Such damage may be visible, particularly if a brittle surface finishing, such as ceramic tiles, is adopted. The risk of such damage should be weighed against the additional cost associated with alternative slab support systems such as structurally supported slabs.

4.3 Deep Foundations

4.3.1 Cast-in-Place Concrete Piles

Drilled CIP concrete straight shaft piles founded into bedrock may be designed using **Equation [4-1]** and parameters provided in **Table 4-1**.

$$Q_u = q_s P_s L + q_t A \quad [4-1]$$

where:

- Q_u = ultimate load carrying capacity of the pile (kN)
- q_s = ultimate skin friction between the pile and soil (kPa)
- q_t = ultimate end bearing (kPa)
- P_s = perimeter of the pile section (m) = πD_s , where D is pile shaft diameter
- L = effective pile embedment length
- A = cross sectional area of the pile (m²)

CIP concrete piles may be designed using parameters provided in **Table 4-1**.

Table 4-1. Recommended Ultimate Design Parameters for CIP Concrete Piles

Soil/Bedrock Unit	Depth (mBGS)	Ultimate Skin Friction (kPa)	Ultimate End Bearing (kPa)
Season Frost Zone	0.0 – 3.0	0	0
Gravel/Sand and Gravel/Sand	3.0 – 6.0	46	0
Clay	6.0 – 9.5	40	0
Bedrock	> 9.5	125	2,100

For limit states design method, a resistance factor of 0.4 should be applied on the ultimate soil resistance to obtain the factored soil resistance.

The minimum pile spacing should be three times the pile diameter measured centre to centre. Group effects should be considered, if pile spacing is less than the minimum recommended spacing.

To reduce the risks associated with the presence of potential boulders, straight shaft CIP concrete piles should have a minimum diameter of 600 mm.

The pile bases should be free of disturbed and/or softened material or ponded water. The pile bases should be cleaned to remove all loose, sloughed, or disturbed material. End-bearing will not be applicable if pile bases are not thoroughly cleaned. Where significant quantities of water are present, and it is impractical or not possible to remove the water from the pile hole, concrete should be poured using the tremie technique. The tremie pipe should be kept immersed in fresh concrete in the pile hole so that the concrete rising from the bottom displaces the water, thus reducing the potential for concrete segregation and washing-out of cement.

The Contractor should have provisions for tremie mix, if required due to excessive seepage. Due to the possibility of seepage, sloughing and stress relief caused by the removal of the excavated soil, the concrete should be poured immediately after completion of the pile hole. Any pile hole left open for a significant time period should be subject to review by a qualified geotechnical engineer. Concrete should be poured without segregation and carefully vibrated throughout the pile to reduce the risk of voids forming in the pile shaft.

For piles installed in groups, the minimum pile spacing should be three times the pile diameter measured centre to centre. Group effects should be considered if pile spacing is less than three times the pile diameter measured centre to centre. Piles spaced closer than three times the pile diameter measured centre to centre should not be drilled consecutively until the initial pile has been cast and set for at least 24 hours.

All piles should be installed at least 1 m into bedrock. End-bearing and skin friction for bedrock will not be applicable and piles will not be acceptable if not installed at least 1 m in bedrock.

All piles should be inspected by qualified geotechnical personnel to confirm that piles have been installed in accordance with the recommendations provided in this report.

4.3.2 Driven Steel Piles

Driven steel piles may be considered subject to the precautions and recommendations provided in this report. The ultimate load carrying capacity of driven steel piles may be calculated using **Equation [4-1]** and the parameters provided in **Table 4-2**.

Table 4-2. Recommended Ultimate Design Parameters for Driven Piles

Soil/Bedrock Unit	Depth (mBGS)	Ultimate Skin Friction (kPa)	Ultimate End Bearing (kPa)
Season Frost Zone	0.0 – 3.0	0	0
Gravel/Sand and Gravel/Sand	3.0 – 6.0	60	0
Clay	6.0 – 9.5	40	0
Bedrock	> 9.5	125	3,150

Piles should be driven into bedrock to practical refusal. Piles will not be acceptable if not driven to practical refusal in bedrock. For steel piles driven to practical refusal in bedrock, the perimeter of the pile section (P_s) and cross-sectional area of the piles to be used in **Equation [4-1]** are provided below:

P_s = perimeter of the pile section (m); for circular piles, $P_s = \pi D$, where “D” is the outer diameter of the pipe pile; for H-piles, $P_s = 2(b+d)$ where “b” is the flange width and “d” is the web height of the H-pile

A_t = cross-sectional area of the plugged steel pile (m^2) = $\pi D^2/4$ (for circular piles); and, bxd (for H piles)

Piles driven to practical refusal can have significantly higher capacity than estimated from parameters provided in **Table 4-2**; however, higher capacity needs to be confirmed with Pile Dynamic Analyzer (PDA) testing.

Pile Dynamic Analyzer (PDA) testing is recommended to be made mandatory in the tender documents.

A resistance factor of 0.4 should be applied on the ultimate load capacity of the pile to obtain the factored load capacity. A resistance factor of 0.5 can be applied on the ultimate load capacity if piles are tested in the field using a PDA.

The overburden soils, specifically gravel and sand and gravel, contain cobbles and occasional boulders. Predrilling may be required if piles encounter refusal on cobbles/boulders.

The piles should be spaced at least three times the pile diameter (measured centre to centre). For piles installed at closer than three times the pile diameter (measured centre to centre), group effects should be considered by applying appropriate load reduction factors.

Piles driven in groups should be installed from the centre of the group outwards. Heave of adjacent piles should be monitored during installation of pile groups. The capacity of all piles that have heaved as a result of adjacent pile installation should be re-evaluated and may require re-driving to a slightly deeper elevation than their original embedment depth.

The soils encountered at the site are mildly to moderately corrosive; therefore, the selection and design of the steel piles should take into account the loss of pile section due to corrosion. Final design of steel piles should make appropriate allowances for corrosion.

General recommendations for driven steel piles are provided below:

- Pile capacities based on static design parameters are typically conservative. PDA testing should be performed to reduce conservatism in the design. With a PDA test it is possible to estimate the ultimate pile capacities, stresses in steel, detect damage to the pile during pile driving and estimate pile set criteria.
- The proposed hammer, piling rig and methodology should be approved in advance of construction and the refusal criterion should be confirmed for the actual hammer and design load. This can be achieved by performing a wave equation analysis using commercially available software such as GRLWEAP. AECOM can perform a WEAP analysis, if requested, when information on pile lengths, loads, and pile driving equipment (hammer type) is available. The hammer should be approved by performing a WEAP analysis prior to mobilizing to the site to confirm that the hammer is capable of driving the piles to the required depth without damaging the pile.
- The pile termination criterion to achieve the required capacity should be confirmed with PDA testing.
- For piles driven in the winter, increased driving resistance should be expected in the upper frozen layer; consequently, pre-drilling through the frozen layer may be required. Pre-drilling and/or installation of additional piles may also be required if increased pile resistance is encountered during pile driving due to the presence of cobbles/boulders. The contract should have provisions for pre-drilling or additional piles, if warranted due to site conditions.
- Pile driving should be stopped immediately if abrupt high resistance to penetration is encountered. In such cases, the driving record and depth of penetration should be carefully examined to determine if the pile has

adequate bearing capacity. If the depth of penetration is inadequate, the need for additional piles or pre-drilling should be evaluated.

- After each pile is driven to practical refusal in bedrock, an elevation should be taken of the pile top or of a suitable mark on the side of the pile. This elevation should be checked periodically to measure potential heave caused by driving of adjacent piles or any uplift forces. Piles that have heaved must be re-driven to at least their previous final elevation and final set.
- Full time inspection by qualified geotechnical personnel during pile driving is recommended to maintain pile driving records. Information to be recorded should include pile dimensions, hammer type, rated energy, ram weight, stroke, anvil weight, cushion parameters, number of blows for each 0.25 m penetration and final set. It is recommended that each pile be reviewed by the geotechnical engineer responsible for the design to assess that the required load capacity is achieved.
- Strict control of pile location and orientation should be exercised to obtain accurate pile installation.

4.3.3 Lateral Pile Capacity

Lateral pile performance may be analysed using a lateral pile computer program (such as LPILE) to determine pile top deflections and bending moments. The soil parameters required for estimating lateral pile capacity in clay or extremely weak to weak bedrock are generally modulus of subgrade reaction (k), undrained shear strength (S_u), unit weight (γ), and soil strain parameter (E_{50}). In sand, the parameters used for estimating lateral pile capacity are k and γ . These parameters are based on review of published literature, local soil conditions, and our judgement and experience with the local soils. The lateral soil parameters for pile design are provided in **Table 4-3**.

Table 4-3. Recommended Ultimate Design Parameters - CIP Concrete and Driven Steel Piles

Soil/Bedrock Unit	Depth (mBGS)	S_u (kPa)	ϕ (degrees)	γ' (kN/m ³)	k (kN/m ³)	E_{50}
Compact to Dense Gravel/Sand and Gravel/Sand	0.0 – 6.0	-	35	20.0	25,000	-
Stiff Clay	6.0 – 9.5	50	28	9.2	20,000	0.007
Bedrock	> 9.5	350	-	12.2	250,000	0.004

The design of laterally loaded piles is generally governed by Serviceability Limit States limiting the top of pile movement to tolerable limits.

The lateral capacity of individual piles in a group is primarily affected by the spacing of the piles, measured centre to centre along an alignment parallel to the lateral load applied (provided that the pile spacing perpendicular to the applied load is at least three pile diameters). Group effects diminish at a pile spacing of six pile diameters or greater. Similar to axial loading, reduction factors for lateral loading should also be applied. The lateral load reduction factors (pile spacing parallel to applied load) are provided in **Table 4-4**.

Table 4-4. Recommended Lateral Load Reduction Factor for Pile Groups (Moskwa 1999)

Pile Spacing – Measured Centre to Centre (Multiples of pile diameter)	Lateral Load Reduction Factors	
	1 st Row (Lead Row)	2 nd Row
6 or greater	1.00	1.00
5	0.94	0.88
4	0.88	0.78
3	0.83	0.67

4.3.4 Tension Loads/Uplift Forces on Piles

The piles will be subject to uplift forces due to frost heave, tensile forces due to lateral loading, overturning movements due to wind, etc. The piles should be designed to resist these uplift forces. The resistance to uplift will be provided by pile self-weight, applied dead loads, and skin resistance. Factors such as seasonal frost depth, heating and insulation, and soil type should be taken into account while designing the pile against uplift.

The resistance to uplift may be calculated using ultimate skin friction parameters provided in **Table 4-1** and **Table 4-2**. A resistance factor of 0.3 should be applied on ultimate uplift capacity to obtain factored uplift capacity.

4.3.5 Downdrag Loading on Piles

Piles will be subjected to downdrag forces (negative skin friction) if fill greater than 2 m in height is placed on-site. Based on available information fill is not expected to be placed on-site; therefore, recommendations for downdrag loading on piles are not provided in this report. AECOM should be informed to provide recommendations on downdrag if fill greater than 2 m in height is placed on-site.

4.4 Flexible Pavements

4.4.1 Pavement Design Parameters

For the design of flexible pavements, the subgrade strength in soaked and unsoaked conditions is required. The soaked and unsoaked subgrade strengths were estimated by performing CBR tests on the near-surface soil samples from two locations combined into one bulk sample. The unsoaked and soaked CBR values were 54.8 % and 25.3 %, respectively. The CBR test results are provided in **Section 3.4** and **Appendix B**.

The measured soaked and unsoaked CBR values were 25.3 % and 54.8 %, respectively. No traffic information was provided however, during site visits and the site investigation, the observed vehicle usage of the parking lot consisted a low amount of single axle vehicles (sedans, sport utility vehicles, trucks etc.), and the occasional trailer. Based on the lack of traffic information and the high CBR, it is recommended to follow the minimum requirements for roadway pavement structures for local or lane roads based on the Design Standards, City of Lethbridge (2016). The minimum recommended pavement structures are provided in **Table 4-5**.

Table 4-5. Minimum Requirements for Roadway Pavement Structures (mm)

Materials	Local	Lane
Type III Asphalt Surface	90	80
Granular Base Course	250	200
Prepared Subgrade	300	300

The subgrade under pavements should be prepared in accordance with **Section 4.6**.

4.5 Temporary Excavations and Dewatering

The composition and consistency of the soils encountered at the site were such that conventional hydraulic excavators should be able to excavate these materials, although a ripper may be required to excavate seasonally frozen soils or if bedrock is encountered in the excavations. Cobbles and boulders and sloughing conditions were encountered in testholes during drilling and should be expected in excavations during construction. The Contractor

is responsible for the selection of suitable equipment to excavate cobbles, boulders and bedrock (if encountered in excavations).

Construction should be in accordance with good practices and should conform to Alberta's Occupational Health and Safety guidelines. Excavations should be sloped or adequately shored in accordance with Occupational Health and Safety guidelines. The appropriate side slopes for excavations will depend on the soil type, controlling groundwater flow into the excavations and the time the trench is left open.

The subsurface soils encountered within the testholes are categorized as "Likely to Crack and Crumble Soils" in the upper 3.5 mBGS and "Soft, Sandy or Loose Soils" below 3.5 mBGS in accordance with Alberta's Health and Safety Act, 2017 Edition, Part 32 Excavating and Tunnelling. Groundwater was encountered below a depth of 5.0 mBGS but is expected to be higher following spring thaw and in the summer; therefore, temporary dewatering should be expected if excavations extend below the groundwater table or if seepage is encountered at shallower depths. The Contractor is responsible for maintaining stability of the excavation slopes and dewatering of excavations.

The method of excavation and safe support of excavation/trench sidewalls and protection of the existing infrastructure are the responsibility of the Contractor and are subject to the applicable regulations of Alberta's Health and Safety Act (2017). The Contractor is required to employ appropriate mitigation measures to avoid impacts on existing site infrastructure adjacent to excavations (if any).

Temporary surcharge loads from construction materials, equipment or excavated soils should not be allowed within a distance equal to the depth of excavation from the unsupported excavated face. Vehicles delivering material should be kept a safe distance away from excavation faces.

4.6 Subgrade Preparation

All vegetation, peat, organics, organic rich soils, topsoil, frozen and wet soils (if encountered) should be stripped from the footprint of the structures including pavements, foundations and slab-on-grade floors. The organic material should be stockpiled separately for site erosion and sedimentation control.

Following organic stripping and excavation to achieve design grades, the exposed subgrade should be scarified to a minimum depth of 300 mm, moisture conditioned to within 2 % of the OMC and compacted to a minimum of 98 % of the SPMDD. Following moisture conditioning and compaction, the subgrade should be proof-rolled to identify loose and/or soft areas. Any loose and/or soft areas should be over-excavated to expose the underlying competent soils and replaced with general engineered fill compacted to at least 98 % of the SPMDD within 2 % of the OMC. The prepared subgrade should be proof-rolled again after repairing soft areas to confirm that the prepared subgrade is stable prior to fill placement and construction of the pavement or other structures. Bridging with non-woven geotextile and bi-axial geogrids may be required at some locations to stabilize the subgrade if the prepared subgrade is not stable and shows deflections during proof roll. The contract should include provisions for providing non-woven geotextile and bi-axial geogrid if required during construction.

Ponding on the prepared subgrade may result in subgrade softening, which could be detrimental to pavements and other structures; therefore, the prepared subgrade should be graded to shed water away from footprint of the structures to avoid ponding.

The prepared subgrade should be protected from disturbance by construction equipment and site traffic to avoid loosening of the prepared subgrade before construction of the pavement or other structures. The prepared subgrade should not be left exposed for extended periods of time to avoid wetting, drying, and/or freezing of the subgrade.

4.7 Fill Placement and Compaction

Following organic stripping and subgrade preparation, as described in **Section 4.6**, fill can be placed and compacted in accordance with the recommendations.

Soils used for filling purposes may consist of general engineered fill comprised of inorganic well-graded granular soils (well-graded mixture of sand and gravel) or inorganic low-to-medium plastic clay. Native inorganic sand and gravel obtained from excavations may be used as general engineered fill, provided these soils are properly moisture conditioned and provided all oversize material (particle size greater than 75 mm) has been removed.

Inorganic soils obtained from excavations may have natural moisture content different than their OMC; therefore, the soils should be properly moisture conditioned prior to using them as fill.

Structural fill should be used in areas where performance of fill is more critical, such as under foundations, etc. Structural fill should consist of pit run gravel with maximum particle size of 75 mm, 20 mm minus and/or 40 mm minus crushed material. Structural fill may be obtained from screened pit run or crushed material depending on specific requirements. The structural fill should be compacted to 100 % of the SPMDD.

Fill material should not be placed in a frozen state or placed on frozen subgrade. All lumps of fill material should be broken down during placement. The maximum particle size in the fill material should not exceed half the layer thickness. Fill material should not contain deleterious materials such as debris, organics, coal particles, wood chunks, etc.

It should be noted that the ultimate performance of the trench backfill is directly related to the uniformity of the backfill compaction. In order to achieve this uniformity, the lift thickness and compaction criteria must be strictly enforced.

4.8 Fill Settlement

Compacted fill may settle due to self-weight and under any loads applied on the fill. The expected fill settlement depends on the type of fill material, degree of compaction and uniformity of compaction. Fill settlement can be reduced by using strict placement and compaction specifications. Uniform fill placement and compaction techniques are necessary for uniform settlement behaviour and to reduce differential settlement. The consequences of lower than recommended compaction standards include increased settlement of fill under its own weight. The estimated settlement of cohesive (low-to-medium plastic clays) and granular fill material as a function of compaction level are provided in **Table 4-6**.

Table 4-6. Estimated Settlement Vs Compaction

Compaction Level (% of SPMDD)	Fill Settlement (% of Fill Thickness)	
	Cohesive Soils	Granular Soils
100	0.5	<0.5
98	1.0	0.5
95	1.5	1.0
90	4.0	3.0
< 90	> 4.0	> 3.0

4.9 Site Grading and Drainage

The site should be properly graded to drain surface water away from the site as quickly as possible during and after construction. The finished grade for all areas should be prepared so that surface water is drained away from buildings and other structures by the shortest possible route.

The site should be graded to have overall grades of no less than 1 % to reduce ponding. The access roads should also be crowned to a minimum of 2 % (or super-elevated around curves) to shed water to adjacent ditches.

Ditches should be constructed along roadways and parking lots to promote drainage and reduce the potential for ponding near roadways and pavement structures. Ditch gradients in excess of 2 % may cause ditch erosion, and ditch gradients less than 0.5 % may result in inadequate longitudinal drainage. Longitudinal gradients less than 0.5 % may also result in localized ponding, growth of aquatic plants, odour from stagnant water, and insects. The lower longitudinal gradient will reduce erosion but will result in increased silt deposition within the ditches.

Erosion protection for ditch slopes can be provided through the application of a layer of topsoil and grass seed. Erosion protection mats may be required to reduce ditch erosion in the short term. Silt fences may also be required during construction to reduce silt flow into the water bodies.

From a slope stability perspective, maximum ditch side slopes of 3H:1V are recommended. Ditch side slopes steeper than 3H:1V are not recommended, as steeper ditch slopes may cause localized toe failures, especially in areas where longitudinal drainage causes undercutting of the slope toe.

The use of riprap is recommended at locations where heavy erosion and scour are to be avoided. These locations may include entrance and egress locations of culverts. Where utilized, all riprap should be placed on a medium weight, non-woven geotextile.

Downspouts from buildings and structures may be discharged onto landscaped or gravel surface areas, provided that water is carried by means of a concrete splash pad or extendable sections so that the point of discharge of water is at least 2 m from building walls. The ground surface adjacent to walls and key infrastructure should be graded to slope away from buildings at a gradient of at least 4 % within 3 m of the building perimeter.

4.10 Frost Susceptibility, Seasonal Frost Penetration Depths and Frost Design Considerations

4.10.1 General

The surficial soils within the upper 4 m primarily consist of gravel, sand and gravel, and gravel and sand (GW, GP and SM). The qualitative frost susceptibility of granular soils is typically assessed using guidelines developed by Casagrande (1932) on the basis of the percentage by weight of the soil finer than 0.02 mm. This classification system has been adapted by the U.S. Army Corps of Engineers and the Canadian Foundation Engineering Manual (CFEM 2006). Soils are classified as F1 through F4 in order of increasing frost susceptibility. Based on the sieve analysis results, the near surface soils contain less than 15 % particles finer than 0.02 mm by weight, are non-plastic, and are, therefore, classed as F1 to F2 (slightly to non-frost susceptible soils). The groundwater is also deep; therefore, seasonal frost heave is not a major concern at this site; however, it is standard practice to protect structures from seasonal frost heave forces. Recommendations for protection against seasonal frost heave are provided in the following section.

The seasonal frost penetration is estimated to be approximately 3.0 m in the surficial granular soils; therefore, pipelines and other infrastructure elements below the finished grade should be protected from seasonal frost heave either by burial below the seasonal frost zone or by shallow burial combined with insulation and/or heat tracing.

4.10.2 Utility Lines

The minimum burial depth of un-insulated utility lines, and water and sewer pipelines should not be less than the seasonal frost penetration depth. Insulation should be provided if pipelines are buried with soil cover less than the seasonal frost penetration depths. The insulation should be of rigid polystyrene composition (Styrofoam HI-40 or equivalent). The insulation should be at least 100 mm thick. A minimum insulation burial depth of 1.5 m is recommended below the finished grade. A 600 mm thick compacted clay layer should be placed on the surface to reduce infiltration. The compacted clay layer should be placed above the insulation footprint and should extend at least 1 m outwards from the insulation edges on all sides. The insulation should be sandwiched between two 100 mm thick layers of bedding sand to protect it from any damage. For pipelines the width of insulation (W) extending outwards from the pipe centreline on each side can be calculated using the following equation:

$$W = 0.5 [d + 2 (F - I)] \quad [4-2]$$

where:

- d = pipe diameter (m)
- F = seasonal frost penetration depth (m)
- I = insulation depth below finished grade (m)

The insulation width on either side of the pipelines should not be less than 2 m in any case.

4.10.3 Shallow Foundations (Strip and Spread Footings)

Insulation is not required for structures and foundations located in heated premises. However, perimeter insulation should be provided for exterior footings and grade beams of heated structures if the foundation base is at a shallower depth than the seasonal frost penetration depth. The insulation should be at least 100 mm thick. The insulation should be rigid and high strength (Styrofoam HI-40, HI-60, or HI-80) with appropriate design compressive strengths required for structural purposes. The insulation should be applied vertically to the outside of the foundation wall/grade beam to the top of the footing and should extend horizontally outwards a minimum distance of 1.5 m.

For unheated buildings, insulation is required for all exterior and interior footings if founded at depths less than the seasonal frost penetration depth. Insulation, approximately 100 mm thick, should be provided on all sides of the foundations extending at least 2 m outside from the grade beam/foundation wall edges.

The insulation should be sandwiched between two layers of bedding sand, at least 75 mm in thickness, and should be sloped down and away from the structure at 1%. A compacted clay layer approximately 600 mm thick is recommended at surface to reduce infiltration. The compacted clay layer should be placed above the insulation footprint and should extend at least 1 m outwards from the insulation edges on all sides.

4.10.4 Slab-on-Grade Floors

For heated buildings, insulation is not required under slab-on-grade floors. For unheated buildings, insulation is required under and around the slab-on-grade floors. The insulation (HI40 or equivalent) should be 100 mm thick and should be placed on a 300 mm thick levelling course of 20 mm minus crushed gravel. The insulation should

extend 2 m outside the edges of the foundation walls on either side. A compacted clay layer approximately 600 mm thick is recommended at surface to reduce infiltration. The compacted clay layer should be placed above the insulation footprint and should extend at least 1 m outwards from the insulation edges on all sides.

4.10.5 Piles

Frost action should also be considered on pile foundations which includes uplift due to frost heave on the underside of grade beams/pile caps, and adhesion freezing forces (adfreeze) along the pile shaft and sides of grade beams/pile caps within the seasonal frost zone. The adfreeze bond stresses on unheated pile shafts in the seasonal frost zone may range from 65 kPa (for concrete piles) to 100 kPa (for steel piles); therefore, the pile embedment below the seasonal frost zone should be sufficient to resist the uplift due to frost heave. The minimum pile embedment to resist frost heave should be calculated using appropriate adfreeze stress on pile shaft within the seasonal frost zone, dead loads on piles, pile self-weight and skin friction below the seasonal frost zone. The critical scenario would be during construction when there will be no dead load on the piles; therefore, the minimum pile embedment should be calculated without considering dead load on the piles.

The exterior pile caps and grade beams of heated buildings and pile caps and grade beams of unheated buildings can also experience frost heave forces acting on the underside of these structures. These forces can be extremely high in some cases, particularly if drainage is not provided away from the structure. The recommended construction procedure for preventing frost heave under the pile caps and grade beams involves placing a crushable non-degradable void form under the grade beams and pile caps. The void form should be placed on a bedding sand layer approximately 75 mm thick. The grade beam or pile cap should be designed in accordance with the crushing strength of the void form. A minimum thickness of void form of 150 mm is recommended, and a potential frost heave of 50 mm should be assumed, resulting in compression of 33 % of the void form. The pile caps/grade beams should consider the uplift forces induced by collapse of the void form by 50 mm which is supplied in the product supplier literature. It is particularly important that water is not allowed to pond near or under the pile caps and grade beams. Ponding near or adjacent to structures may saturate and damage the void form resulting in uplift on the underside of the grade beam/pile cap; therefore, the finished grade adjacent to grade beams/pile caps should be capped with well-compacted clay and adequately sloped away from the structure.

Another frost effect is adfreeze/uplift pressure acting on the sides of grade beams and pile caps for unheated structures. This can be reduced by providing good drainage and applying a frost bond breaker to the faces of pile caps and grade beams.

4.10.6 Pavements

Pavement performance is affected by climatic factors including frost penetration and precipitation. Frost action includes frost heave and loss of subgrade support during the frost melt period. For frost heave to occur certain factors such as frost susceptible soils, freezing temperatures and a source of water must be present. Frost heave will not occur if any of these factors are not present. At this site, the surficial soils are not frost susceptible and the groundwater is also deep; therefore, seasonal frost heave is not a concern provided adequate drainage is provided and water is not allowed to pond near pavements. The subgrade and pavement structure should be kept dry throughout the year to minimize the adverse effects of frost on pavement performance by providing adequate surface drainage.

4.11 Subsurface Drainage

The measured groundwater is at a depth of approximately 5.35 mBGS and the maximum expected groundwater depth is approximately 3.85 mBGS assuming a 1.5 fluctuation in groundwater levels. The minimum recommended depth of footing bases is 1.5 mBGS; therefore, the footing bases are expected to be at least 2.35 m above the

maximum expected groundwater level. Under these conditions a subsurface drainage system (weeping tiles) is not required. A subsurface drainage system will be required below the footing bases if basements are incorporated in any of the buildings and/or if the minimum separation between the highest expected groundwater level and the base of the footings or any other structures is less than 1 m. AECOM should be informed to provide recommendations on the subsurface drainage system if the separation between the highest expected groundwater level and footing bases of any structure is less than 1 m.

4.12 Sulphate Attack and Corrosion

The test results in **Table 3-5** indicate that the native soils have low potential for sulphate attack; however, it is common practice to use sulphate resistant concrete for any structures in contact with subsoils and groundwater. Therefore, it is recommended to use Type HS Sulphate Resistant cement for all concrete structures in contact with subsurface soils and groundwater.

The measured resistivity values ranged from 7210 ohm-cm to 11,200 ohm-cm. Based on the resistivity values, the native soils are mildly to moderately corrosive. It is, therefore, recommended that all metals in contact with subsurface soils be designed for a corrosive environment.

5. Review of Design and Construction

All recommendations provided in this report are based on the assumption that an adequate level of monitoring will be provided during construction, and that all construction will be carried out by suitably qualified contractors, experienced in earthworks and foundation construction. Adequate levels of monitoring for earthworks are considered to be full time monitoring and compaction quality control. For deep foundations (piles), an adequate level of monitoring is considered to be full-time inspection and design review during construction.

Qualified geotechnical personnel independent of the Contractor should carry out all such quality assurance monitoring. The main purpose of monitoring is to check that the recommendations provided in this report, which are based on the findings at discrete testhole locations, are relevant to other areas of the site. AECOM can provide these services, if requested.

6. References

Canadian Standards Association (2004). CSA – A23.1-04, Concrete Materials and Methods of Concrete Construction.

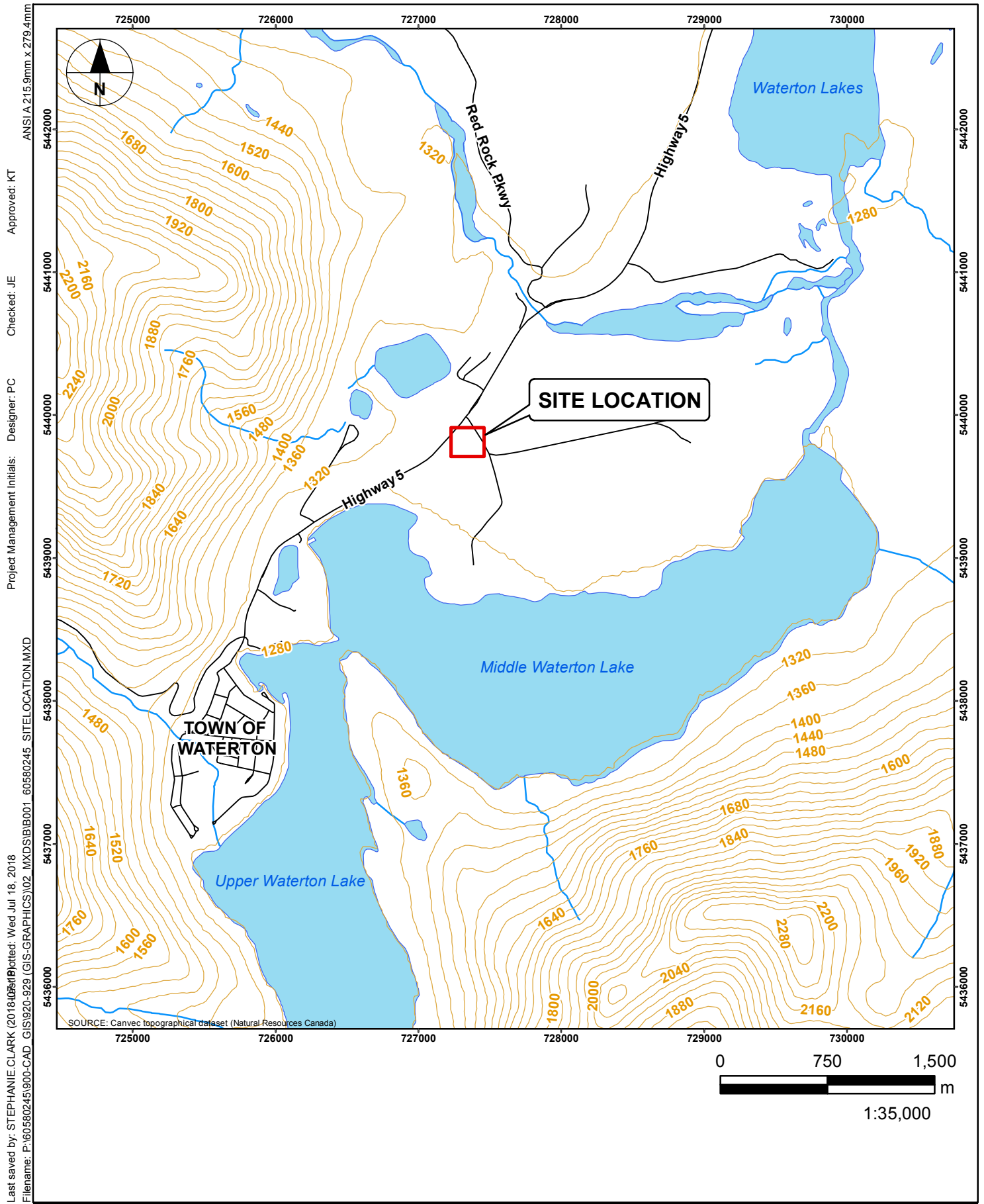
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NBCC (2015). National Building Code of Canada, National Research Council Canada.

Roberge, P.R. (1999). Handbook of Corrosion Engineering. McGraw Hill.

Figures

- Figure 1. Site Location Plan
- Figure 2. Testhole Location Plan



Appendix **A**

Testhole Logs

EXPLANATION OF FIELD & LABORATORY TEST DATA

The field and laboratory test results, as shown for each hole, are described below.

1. NATURAL MOISTURE CONTENT

The relationship between the natural moisture content and depth is significant in determining the subsurface moisture conditions. The Atterberg Limits for a sample should be compared to its natural moisture content and plotted on the Plasticity Chart in order to determine the soil classification.

2. SOIL PROFILE AND DESCRIPTION

Each soil strata is classified and described noting any special conditions. The modified Unified Soil Classification (UCS) system is used. The soil profile refers to the existing ground level at the time the hole was done. Where available, the ground elevation is shown. The soil symbols used are shown in detail on the soil classification chart.

3. TESTS ON SOIL SAMPLES

Laboratory and field tests are identified by the following and are on the logs:

- N - Standard Penetration Test (SPT) Blow Count. The SPT is conducted in the field to assess the in situ consistency of cohesive soils and the relative density of non-cohesive soils. The N value recorded is the number of blows from a 63.5 kg hammer dropped 760 mm which is required to drive a 51 mm split spoon sampler 300 mm into the soil.
- SO₄ - Water Soluble Sulphate Content. Expressed in percent. Conducted primarily to determine requirements for the use of sulphate resistant cement. Further details on the water soluble sulphate content are given in Section 6.
- γ_D - Dry Unit Weight. Usually expressed in kN/m³.
- γ_T - Total Unit Weight. Usually expressed in kN/m³.
- Q_U - Unconfined Compressive Strength. Usually expressed in kPa and may be used in determining allowable bearing capacity of the soil.

- C_u - Undrained Shear Strength. Usually expressed in kPa. This value is determined by either a direct shear test or by an unconfined compression test and may also be used in determining the allowable bearing capacity of the soil.
- C_{PEN} - Pocket Penetrometer Reading. Usually expressed in kPa. Estimate of the undrained shear strength as determined by a pocket penetrometer.

The following tests may also be performed on selected soil samples and the results are given on separate sheets enclosed with the logs:

- Grain Size Analysis
- Standard or Modified Proctor Compaction Test
- California Bearing Ratio Test
- Direct Shear Test
- Permeability Test
- Consolidation Test
- Triaxial Test

4. SOIL DENSITY AND CONSISTENCY

The SPT test described above may be used to estimate the consistency of cohesive soils and the density of cohesionless soils. These approximate relationships are summarized in the following tables:

Table 1 Cohesive Soils

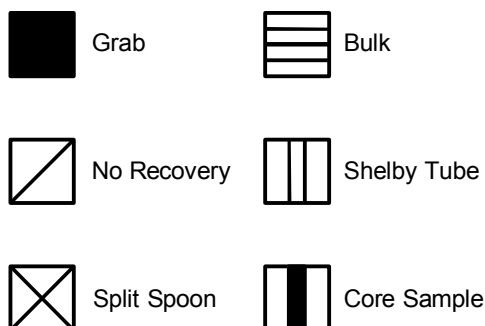
N	Consistency	C_u (kPa) approx.
0 - 1	Very Soft	<10
1 - 4	Soft	10 - 25
4 - 8	Firm	25 - 50
8 - 15	Stiff	50 - 100
15 - 30	Very Stiff	100 - 200
30 - 60	Hard	200 - 300
>60	Very Hard	>300

Table 2 Cohesionless Soils

N	Density
0 - 5	Very Loose
5 - 10	Loose
10 - 30	Compact
30 - 50	Dense
>50	Very Dense

5. SAMPLE CONDITION AND TYPE

The depth, type, and condition of samples are indicated on the logs by the following symbols:



6. WATER SOLUBLE SULPHATE CONCENTRATION

The following table, from CSA Standard A23.1-09, indicates the requirements for concrete subjected to sulphate attack based upon the percentage of water-soluble sulphate as presented on the logs. CSA Standard A23.1-09 should be read in conjunction with the table.

Table 3 Requirements For Concrete Subjected to Sulphate Attack*

Class of exposure	Degree of exposure	Water-soluble sulphate (SO ₄)† in soil sample, %	Sulphate (SO ₄) in groundwater samples, mg/L‡	Water soluble sulphate (SO ₄) in recycled aggregate sample, %	Cementing materials to be used§**	Maximum expansion when tested using CSA A3004-C8, %	
						At 6 months	At 12 months††
S-1	Very Severe	> 2.0	>10 000	> 2.0	HS** or HSb	0.05	0.10
S-2	Severe	0.20 – 2.0	1500 – 10 000	0.60 – 2.0	HS** or HSb	0.05	0.10
S-3	Moderate	0.10 – 0.20	150 - 1500	0.20 – 0.60	MS, MSb, LH, HS**, or HSb	0.10	

*For sea water exposure, see Clause 4.1.1.5.

†In accordance with CSA A23.2-3B.

‡In accordance with CSA A23.2-2B.

§Where combinations of supplementary cementing materials and portland or blended hydraulic cements are to be used instead of the cementing materials listed, the performance requirements shall be used to demonstrate equivalent performance against sulphate exposure (see Clauses 4.1.1.6.2, 4.2.1.1, and 4.2.1.3, and 4.2.1.4). Such combinations shall not be designated as blended cements.

**Type HS cement shall not be used in reinforced concrete exposed to both chlorides and sulphates. Refer to Clause 4.1.1.6.3.

††If the expansion is greater than 0.05% at 6 months but less than 0.10% at 1 year, the cementing materials combination under test shall be considered to have passed.

7. Soil Corrosivity

The following table, from the Handbook of Corrosion Engineering (Roberge, 1999) indicates the corrosivity rating can be obtained from the soil resistivity, presented on the logs.

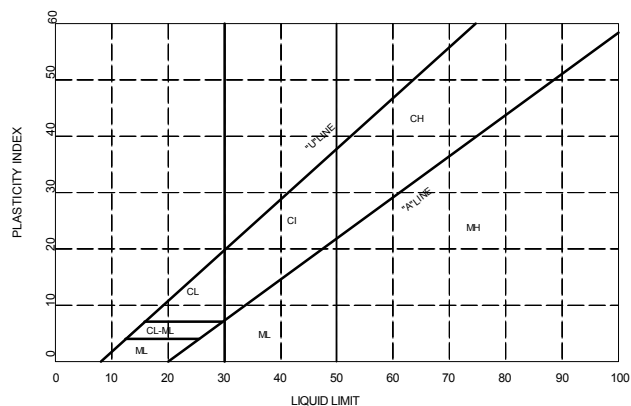
Table 4 – Corrosivity Ratings Based on Soil Resistivity

Soil Resistivity (ohm cm)	Corrosivity Rating
>20,000	Essentially noncorrosive
10,000 – 20,000	Mildly corrosive
5,000 – 10,000	Moderately corrosive
3,000 – 5,000	Corrosive
1,000 – 3,000	Highly Corrosive
<1000	Extremely Corrosive

8. GROUNDWATER TABLE

The groundwater table is indicated by the equilibrium level of water in a standpipe installed in a testhole or test pit. This level is generally taken at least 24 hours after installation of the standpipe. The groundwater level is subject to seasonal variations and is usually highest in the spring. The symbol on the logs indicating the groundwater level is an inverted solid triangle (▼).

MAJOR DIVISION			LOG SYMBOLS	UCS	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS	GRAVELS (MORE THAN HALF COARSE GRAINS LARGER THAN 4.75 mm)	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
				GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE W_p LESS THAN 4
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE W_p MORE THAN 7
	SANDS (MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75 mm)	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
				SP	POORLY GRADED SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		SANDS WITH FINES		SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW 'A' LINE W_p LESS THAN 4
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE 'A' LINE W_p MORE THAN 7
FINE GRAINED SOILS	SILTS (BELOW 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 50$		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW) WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER 'F'. E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY	
		$W_L > 50$		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS		
	CLAYS (ABOVE 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 30$		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS		
		$30 < W_L < 50$		CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50$		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS (BELOW 'A' LINE)	$W_L < 50$		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		$W_L > 50$		OH	ORGANIC CLAYS OF HIGH PLASTICITY		
	HIGHLY ORGANIC SOILS				Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE
BEDROCK				BR	SEE REPORT DESCRIPTION		
FILL				FILL	SEE REPORT DESCRIPTION		
































NOTE:
1. BOUNDARY CLASSIFICATION POSSESSING CHARACTERISTICS OF TWO GROUPS ARE GIVEN GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL MIXTURE WITH CLAY BINDER BETWEEN 5% AND 12%

SOIL COMPONENTS					
FRACTION		SIEVE SIZE (mm)		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		PASSING	RETAINED	PERCENT	IDENTIFIER
GRAVEL	COARSE	75	19	50 - 35	AND
	FINE	19	4.75		
SAND	COARSE	4.75	2.00	35 – 20	____Y
	MEDIUM	2.00	0.425		
		FINE	0.425	0.080	20 – 10
SILT (non-plastic) or CLAY (plastic)		0.080		10 - 1	TRACE
OVERSIZE MATERIALS					
ROUNDED OR SUB-ROUNDED COBBLES 75 mm TO 200 mm BOULDERS >200 mm			ANGULAR ROCK FRAGMENTS ROCKS > 0.75 m3 IN VOLUME		

MODIFIED UNIFIED SOIL CLASSIFICATION SYSTEM

August 2015

PROJECT: Waterton Lakes NP - Alpine Stables				CLIENT: PWGSC				TESTHOLE NO: TH18-01						
LOCATION: N 5,439,160.2 E 289,156.0								PROJECT NO.: 60581915						
CONTRACTOR: Earth Drilling Company Ltd.				METHOD: Solid Stem Auger/ODEX				ELEVATION (m): 1298.563						
SAMPLE TYPE		 GRAB		 SHELBY TUBE		 SPLIT SPOON		 BULK		 NO RECOVERY		 CORE		
DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION						SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS		ELEVATION (m)
<div>◆ SPT (Standard Pen Test) ◆ (Blows/foot) 20 40 60 80 PLASTIC M.C. LIQUID 10 20 30 40</div>														
0	GP		GRAVEL (50 mm) - road surface GRAVEL - sandy, trace silt, trace cobbles/boulders, brown, damp, well graded									Sloughed to surface Switched to ODEX		1298
1			- dense							1	32			
2	GW		- gravel = 66 %, sand = 26 %, silt/clay = 8 % - pH = 8.51, resistivity = 9,360 ohm-cm, sulphate content = 51.9 mg/L / 11.5 mg/kg / < 0.1 %, chloride content = 29 mg/L / 6.5 mg/kg							2	37			1297
3			- very dense							3				1296
4			SAND - gravelly, some silt, trace clay, moist							4	62			1295
5			- moist to wet, loose - gravel = 22 %, sand = 60 %, silt/clay = 18 %							5				1294
6			- trace gravel							6	7			1293
7	SM		- seepage, compact							7				1292
8			- wet to saturated							8	13			1291
9			- trace bedrock fragments							9				1290
10	BR		BEDROCK - bluish-grey, extremely weak, completely weathered, humid							10	9			1289
										11				
										12	26			

AECOM

LOGGED BY: JE
REVIEWED BY: KT
PROJECT ENGINEER: Anwar Majid

COMPLETION DEPTH: 10.67 m
COMPLETION DATE: 6/26/18

Page 1 of 2

AECOM

LOGGED BY: JE

REVIEWED BY: KT





PROJECT ENGINEER: Anwar Majid


COMPLETION DEPTH: 10.67 m

COMPLETION DATE: 6/26/18

Page 1 of 2

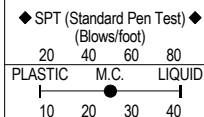
PROJECT: Waterton Lakes NP - Alpine Stables			CLIENT: PWGSC			TESTHOLE NO: TH18-01		
LOCATION: N 5,439,160.2 E 289,156.0						PROJECT NO.: 60581915		
CONTRACTOR: Earth Drilling Company Ltd.				METHOD: Solid Stem Auger/ODEX		ELEVATION (m): 1298.563		
SAMPLE TYPE			<input checked="" type="checkbox"/> GRAB	<input type="checkbox"/> SHELBY TUBE	<input checked="" type="checkbox"/> SPLIT SPOON	<input type="checkbox"/> BULK	<input checked="" type="checkbox"/> NO RECOVERY	<input type="checkbox"/> CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION (m)
10	BR		BEDROCK - continued from previous page		13			
11			END OF TESTHOLE (10.67 m) - at refusal on BEDROCK		14	50/0mm		
12								1287
13								1286
14								1285
15								1284
16								1283
17								1282
18								1281
19								1280
20								1279



LOGGED BY: JE
 REVIEWED BY: KT
 PROJECT ENGINEER: Anwar Majid

COMPLETION DEPTH: 10.67 m
 COMPLETION DATE: 6/26/18
 Page 2 of 2



PROJECT: Waterton Lakes NP - Alpine Stables				CLIENT: PWGSC		TESTHOLE NO: TH18-02	
LOCATION: N 5,439,180.2 E 289,171.0				PROJECT NO.: 60581915			
CONTRACTOR: Earth Drilling Company Ltd.				METHOD: Solid Stem Auger/ODEX		ELEVATION (m): 1299.107	
SAMPLE TYPE		GRAB	SHELBY TUBE	SPLIT SPOON	BULK	NO RECOVERY	CORE
BACKFILL TYPE		BENTONITE	GRAVEL	SLOUGH	GROUT	CUTTINGS	SAND

DEPTH (m)	STANDPIPE	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION (m)
0		OR		TOPSOIL (50 mm) SAND and GRAVEL - some silt, trace cobbles/boulders, brown, damp		1			1299
1				- dense		2	37		1298
2				- moist, compact		3	15		1297
3				- trace clay, dark brown - gravel = 41 %, sand = 45 %, silt/clay = 14 % - pH = 8.19, resistivity = 11,200 ohm-cm, sulphate content = 26.8 mg/L / 6.0 mg/kg / < 0.1 %, chloride content = < 20 mg/L / < 4.4 mg/kg		4			1296
4				- trace oxidation		5	17		1295
5				- trace cobbles		6			1294
6		SM		- trace oxidation		7	24	Sloughed to surface Switched to ODEX	1293
7				- seepage, wet, loose		8			1292
8				- silty, trace clay		9	6		1291
9				- trace oxidation, compact		10			1290
10				- wet		11	23		
11				- trace bedrock fragments		12			
12						13	50/ 51mm	Hard drilling	
13				END OF TESTHOLE (9.30 m) - at refusal on BEDROCK - standpipe installed upon completion of drilling - groundwater level measured at 5.74 mBGS on June 27, 2018					

AECOM	LOGGED BY: JE	COMPLETION DEPTH: 9.30 m
	REVIEWED BY: KT	COMPLETION DATE: 6/25/18
	PROJECT ENGINEER: Anwar Majid	Page 1 of 1

LOG OF TESTHOLE 60581915_WATERTON ALPINE STABLE_TH LOGS.GPJ UMA.GDT 7/18/18

PROJECT: Waterton Lakes NP - Alpine Stables				CLIENT: PWGSC				TESTHOLE NO: TH18-03					
LOCATION: N 5,439,140.2 E 289,170.0								PROJECT NO.: 60581915					
CONTRACTOR: Earth Drilling Company Ltd.				METHOD: Solid Stem Auger/ODEX				ELEVATION (m): 1298.06					
SAMPLE TYPE		GRAB	SHELBY TUBE	SPLIT SPOON	BULK	NO RECOVERY		CORE					
BACKFILL TYPE		BENTONITE	GRAVEL	SLOUGH	GROUT	CUTTINGS		SAND					
DEPTH (m)	STANDPIPE	USC	SOIL SYMBOL	SOIL DESCRIPTION				SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS		ELEVATION (m)
0				GRAVEL and SAND - some silt, trace rootlets near surface, brown, damp									1298
1				- compact				X	1	13			1297
2				- dark brown				X	2	16			1296
				- trace cobbles									
				- gravel = 58 %, sand = 33 %, silt/clay = 9 %					3				
3				- gravel = 45 %, sand = 44 %, silt/clay = 11 %					4	35			1295
				- SPMDD = 2,138 kg/m³, OMC = 7.2 %									
				- CBR values: soaked = 25.3 %, unsoaked = 54.8 %									
				- pH = 8.01, resistivity = 7,210 ohm-cm, sulphate content = 63.4 mg/L / 15.5 mg/kg / < 0.1 %, chloride content = < 20 mg/L / < 4.9 mg/kg									
				- damp to moist, dense					5				1294
4			GP	- dense				X	6	22	Sloughed 1.5 m Switched to ODEX		1293
5									7				
6				- trace to some clay, moist to wet				X	8	8			1292
				- seepage, silty, wet									
7				- trace clay, brown, saturated					9				1291
8			CL	CLAY - silty, some sand, trace gravel, trace bedrock fragments, grey, oxidation, wet to moist, soft				X	10	3			1290
				- trace bedrock fragments					11				
9								X	12	50/ 51mm	>>>		1289
10				END OF TESTHOLE (9.30 m) - at refusal on BEDROCK									
				- standpipe installed upon completion of drilling									
				- groundwater level measured at 5.43 mBGS on June 27, 2018									
				LOGGED BY: JE				COMPLETION DEPTH: 9.30 m					
				REVIEWED BY: KT				COMPLETION DATE: 6/25/18					
				PROJECT ENGINEER: Anwar Majid				Page 1 of 1					

LOG OF TESTHOLE 60581915 WATERTON ALPINE STABLE TH LOGS.GPJ UMA.GDT 7/18/18

PROJECT: Waterton Lakes NP - Alpine Stables				CLIENT: PWGSC				TESTHOLE NO: TH18-04										
LOCATION: N 5,439,140.2 E 289,179.0								PROJECT NO.: 60581915										
CONTRACTOR: Earth Drilling Company Ltd.				METHOD: ODEX				ELEVATION (m): 1297.961										
SAMPLE TYPE		<input checked="" type="checkbox"/> GRAB		<input type="checkbox"/> SHELBY TUBE		<input checked="" type="checkbox"/> SPLIT SPOON		<input type="checkbox"/> BULK		<input checked="" type="checkbox"/> NO RECOVERY		<input type="checkbox"/> CORE						
DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION						SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS		ELEVATION (m)				
															<div>◆ SPT (Standard Pen Test) (Blows/foot) ◆ 20 40 60 80 PLASTIC M.C. LIQUID 10 20 30 40</div>			
0	OR		TOPSOIL (50 mm) GRAVEL and SAND - trace silt, grey, dry, well graded															
1			- trace cobbles/boulders, dry - gravel = 63 %, sand = 31 %, silt/clay = 6 %							1	46			1297				
2			- humid							2	33			1296				
3	GW		- humid to damp, compact							3				1295				
4			- dense							4	20			1294				
5			- brown, moist							5				1293				
6			SAND - some gravel, some silt, trace clay, wet, compact - seepage							6	57			1292				
7	SM		- silty, trace to some gravel, brown, saturated - gravel = 13.6 %, sand = 63.2 %, silt = 15.7 %, clay = 7.5 %							7				1291				
8			CLAY - sandy, silty, trace gravel, trace oxidation, grey, moist to wet, low plastic							8	11			1290				
9	CL		- trace bedrock fragments							9				1289				
10			END OF TESTHOLE (9.30 m) - at refusal on BEDROCK							10	12							
										11								
										12	50/51mm	>>>						
				LOGGED BY: JE				COMPLETION DEPTH: 9.30 m										
				REVIEWED BY: KT				COMPLETION DATE: 6/26/18										
				PROJECT ENGINEER: Anwar Majid				Page 1 of 1										

AECOM

LOGGED BY: JE

REVIEWED BY: KT

PROJECT ENGINEER: Anwar Majid

COMPLETION DEPTH: 9.30 m

COMPLETION DATE: 6/26/18

Page 1 of 1

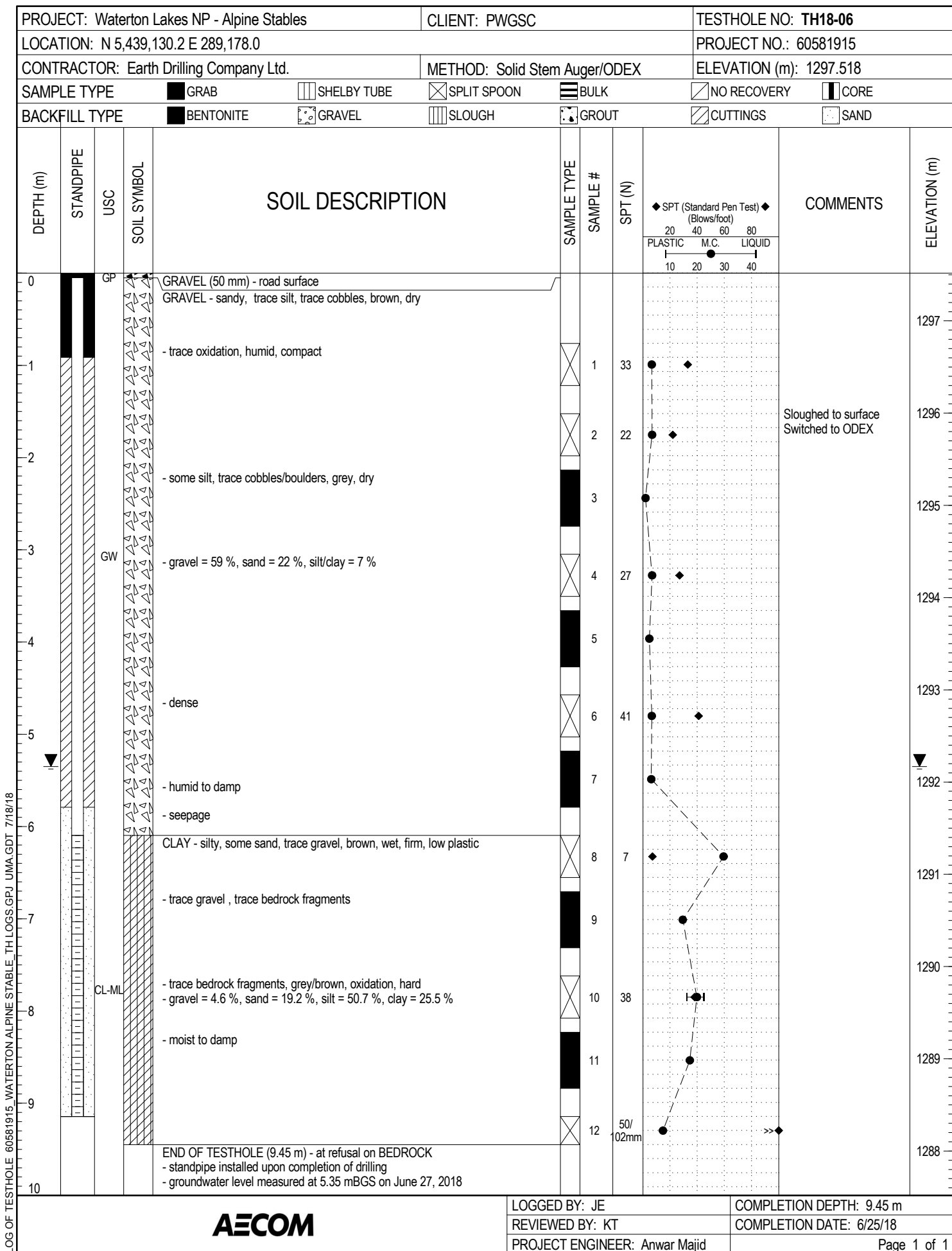
PROJECT: Waterton Lakes NP - Alpine Stables				CLIENT: PWGSC				TESTHOLE NO: TH18-05				
LOCATION: N 5,439,120.2 E 289,170.0								PROJECT NO.: 60581915				
CONTRACTOR: Earth Drilling Company Ltd.				METHOD: ODEX				ELEVATION (m): 1297.2				
SAMPLE TYPE				<input checked="" type="checkbox"/> GRAB <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> SPLIT SPOON <input type="checkbox"/> BULK <input type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE								
<div><div>DEPTH (m)</div><div>USC</div><div>SOIL SYMBOL</div><div>SOIL DESCRIPTION</div><div>SAMPLE TYPE</div><div>SAMPLE #</div><div>SPT (N)</div><div><div>◆ SPT (Standard Pen Test) ◆ (Blows/foot)</div><div>20 40 60 80</div><div>PLASTIC M.C. LIQUID</div><div>10 20 30 40</div></div><div>COMMENTS</div><div>ELEVATION (m)</div></div>												
0	GP		GRAVEL (50 mm) - road surface GRAVEL and SAND - some silt, grey, dry, well graded									1297
1			- trace cobbles/boulders, brown, dense		1	43						1296
2			- very dense - gravel = 49 %, sand = 40 %, silt/clay = 11 % - pH = 8.25, resistivity = 7,670 ohm-cm, sulphate content = 48.5 mg/L / 9.7 mg/kg / < 0.1 % - chloride content = 45 mg/L / 9.0 mg/kg		2	51						1295
3	GW				3							1295
4					4	46					Poor recovery	1294
5			- compact		5							1293
6			- trace clay, damp		6	22						1292
7	SM		SAND - silty, trace gravel, trace clay, very dense - seepage - gravel = 7 %, sand = 44 %, silt/clay = 39 %		7							1291
8			- trace bedrock fragments		8	56						1291
9					9							1290
10	CL		CLAY - silty, some sand, trace bedrock fragments, grey, humid, hard, low plastic - bedrock fragments, completely weathered		10	35						1289
11					11							1289
12					12	50/25mm					>>>	1288
END OF TESTHOLE (9.45 m) - at refusal on BEDROCK												

AECOM

LOGGED BY: JE
REVIEWED BY: KT
PROJECT ENGINEER: Anwar Majid

COMPLETION DEPTH: 9.45 m
COMPLETION DATE: 6/26/18

Page 1 of 1



LOG OF TESTHOLE 60581915_WATERTON ALPINE STABLE_TH LOGS.GPJ UMA.GDT 7/18/18

Appendix **B**

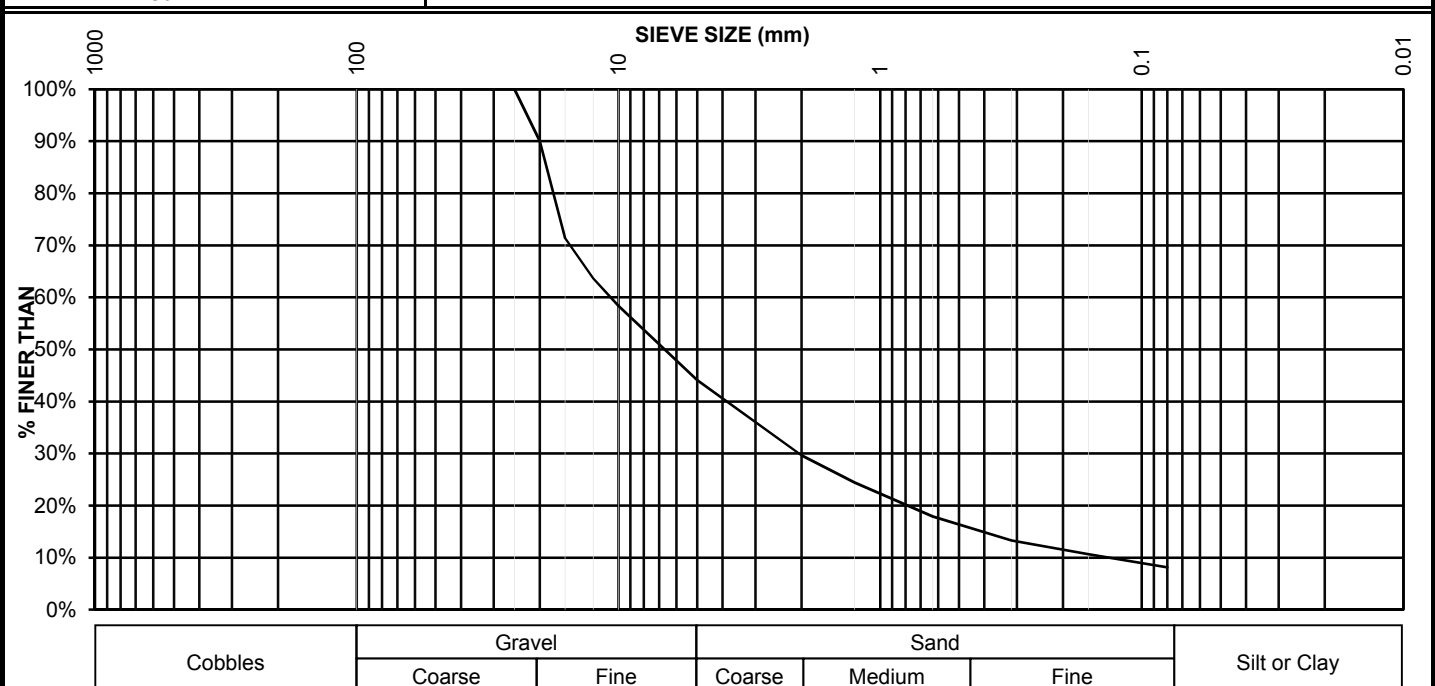
Laboratory Test Results

SIEVE ANALYSIS (ASTM C136)

CLIENT :	Parks Canada		
PROJECT :	Waterton Lakes National Park - Alpine Stables		
JOB No. :	60581915	DESIGNATION:	
LOCATION :		SAMPLE:	2
TESTHOLE:	18-01	DEPTH :	
DATE :	04-Jul-18	TECHNICIAN :	GU

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	SPECIFICATION	
		APPROX. INCHES	mm				LOWER	UPPER
Before Washing	100000	6	100.0			100%		
Wet + Tare	80000	3	80.0			100%		
Dry+Tare 469.6	50000	2	50.0			100%		
Tare 260.8	40000	1 1/2	40.0			100%		
Wt. Dry 208.8	25000	1	25.0			100%		
Moisture Content	20000	3/4	20.0	20.9	10%	90%		
Wet + Tare	16000	5/8	16.0	59.8	29%	71%		
Dry+Tare	12500	1/2	12.5	75.9	36%	64%		
Tare	10000	3/8	10.0	86.9	42%	58%		
MC (%)	5000	0.1969	5.00	116.7	56%	44%		
Passing								
After Washing	2000	0.0787	2.00	146.9	70%	30%		
Wt. Dry+Tare	1250	0.0492	1.25	157.8	76%	24%		
Tare	630	0.0248	0.630	171.4	82%	18%		
Wt. Dry	315	0.0124	0.315	181.1	87%	13%		
Tare No.	160	0.0063	0.160	186.6	89%	11%		
	80	0.0031	0.080	191.8	92%	8%		
	PAN							

Classification:	GW-GM	Description and Remarks:
Cc	2.9	
Cu	77	

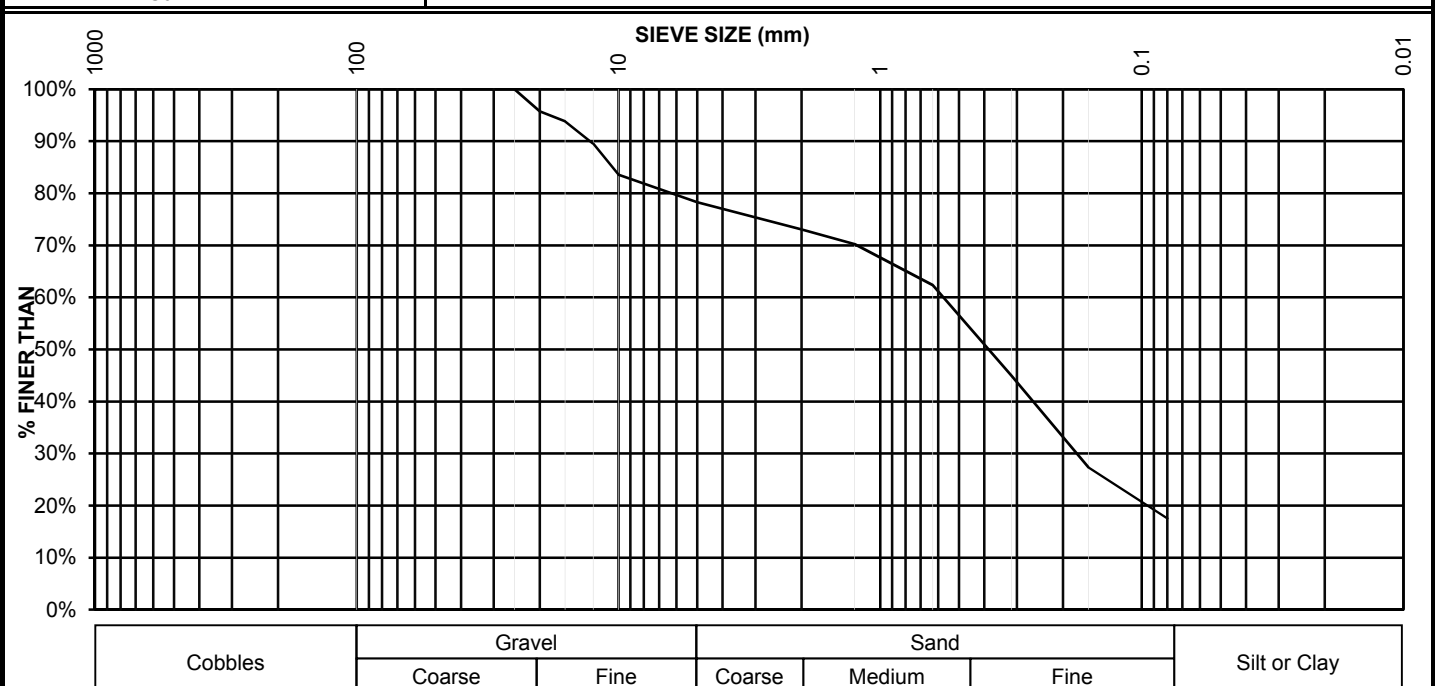


SIEVE ANALYSIS (ASTM C136)

CLIENT :	Parks Canada		
PROJECT :	Waterton Lakes National Park - Alpine Stables		
JOB No. :	60581915	DESIGNATION:	
LOCATION :		SAMPLE:	6
TESTHOLE:	18-01	DEPTH :	
DATE :	04-Jul-18	TECHNICIAN :	GU

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	SPECIFICATION	
		APPROX. INCHES	mm				LOWER	UPPER
Before Washing	100000	6	100.0			100%		
Wet + Tare	80000	3	80.0			100%		
Dry+Tare 618.7	50000	2	50.0			100%		
Tare 263.3	40000	1 1/2	40.0			100%		
Wt. Dry 355.4	25000	1	25.0			100%		
Moisture Content	20000	3/4	20.0	15.2	4%	96%		
Wet + Tare	16000	5/8	16.0	22.0	6%	94%		
Dry+Tare	12500	1/2	12.5	37.2	10%	90%		
Tare	10000	3/8	10.0	58.5	16%	84%		
MC (%)	5000	0.1969	5.00	77.2	22%	78%		
Passing								
After Washing	2000	0.0787	2.00	95.9	27%	73%		
Wt. Dry+Tare	1250	0.0492	1.25	105.9	30%	70%		
Tare	630	0.0248	0.630	133.8	38%	62%		
Wt. Dry	315	0.0124	0.315	195.6	55%	45%		
Tare No.	160	0.0063	0.160	258.4	73%	27%		
	80	0.0031	0.080	293.1	82%	18%		
	PAN							

Classification:	SM or SC	Description and Remarks:
Cc	#N/A	
Cu	#N/A	

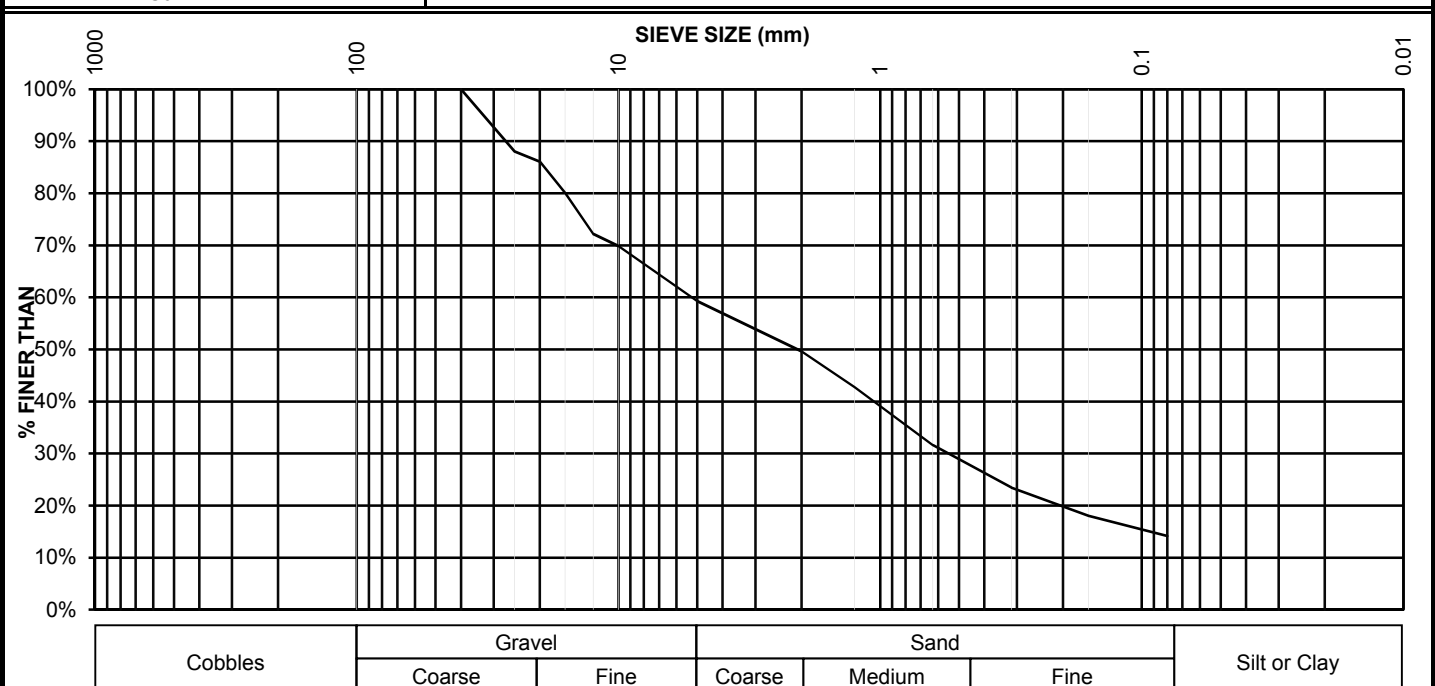


SIEVE ANALYSIS (ASTM C136)

CLIENT :	Parks Canada		
PROJECT :	Waterton Lakes National Park - Alpine Stables		
JOB No. :	60581915	DESIGNATION:	
LOCATION :		SAMPLE:	4
TESTHOLE:	18-02	DEPTH :	
DATE :	04-Jul-18	TECHNICIAN :	GU

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	SPECIFICATION	
		APPROX. INCHES	mm				LOWER	UPPER
Before Washing	100000	6	100.0			100%		
Wet + Tare	80000	3	80.0			100%		
Dry+Tare 717.3	50000	2	50.0			100%		
Tare 238.1	40000	1 1/2	40.0			100%		
Wt. Dry 479.2	25000	1	25.0	57.4	12%	88%		
Moisture Content	20000	3/4	20.0	66.8	14%	86%		
Wet + Tare	16000	5/8	16.0	95.6	20%	80%		
Dry+Tare	12500	1/2	12.5	133.2	28%	72%		
Tare	10000	3/8	10.0	144.5	30%	70%		
MC (%)	5000	0.1969	5.00	195.3	41%	59%		
Passing								
After Washing	2000	0.0787	2.00	241.5	50%	50%		
Wt. Dry+Tare	1250	0.0492	1.25	274.4	57%	43%		
Tare	630	0.0248	0.630	327.8	68%	32%		
Wt. Dry	315	0.0124	0.315	367.0	77%	23%		
Tare No.	160	0.0063	0.160	392.8	82%	18%		
	80	0.0031	0.080	411.3	86%	14%		
	PAN							

Classification:	SM or SC	Description and Remarks:
Cc	#N/A	
Cu	#N/A	

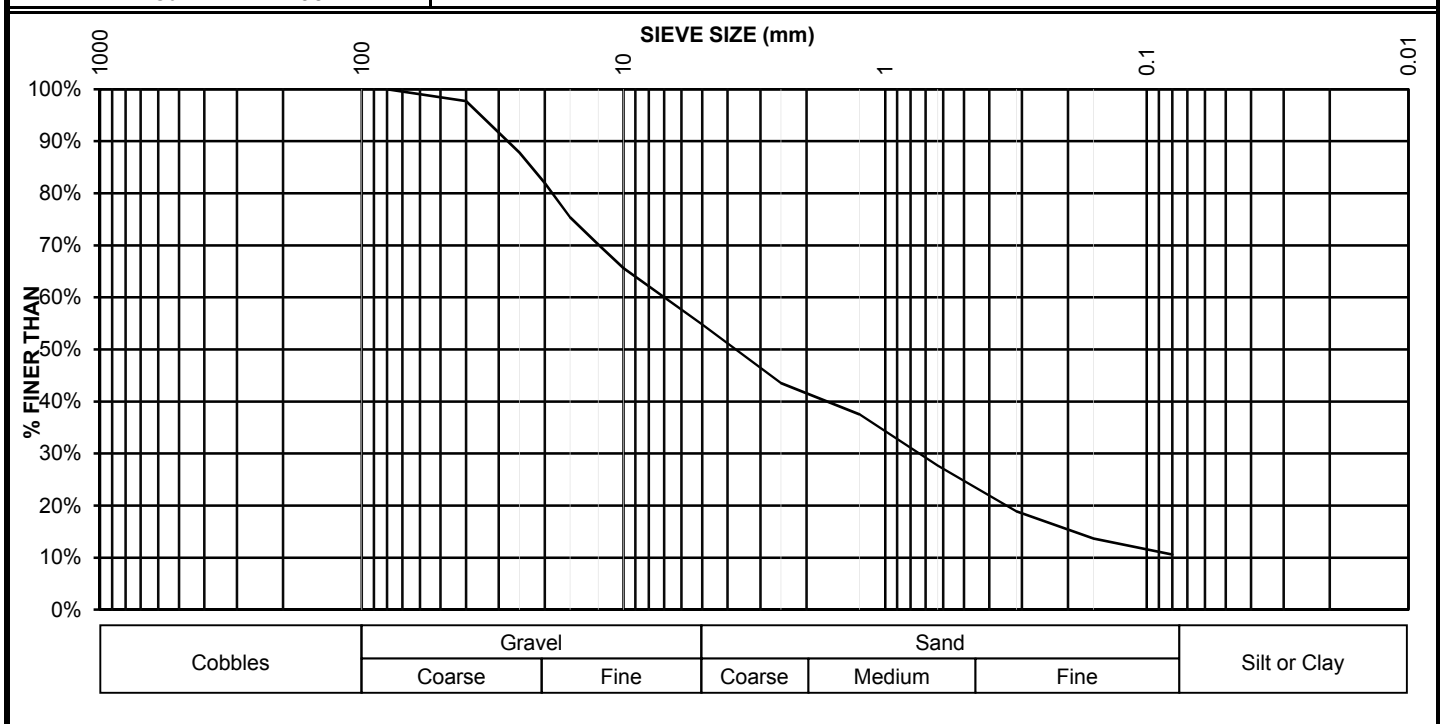


SIEVE ANALYSIS (ASTM C136)

CLIENT :	Parks Canada		
PROJECT :	Waterton Lakes National Park - Alpine Stables		
JOB No. :	60581915	DESIGNATION:	
LOCATION :		SAMPLE:	#4 & #3 Combined
TESTHOLE:	18-02 & 18-03	DEPTH :	
DATE :	05-Jul-18	TECHNICIAN :	CK

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	SPECIFICATION	
		APPROX. INCHES	mm				LOWER	UPPER
Before Washing	100000	6	100.0			100%		
Wet + Tare	80000	3	80.0			100%		
Dry+Tare	50000	2	50.0	262.8	1%	99%		
Tare	40000	1 1/2	40.0	571.9	2%	98%		
Wt. Dry 24720.2	25000	1	25.0	3018.6	12%	88%		
Moisture Content	20000	3/4	20.0	4465.0	18%	82%		
Wet + Tare 740.0	16000	5/8	16.0	6088.4	25%	75%		
Dry+Tare 730.8	12500	1/2	12.5	7374.0	30%	70%		
Tare 13.6	10000	3/8	10.0	8509.7	34%	66%		
MC (%) 1.3%	5000	0.1969	5.00	11183.5	45%	55%		
Passing								
After Washing	2500	0.0984	2.50	13953.0	56%	44%		
Wt. Dry+Tare	1250	0.0492	1.25	15443.4	62%	38%		
Tare	630	0.0248	0.630	17873.4	72%	28%		
Wt. Dry	315	0.0124	0.315	20058.7	81%	19%		
Tare No.	160	0.0063	0.160	21351.4	86%	14%		
	80	0.0031	0.080	22106.9	89%	11%		
	PAN							

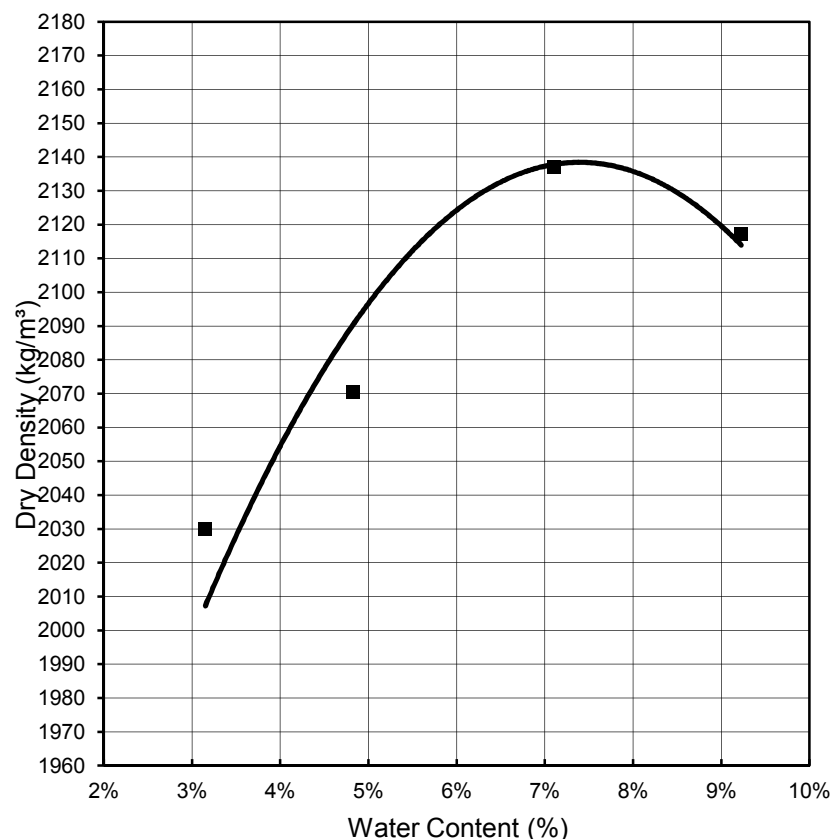
Classification:	GW-GM	Description and Remarks:
Cc	1.0	
Cu	93	



PROCTOR TEST (ASTM D698)

CLIENT : Parks Canada
PROJECT : Waterton Lakes National Park - Alpine Stables
JOB No. : 60581915
LOCATION : **SAMPLE:** #4 & #3 Combined
BOREHOLE: 18-02 & 18-03 **DEPTH :**
DATE : 4-Jul-18 **TECHNICIAN :** GU

TRIAL No.	1	2	3	4		
DENSITY DETERMINATION						
Mould Number						
Volume of Mould (cm³)	2133.0	2133.0	2133.0	2133.0		
Wt. Sample (wet+mould)(g)	10912.6	11075.7	11328.4	11378.9		
Wt. Mould (g)	6446.2	6446.2	6446.2	6446.2		
Wet Density (kg/m³)	2094	2170	2289	2313		
Dry Density (kg/m³)	2030	2071	2137	2117		
WATER CONTENT DETERMINATION						
Tare Number						
Wt. Sample (wet+tare)(g)	755.3	597.2	534.1	731.5		
Wt. Sample (dry+tare)(g)	732.6	570.3	499.5	670.8		
Wt. Tare (g)	12.5	12.8	12.9	13.0		
Wt. Dry Soil (g)	720.1	557.5	486.6	657.8		
Wt. Water (g)	22.7	26.9	34.6	60.7		
Water Content (%)	3.2%	4.8%	7.1%	9.2%		



At Optimum:		
Water Content		7.2%
Dry Density (kg/m³)		2138
<hr/>		
Method of Compaction:	D-698	
Dia. of Mould (cm):	15	
No. of Layers:	3	
No. Blows per Layer:	56	
Ht. of Free Fall (cm):	30	
Wt. of Tamper (g)	4500	
Shape of Tamping Face:	FLAT	
<hr/>		
Description of Sample:		
Gravel (GW-GM) with some sand and some silt, 18% rock >20mm		
<hr/>		
Rock Corrections:		
% Rock	Density	Optimum
5%	2162	6.9%
10%	2187	6.5%
15%	2212	6.2%
20%	2238	5.8%
<hr/>		
Remarks:		

Remarks:

C.B.R. TEST (ASTM D1883)

CLIENT :		Parks Canada	
PROJECT :		Waterton Lakes National Park - Alpine Stables	
JOB No. :		60581915	
LOCATION :		SAMPLE: #4 & #3 Combined	
TESTHOLE: 18-02 & 18-03		DEPTH :	
DATE : July 5, 2018		TECHNICIAN : CK	

Density Determination		Water Content Determination		
Mould Number		Wt. Sample (wet+tare) (g)	Before	After
Wt. Sample (wet+mould) (g)	9045	Wt. Sample (dry+tare) (g)	1320	1223
Wt. Mould (g)	4184	Wt. Tare	1246	1148
Wt Sample (wet) (g)	4861	Wt. Dry Soil (g)	198	198
Volume of Mould	2125	Wt. Water (g)	1048	950
Wet Density (kg/m³)	2287	Water Content (%)	74	75
Dry Density (kg/m³)	2136		7.1%	7.9%

Expansion Test				Water Content Data - Soaked Sample Top 25 mm	
Expansion (mm)	Reading (0.001 in)	Date	Elapsed Time	Tare Number	
NA	0	5-Jul-18	0	Wt. Sample (wet+tare) (g)	781
0.0635	2.5	7-Jul-18	48	Wt. Sample (dry+tare) (g)	726
0.0762	3	9-Jul-18	96	Wt. Tare	155
				Wt. Dry Soil (g)	572
				Wt. Water (g)	55
				Moisture Content (%)	9.7%

Penetration Test Data							
Before Soaking				After Soaking			
Dial Reading	Penetration (in)	Load (N)	Pressure (MPa)	Dial Reading	Penetration (in)	Load (N)	Pressure (MPa)
0	0.000	-87	0.00	0	0.000	-87	0.00
46	0.025	1887	1.02	9	0.025	312	0.21
88	0.050	3780	2.00	23	0.050	932	0.53
125	0.075	5528	2.90	47	0.075	1930	1.04
163	0.100	7232	3.78	78	0.100	3287	1.74
199	0.125	8754	4.57	107	0.125	4695	2.47
230	0.150	10060	5.24	138	0.150	6149	3.22
259	0.175	11322	5.90	168	0.175	7427	3.88
287	0.200	12584	6.55	197	0.200	8666	4.52
377	0.300	16651	8.65	296	0.300	13014	6.77
454	0.400	20114	10.44	371	0.400	16376	8.51
530	0.500	23388	12.13	435	0.500	19301	10.02

C.B.R. Value Unsoaked:	54.8	C.B.R. Value Soaked:	25.3
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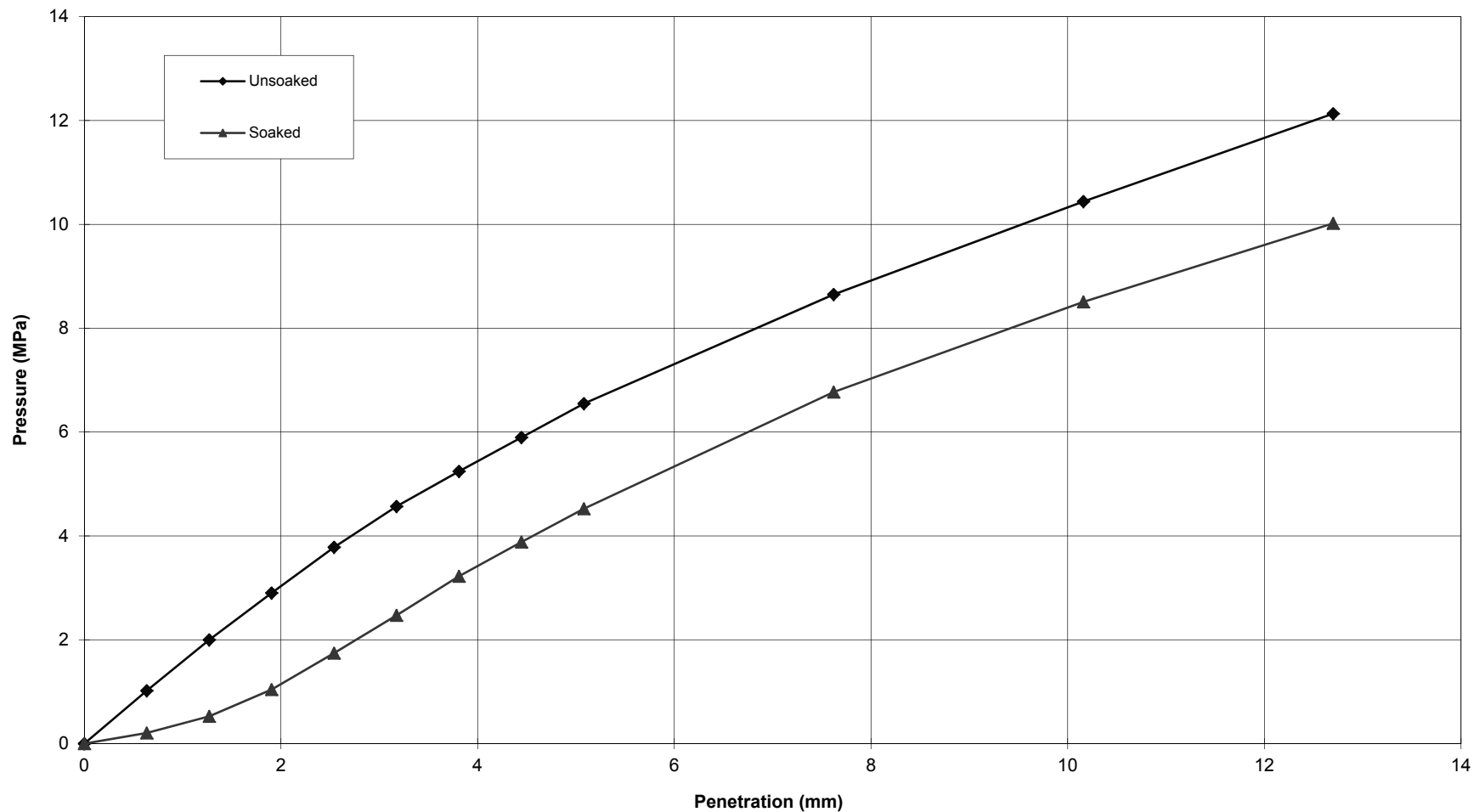
SUMMARY	
Before Soaking	After Soaking
CBR at 0.1" Penetration	54.8
Surcharge (lb)	10
Method of Compaction	STD
RING #	25967
Moisture Content (%)	7.1%
Dry Density (kg/m³)	2136
CBR at 0.1" Penetration	25.3
Surcharge (lb)	10
Soaked for (days)	4
Swell (mm)	0.0762
Moisture Content (%)	7.9%
Dry Density (kg/m³)	2120

SAMPLE DESCRIPTION :	REMARKS :
Gravel (GW-GM) with some sand and some silt, 18% rock >20mm	

C.B.R. TEST (ASTM D1883)

CLIENT : Parks Canada
PROJECT : Waterton Lakes National Park - Alpine Stables
JOB No. : 60581915
LOCATION :
BOREHOLE: 18-02 & 18-03
DATE : July 5, 2018

SAMPLE: #4 & #3 Combined
DEPTH :
TECHNICIAN : CK

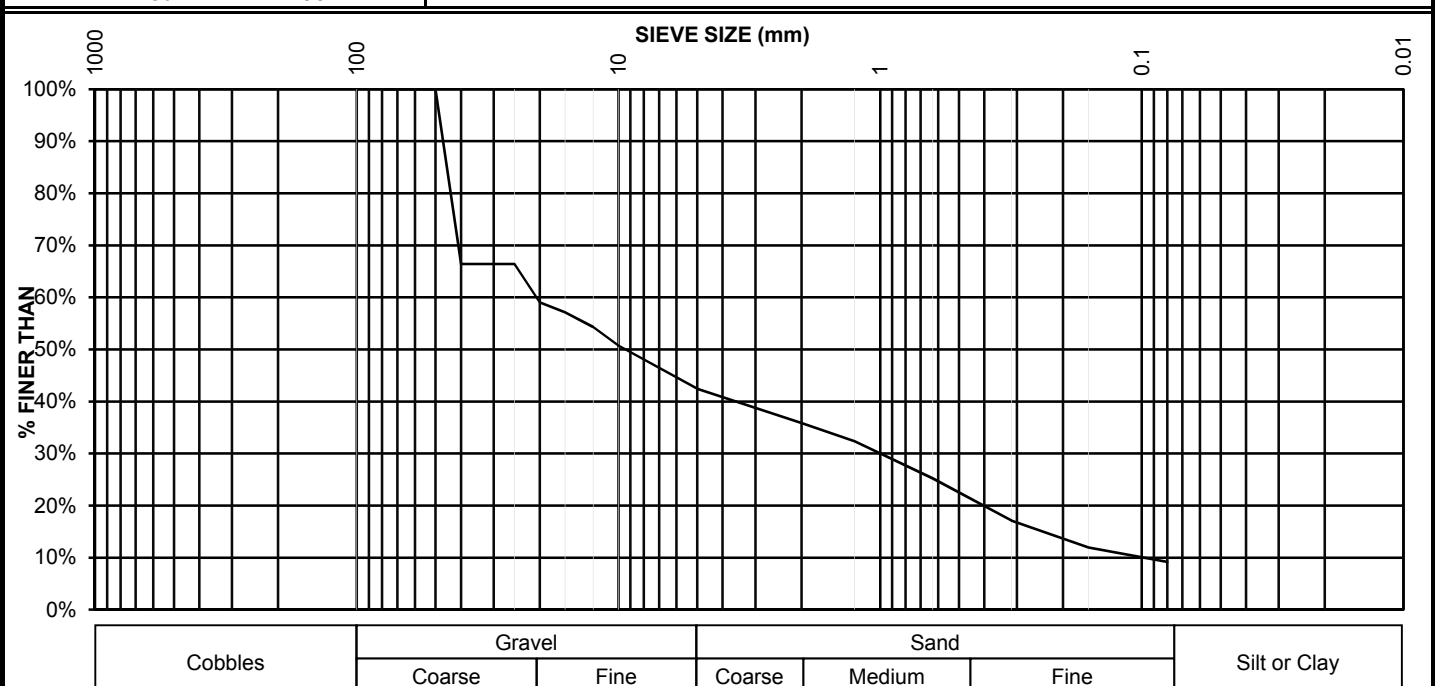


SIEVE ANALYSIS (ASTM C136)

CLIENT :	Parks Canada		
PROJECT :	Waterton Lakes National Park - Alpine Stables		
JOB No. :	60581915	DESIGNATION:	
LOCATION :		SAMPLE:	3
TESTHOLE:	18-03	DEPTH :	
DATE :	04-Jul-18	TECHNICIAN :	GU

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	SPECIFICATION	
		APPROX. INCHES	mm				LOWER	UPPER
Before Washing	100000	6	100.0			100%		
Wet + Tare	80000	3	80.0			100%		
Dry+Tare 762.6	50000	2	50.0			100%		
Tare 250.7	40000	1 1/2	40.0	172.1	34%	66%		
Wt. Dry 511.9	25000	1	25.0	172.1	34%	66%		
Moisture Content	20000	3/4	20.0	209.7	41%	59%		
Wet + Tare	16000	5/8	16.0	219.4	43%	57%		
Dry+Tare	12500	1/2	12.5	233.9	46%	54%		
Tare	10000	3/8	10.0	252.3	49%	51%		
MC (%)	5000	0.1969	5.00	294.8	58%	42%		
Passing								
After Washing	2000	0.0787	2.00	328.3	64%	36%		
Wt. Dry+Tare	1250	0.0492	1.25	346.3	68%	32%		
Tare	630	0.0248	0.630	382.7	75%	25%		
Wt. Dry	315	0.0124	0.315	424.3	83%	17%		
Tare No.	160	0.0063	0.160	450.8	88%	12%		
	80	0.0031	0.080	464.8	91%	9%		
	PAN							

Classification:	GP-GM	Description and Remarks:
Cc	0.5	
Cu	200	

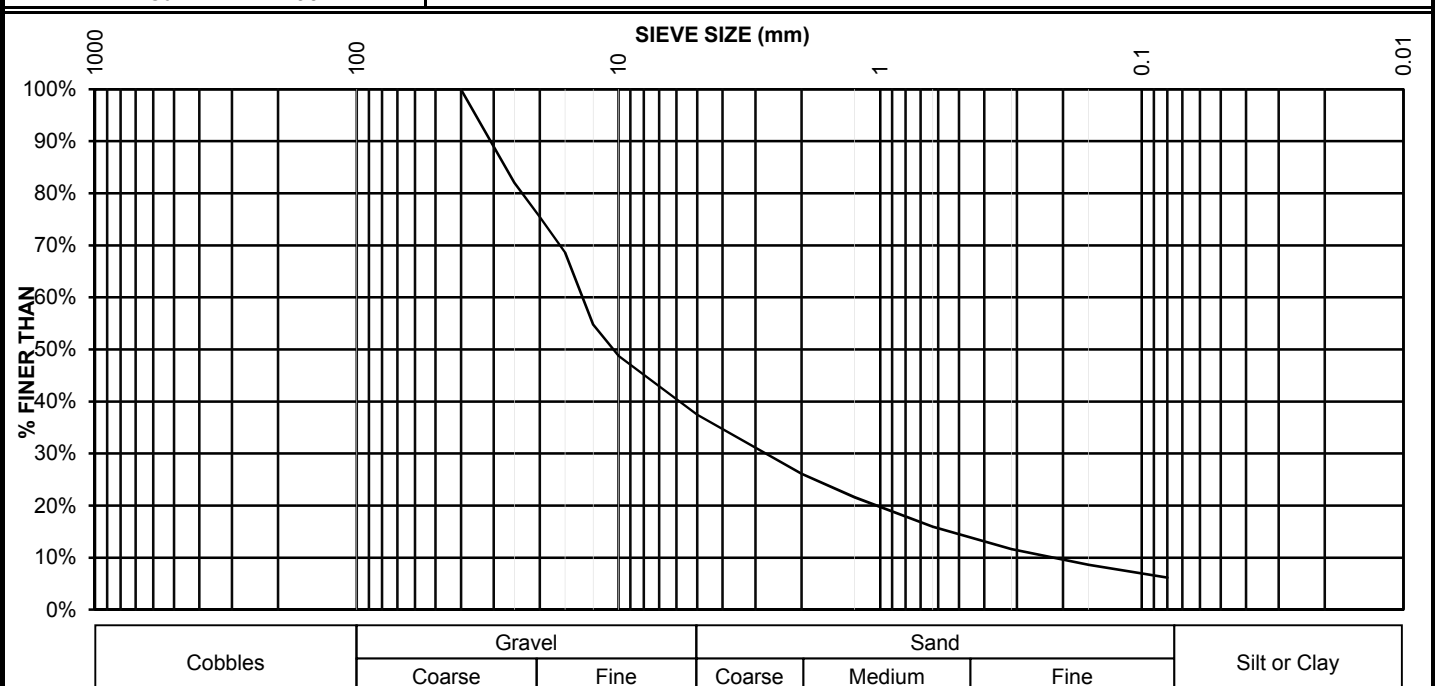


SIEVE ANALYSIS (ASTM C136)

CLIENT :	Parks Canada		
PROJECT :	Waterton Lakes National Park - Alpine Stables		
JOB No. :	60581915	DESIGNATION:	
LOCATION :		SAMPLE:	2
TESTHOLE:	18-04	DEPTH :	
DATE :	04-Jul-18	TECHNICIAN :	GU

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	SPECIFICATION	
		APPROX. INCHES	mm				LOWER	UPPER
Before Washing	100000	6	100.0			100%		
Wet + Tare	80000	3	80.0			100%		
Dry+Tare 575.6	50000	2	50.0			100%		
Tare 253.5	40000	1 1/2	40.0			100%		
Wt. Dry 322.1	25000	1	25.0	57.9	18%	82%		
Moisture Content	20000	3/4	20.0	79.1	25%	75%		
Wet + Tare	16000	5/8	16.0	101.1	31%	69%		
Dry+Tare	12500	1/2	12.5	145.8	45%	55%		
Tare	10000	3/8	10.0	165.1	51%	49%		
MC (%)	5000	0.1969	5.00	201.5	63%	37%		
Passing								
After Washing	2000	0.0787	2.00	238.2	74%	26%		
Wt. Dry+Tare	1250	0.0492	1.25	252.6	78%	22%		
Tare	630	0.0248	0.630	270.8	84%	16%		
Wt. Dry	315	0.0124	0.315	284.6	88%	12%		
Tare No.	160	0.0063	0.160	294.4	91%	9%		
	80	0.0031	0.080	302.2	94%	6%		
	PAN							

Classification:	GW	Description and Remarks:
Cc	2.9	
Cu	60	



GRAIN SIZE ANALYSIS (ASTM D422)

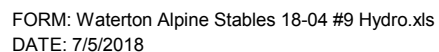
CLIENT : Parks Canada
PROJECT : Waterton Lakes National Park - Alpine Stables
JOB No. : 60581915
LOCATION :
TESTHOLE: 18-04
DATE : July 3, 2018
SAMPLE: 9
DEPTH :
TECHNICIAN : CK

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	REMARKS
		APPROX. INCHES	mm				
<u>Before Washing</u>	150,000	6	150.0		0%	100%	
Wet + Tare	75,000	3	75.0		0%	100%	
Dry+Tare 997.8	50,000	2	50.0		0%	100%	
Tare 100.0	40,000	1 1/2	40.0		0%	100%	
Wt. Dry 897.8	25,000	1	25.0		0%	100%	
<u>Moisture Content</u>	20,000	3/4	20.0		0%	100%	
Wet + Tare	16,000	5/8	16.0	17.4	2%	98.1%	
Dry+Tare	12,500	1/2	12.5	39.3	4%	95.6%	
Tare	10,000	3/8	10.0	64.1	7%	92.9%	
MC (%)	5,000	0.185	5.0	121.8	14%	86.4%	
Passing							
<u>After Washing</u>	2,000	0.0937	2.0	183.9	20%	79.5%	
Wt. Dry+Tare	1,250	0.0469	1.25	229.6	26%	74.4%	
Tare	630	0.0234	0.63	302.4	34%	66.3%	
Wt. Dry	315	0.0116	0.315	405.2	45%	54.9%	
Tare No.	160	0.0059	0.160	539.4	60%	39.9%	
	75	0.00295	0.075	689.3	77%	23.2%	
PAN							
HYDROMETER DATA	READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	PERCENT FINER THAN	REMARKS
Wt Dry+Tare 997.8	18	0.5	0.067	23	14	22.4%	
Wt Tare 100.0	17	1	0.048	23	13	20.9%	
Wt Dry 897.8	16	2	0.034	23	12	18.5%	
Sample Size : 50	14	5	0.022	23	10	16.1%	
Wt Retained 2 mm: 183.9	12	15	0.013	23	8	13.0%	
% Passing 2 mm: 79.5%	11	30	0.009	23	7	11.4%	
Specific Gravity : 2.70	10	60	0.006	23	6	9.8%	
Hydrometer No.: 43-9856	10	120	0.005	23	6	9.1%	
Solution (g/L) : 40	9	240	0.003	23	5	8.3%	
	8	1440	0.001	23	4	6.7%	
	8	2880	0.001	23	4	5.9%	

CLIENT :	Parks Canada
PROJECT :	Waterton Lakes National Park - Alpine Stables
JOB No. :	60581915
LOCATION :	
TESTHOLE:	18-04
DATE :	July 3, 2018

SAMPLE: 9
DEPTH :
TECHNICIAN : CK

Clay = 7.5%

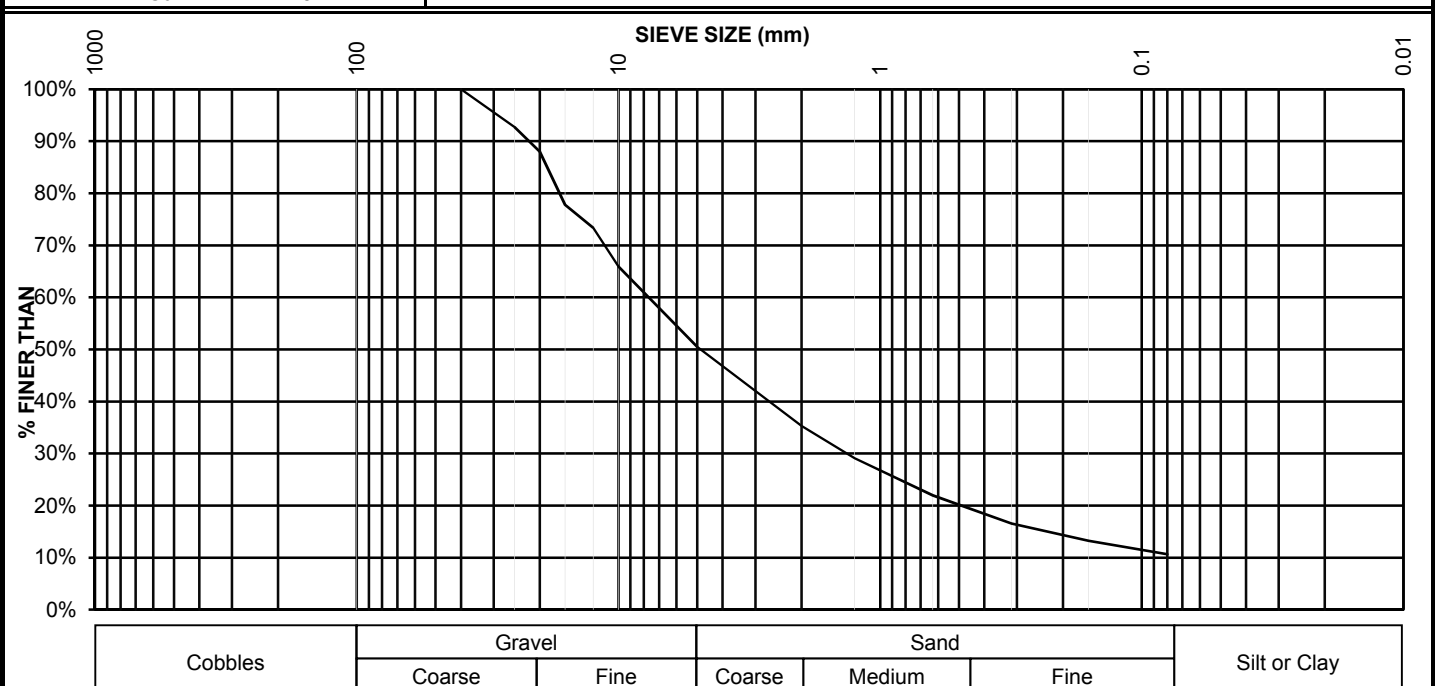


SIEVE ANALYSIS (ASTM C136)

CLIENT :	Parks Canada		
PROJECT :	Waterton Lakes National Park - Alpine Stables		
JOB No. :	60581915	DESIGNATION:	
LOCATION :		SAMPLE:	2
TESTHOLE:	18-05	DEPTH :	
DATE :	04-Jul-18	TECHNICIAN :	GU

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	SPECIFICATION	
		APPROX. INCHES	mm				LOWER	UPPER
Before Washing	100000	6	100.0			100%		
Wet + Tare	80000	3	80.0			100%		
Dry+Tare 723.7	50000	2	50.0			100%		
Tare 299.8	40000	1 1/2	40.0			100%		
Wt. Dry 423.9	25000	1	25.0	30.9	7%	93%		
Moisture Content	20000	3/4	20.0	50.9	12%	88%		
Wet + Tare	16000	5/8	16.0	94.2	22%	78%		
Dry+Tare	12500	1/2	12.5	112.9	27%	73%		
Tare	10000	3/8	10.0	144.4	34%	66%		
MC (%)	5000	0.1969	5.00	209.8	49%	51%		
Passing								
After Washing	2000	0.0787	2.00	274.4	65%	35%		
Wt. Dry+Tare	1250	0.0492	1.25	300.7	71%	29%		
Tare	630	0.0248	0.630	330.9	78%	22%		
Wt. Dry	315	0.0124	0.315	353.7	83%	17%		
Tare No.	160	0.0063	0.160	367.9	87%	13%		
	80	0.0031	0.080	378.7	89%	11%		
	PAN							

Classification:	GW-GM	Description and Remarks:
Cc	2.9	
Cu	101	

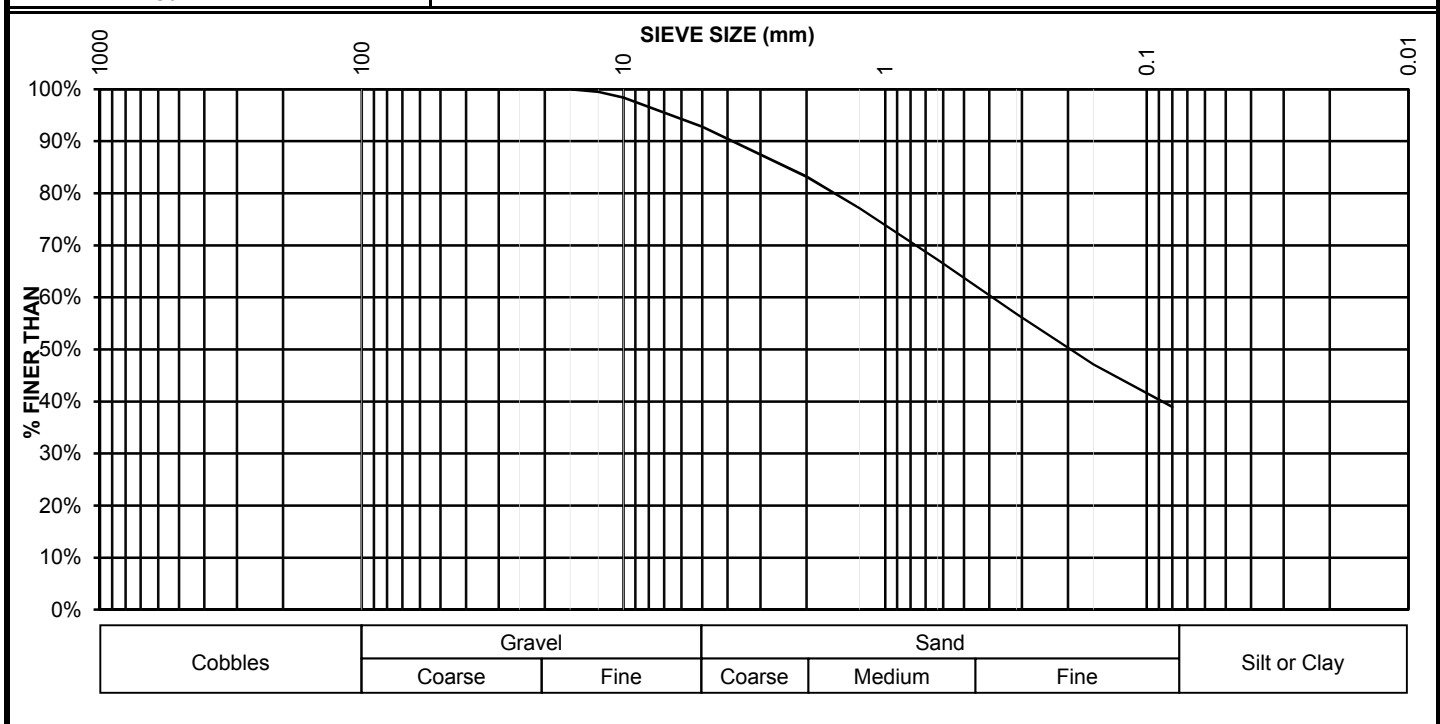


SIEVE ANALYSIS (ASTM C136)

CLIENT :	Parks Canada		
PROJECT :	Waterton Lakes National Park - Alpine Stables		
JOB No. :	60581915	DESIGNATION:	
LOCATION :		SAMPLE:	9
TESTHOLE:	18-05	DEPTH :	
DATE :	04-Jul-18	TECHNICIAN :	GU

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	SPECIFICATION	
		APPROX. INCHES	mm				LOWER	UPPER
Before Washing	100000	6	100.0			100%		
Wet + Tare	80000	3	80.0			100%		
Dry+Tare 847.6	50000	2	50.0			100%		
Tare 251.7	40000	1 1/2	40.0			100%		
Wt. Dry 595.9	25000	1	25.0			100%		
Moisture Content	20000	3/4	20.0			100%		
Wet + Tare	16000	5/8	16.0			100%		
Dry+Tare	12500	1/2	12.5	3.0	1%	99%		
Tare	10000	3/8	10.0	9.6	2%	98%		
MC (%)	5000	0.1969	5.00	43.1	7%	93%		
Passing								
After Washing	2000	0.0787	2.00	100.1	17%	83%		
Wt. Dry+Tare	1250	0.0492	1.25	136.4	23%	77%		
Tare	630	0.0248	0.630	195.4	33%	67%		
Wt. Dry	315	0.0124	0.315	257.5	43%	57%		
Tare No.	160	0.0063	0.160	315.4	53%	47%		
	80	0.0031	0.080	364.0	61%	39%		
	PAN							

Classification:	SM or SC	Description and Remarks:
Cc	#N/A	
Cu	#N/A	

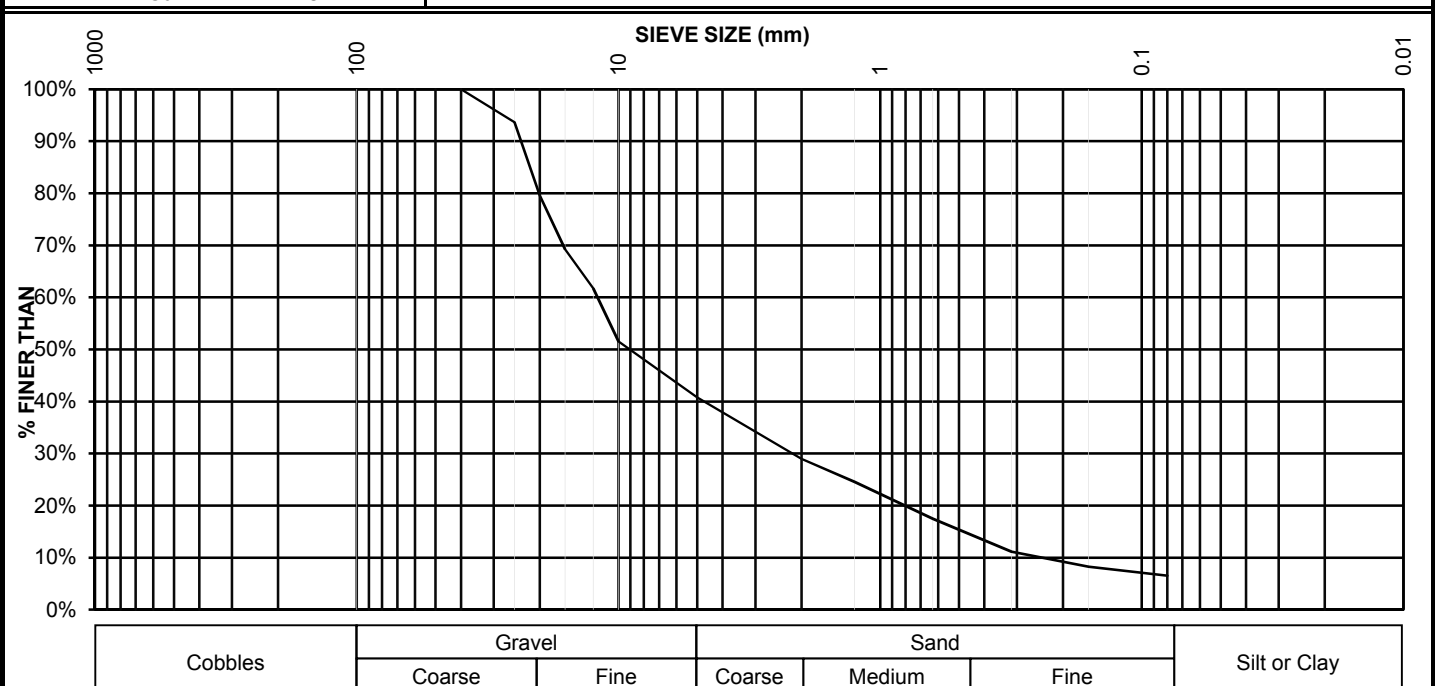


SIEVE ANALYSIS (ASTM C136)

CLIENT :	Parks Canada		
PROJECT :	Waterton Lakes National Park - Alpine Stables		
JOB No. :	60581915	DESIGNATION:	
LOCATION :		SAMPLE:	4
TESTHOLE:	18-06	DEPTH :	
DATE :	04-Jul-18	TECHNICIAN :	GU

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	SPECIFICATION	
		APPROX. INCHES	mm				LOWER	UPPER
Before Washing	100000	6	100.0			100%		
Wet + Tare	80000	3	80.0			100%		
Dry+Tare 721.1	50000	2	50.0			100%		
Tare 296.9	40000	1 1/2	40.0			100%		
Wt. Dry 424.2	25000	1	25.0	27.1	6%	94%		
Moisture Content	20000	3/4	20.0	86.8	20%	80%		
Wet + Tare	16000	5/8	16.0	130.4	31%	69%		
Dry+Tare	12500	1/2	12.5	162.3	38%	62%		
Tare	10000	3/8	10.0	205.7	48%	52%		
MC (%)	5000	0.1969	5.00	251.3	59%	41%		
Passing								
After Washing	2000	0.0787	2.00	301.2	71%	29%		
Wt. Dry+Tare	1250	0.0492	1.25	320.0	75%	25%		
Tare	630	0.0248	0.630	350.1	83%	17%		
Wt. Dry	315	0.0124	0.315	376.9	89%	11%		
Tare No.	160	0.0063	0.160	389.3	92%	8%		
	80	0.0031	0.080	396.5	93%	7%		
	PAN							

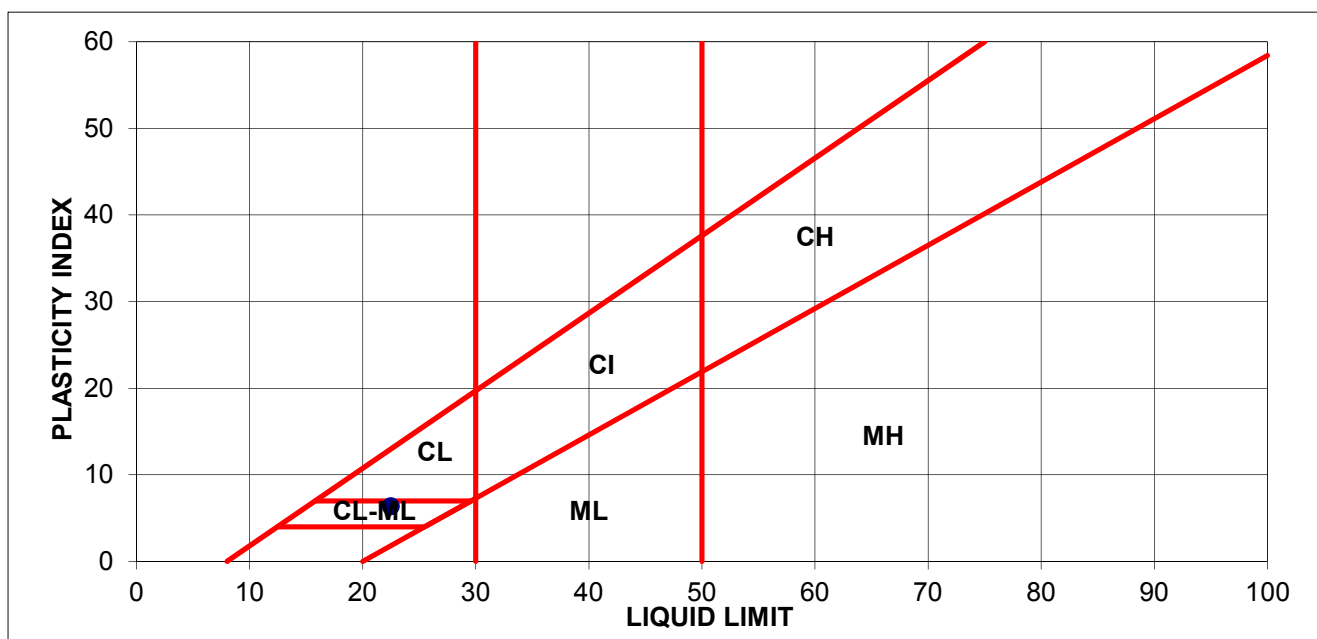
Classification:	GW	Description and Remarks:
Cc	1.7	
Cu	48	



ATTERBERG LIMITS (ASTM D4318)

CLIENT : Parks Canada
 PROJECT : Waterton Lakes National Park - Alpine Stables
 JOB No. : 60581915
 LOCATION :
 TESTHOLE: 18-06
 DATE : July 4, 2018
 SAMPLE: 10
 DEPTH :
 TECHNICIAN : GU

LIQUID LIMIT						
Trial No.	1					
Number of Blows	21					
Container Number						
Wt. Sample (wet+tare)(g)	62.23					
Wt. Sample (dry+tare)(g)	53.32					
Wt. Tare (g)	14.53					
Wt. Dry Soil (g)	38.8					
Wt. Water (g)	8.9					
Water Content (%)	23.0%					
AVERAGE VALUES				PLASTIC LIMIT		
Liquid Limit	22.5			Trial No.	1	
Plastic Limit	16.1			Container Number		
Plasticity Index	6.4			Wt. Sample (wet+tare)(g)	32.74	
SAMPLE DESCRIPTION				Wt. Sample (dry+tare)(g)	29.84	
Classification: CL-ML				Wt. Tare (g)	11.86	
				Wt. Dry Soil (g)	18.0	
				Wt. Water (g)	2.9	
				Water Content (%)	16.1%	



GRAIN SIZE ANALYSIS (ASTM D422)

CLIENT : Parks Canada
PROJECT : Waterton Lakes National Park - Alpine Stables
JOB No. : 60581915
LOCATION :
TESTHOLE: 18-06
DATE : July 3, 2018
SAMPLE: 10
DEPTH :
TECHNICIAN : CK

TOTAL DRY WEIGHT OF SAMPLE	SIEVE NO. (µm)	SIZE OF OPENING		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	REMARKS
		APPROX. INCHES	mm				
<u>Before Washing</u>	150,000	6	150.0		0%	100%	
Wet + Tare	75,000	3	75.0		0%	100%	
Dry+Tare 496.9	50,000	2	50.0		0%	100%	
Tare 100.0	40,000	1 1/2	40.0		0%	100%	
Wt. Dry 396.9	25,000	1	25.0		0%	100%	
<u>Moisture Content</u>	20,000	3/4	20.0		0%	100%	
Wet + Tare	16,000	5/8	16.0		0%	100%	
Dry+Tare	12,500	1/2	12.5	4.1	1%	99.0%	
Tare	10,000	3/8	10.0	7.3	2%	98.2%	
MC (%)	5,000	0.185	5.0	18.2	5%	95.4%	
Passing							
<u>After Washing</u>	2,000	0.0937	2.0	32.4	8%	91.8%	
Wt. Dry+Tare	1,250	0.0469	1.25	39.0	10%	90.2%	
Tare	630	0.0234	0.63	48.4	12%	87.8%	
Wt. Dry	315	0.0116	0.315	55.7	14%	86.0%	
Tare No.	160	0.0059	0.160	63.7	16%	83.9%	
	75	0.00295	0.075	94.4	24%	76.2%	
PAN							
HYDROMETER DATA	READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	PERCENT FINER THAN	REMARKS
Wt Dry+Tare 496.9	45	0.5	0.055	23	41	75.0%	
Wt Tare 100.0	44	1	0.039	23	40	73.2%	
Wt Dry 396.9	42	2	0.028	23	38	69.6%	
Sample Size : 50	37	5	0.019	23	33	60.5%	
Wt Retained 2 mm: 32.4	32	15	0.011	23	28	51.4%	
% Passing 2 mm: 91.8%	28	30	0.008	23	24	44.1%	
Specific Gravity : 2.70	25	60	0.006	23	21	38.6%	
Hydrometer No.: 43-9856	22	120	0.004	23	18	33.2%	
Solution (g/L) : 40	20	240	0.003	23	16	29.5%	
	16	1440	0.001	23	12	21.4%	
	14	2880	0.001	23	10	18.6%	

GRAIN SIZE ANALYSIS (ASTM D422)

CLIENT : Parks Canada
PROJECT : Waterton Lakes National Park - Alpine Stables
JOB No. : 60581915
LOCATION :
TESTHOLE : 18-06
DATE : July 3, 2018

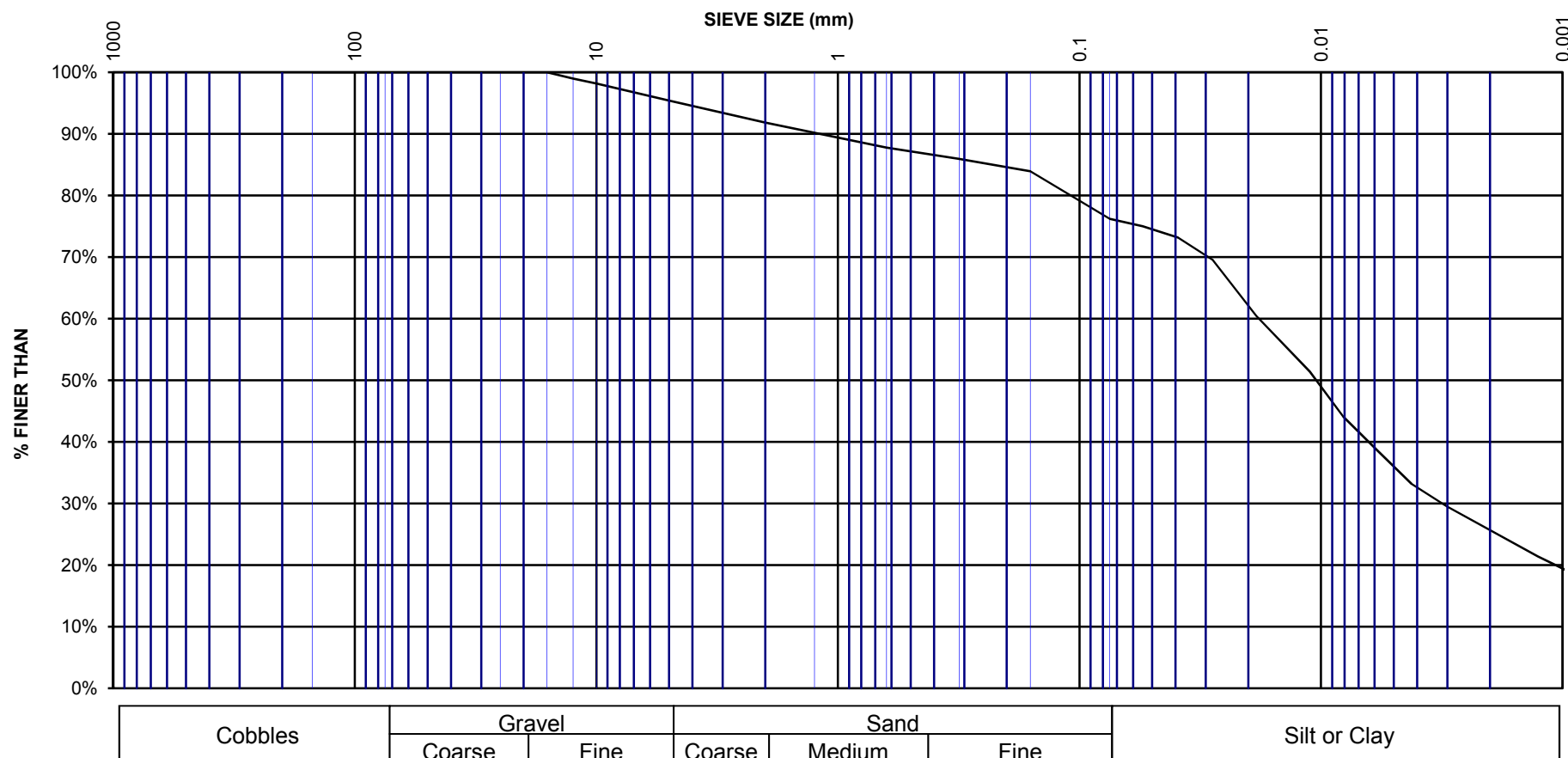
SAMPLE: 10
DEPTH :
TECHNICIAN : CK

Gravel = 4.6%

Sand = 19.2%

Silt = 50.7%

Clay = 25.5%





AECOM Canada Ltd.
ATTN: Chris Keeley
Suite 300, 48 Quarry Park Blvd SE
Calgary AB T2C 5P2

Date Received: 03-JUL-18
Report Date: 17-JUL-18 17:02 (MT)
Version: FINAL

Client Phone: 403-254-3301

Certificate of Analysis

Lab Work Order #: L2122714
Project P.O. #: NOT SUBMITTED
Job Reference: PARKS CANADA - WATERTON LAKES NP- ALPINE STABLES
C of C Numbers:
Legal Site Desc:

Comments: Note: Total Sulphate Ion Content (SO₄- T- CSA- A23- ED) results were <0.2% for all samples, therefore Water Soluble Sulphate Ion Content (SO₄- S- CSA- A23- ED) not required for analysis.

Nelson Kwan, B.Sc.
Account Manager

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ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALSCANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2122714-1 PARKS CANADA - WATERTON LAKES Sampled By: N/A on 03-JUL-18 Matrix: soil Miscellaneous Parameters % Saturation Chloride (Cl) Resistivity Sulfur (as SO4) Total Sulphate Ion Content pH in Saturated Paste Salinity in mg/kg Chloride (Cl) Sulfur (as SO4)		NP-ALPINE STABLES	TH18	01 #2		16-JUL-18		
		22.2		1.0	%		16-JUL-18	R4128548
		29		20	mg/L		17-JUL-18	R4130472
		9360		1.0	ohm cm		16-JUL-18	R4128007
		51.9		6.0	mg/L		17-JUL-18	R4131130
		0.061		0.050	%	16-JUL-18	16-JUL-18	R4128227
		8.51		0.10	pH		16-JUL-18	R4128548
		6.5		4.4	mg/kg		17-JUL-18	
		11.5		1.3	mg/kg		17-JUL-18	
L2122714-2 PARKS CANADA - WATERTON LAKES Sampled By: N/A on 03-JUL-18 Matrix: soil Miscellaneous Parameters % Saturation Chloride (Cl) Resistivity Sulfur (as SO4) Total Sulphate Ion Content pH in Saturated Paste Salinity in mg/kg Chloride (Cl) Sulfur (as SO4)		NP-ALPINE STABLES	TH18	02 #4		16-JUL-18		
		22.2		1.0	%		16-JUL-18	R4128548
		<20		20	mg/L		17-JUL-18	R4130472
		11200		1.0	ohm cm		16-JUL-18	R4128007
		26.8		6.0	mg/L		17-JUL-18	R4131130
		<0.050		0.050	%	16-JUL-18	16-JUL-18	R4128227
		8.19		0.10	pH		16-JUL-18	R4128548
		<4.4		4.4	mg/kg		17-JUL-18	
		6.0		1.3	mg/kg		17-JUL-18	
L2122714-3 PARKS CANADA - WATERTON LAKES Sampled By: N/A on 03-JUL-18 Matrix: soil Miscellaneous Parameters % Saturation Chloride (Cl) Resistivity Sulfur (as SO4) Total Sulphate Ion Content pH in Saturated Paste Salinity in mg/kg Chloride (Cl) Sulfur (as SO4)		NP-ALPINE STABLES	TH18	03 #3		16-JUL-18		
		24.4		1.0	%		16-JUL-18	R4128548
		<20		20	mg/L		17-JUL-18	R4130472
		7210		1.0	ohm cm		16-JUL-18	R4128007
		63.4		6.0	mg/L		17-JUL-18	R4131130
		<0.050		0.050	%	16-JUL-18	16-JUL-18	R4128227
		8.01		0.10	pH		16-JUL-18	R4128548
		<4.9		4.9	mg/kg		17-JUL-18	
		15.5		1.5	mg/kg		17-JUL-18	
L2122714-4 PARKS CANADA - WATERTON LAKES Sampled By: N/A on 03-JUL-18 Matrix: soil Miscellaneous Parameters % Saturation Chloride (Cl) Resistivity Sulfur (as SO4) Total Sulphate Ion Content pH in Saturated Paste Salinity in mg/kg Chloride (Cl) Sulfur (as SO4)		NP-ALPINE STABLES	TH18	05 #2		16-JUL-18		
		20.0		1.0	%		16-JUL-18	R4128548
		45		20	mg/L		17-JUL-18	R4130472
		7670		1.0	ohm cm		16-JUL-18	R4128007
		48.5		6.0	mg/L		17-JUL-18	R4131130
		0.061		0.050	%	16-JUL-18	16-JUL-18	R4128227
		8.25		0.10	pH		16-JUL-18	R4128548
		9.0		4.0	mg/kg		17-JUL-18	
		9.7		1.2	mg/kg		17-JUL-18	

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2122714-4	PARKS CANADA - WATERTON LAKES	NP-ALPINE STABLES-TH18	05 #2					
Sampled By:	N/A on 03-JUL-18							
Matrix:	soil							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-PASTE-COL-CL	Soil	Chloride in Soil (Paste) by Colorimetry	CSSS, APHA 4500-Cl E
A soil extract produced by the saturated paste extraction procedure is analyzed for Chloride by Colourimetry.			
PH-PASTE-CL	Soil	pH in Saturated Paste	CSSS Ch. 15
A soil extract produced by the saturated paste extraction procedure is analyzed by pH meter.			
RESISTIVITY-PASTE-CL	Soil	PASTE RESISTIVITY	ASTM G57-95A
This analysis is carried out using procedures adapted from ASTM G57-95a (2001) "Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method". In summary, 200 to 500 grams of sample is mixed with deionized water as required to create a saturated paste. The sample is then placed directly into a four electrode resistivity soil box and measured for resistivity using a resistivity meter.			
SAL-MG/KG-CALC-CL	Soil	Salinity in mg/kg	Manual Calculation
SAT-PCNT-CL	Soil	% Saturation	CSSS 18.2-Calculation
Saturation Percentage (SP) is the total volume of water present in a saturated paste (in mL) divided by the dry weight of the sample (in grams), expressed as a percentage, as described in "Soil Sampling and Methods of Analysis" by M. Carter.			
SO4-PASTE-ICP-CL	Soil	Sulphate (SO4)	CSSS CH15/EPA 6010B
A soil extract produced by the saturated extraction procedure is analyzed for sulfate by ICPOES.			
SO4-T-CSA-A23-ED	Soil	Total Sulphate Ion Content	CSA INTERNATIONAL A23.2
Total sulphate content is determined by mixing soil with water then hydrochloric acid, and digesting just below boiling point, for 15 minutes. Analysis by ion chromatography follows.			
NOTE: the CSA-A23 method states that for a total sulphate ion content greater than 0.2%, soluble sulphate ion content shall be determined on the basis of a water extraction. This water extraction requires the total sulphate ion content result to calculate the correct ratio for the water extraction.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg ww - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2122714

Report Date: 17-JUL-18

Page 1 of 2

Client: AECOM Canada Ltd.
Suite 300, 48 Quarry Park Blvd SE
Calgary AB T2C 5P2

Contact: Chris Keeley

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-PASTE-COL-CL	Soil							
Batch R4130472								
WG2823932-4 IRM		SAL-STD9						
Chloride (Cl)			107.2		%		70-130	17-JUL-18
WG2823932-3 LCS								
Chloride (Cl)			106.9		%		70-130	17-JUL-18
WG2823932-1 MB								
Chloride (Cl)			<20		mg/L		20	17-JUL-18
PH-PASTE-CL	Soil							
Batch R4128548								
WG2823932-4 IRM		SAL-STD9						
pH in Saturated Paste			7.59		pH		7.23-7.83	16-JUL-18
RESISTIVITY-PASTE-CL	Soil							
Batch R4128007								
WG2823580-2 IRM		SAL-STD9						
Resistivity			86.9		%		70-130	16-JUL-18
WG2823580-1 LCS								
Resistivity			126.2		%		70-130	16-JUL-18
SAT-PCNT-CL	Soil							
Batch R4128548								
WG2823932-4 IRM		SAL-STD9						
% Saturation			99.7		%		80-120	16-JUL-18
SO4-PASTE-ICP-CL	Soil							
Batch R4131130								
WG2823932-4 IRM		SAL-STD9						
Sulfur (as SO4)			86.2		%		70-130	17-JUL-18
WG2823932-1 MB								
Sulfur (as SO4)			<6.0		mg/L		6	17-JUL-18
SO4-T-CSA-A23-ED	Soil							
Batch R4128227								
WG2823070-3 CRM		ED-634A CEMENT						
Total Sulphate Ion Content			104.5		%		80-120	16-JUL-18
WG2823070-2 LCS								
Total Sulphate Ion Content			95.9		%		70-130	16-JUL-18
WG2823070-1 MB								
Total Sulphate Ion Content			<0.050		%		0.05	16-JUL-18

Quality Control Report

Workorder: L2122714

Report Date: 17-JUL-18

Page 2 of 2

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0376a v09 Page 004 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System** please submit using an **Authorized DW COC form**

