



Parks  
Canada

Parcs  
Canada

## **SPECIFICATIONS**

# **CYPRUS LAKE CAMPGROUND HEAD OF TRAILS RENEWAL VISITOR RECEPTION & WASHROOM BUILDING**

**PROJECT 947-05**

**August 16, 2018**

**ISSUED FOR TENDER**

---

<b>Division 1</b>	<b>General Requirements</b>
01 11 00	Summary of Work
01 29 00	Payment Procedures
01 29 83	Payment Procedures for Laboratory Testing Services
01 31 00	Project Management and Coordination
01 33 00	Submittal Procedures
01 35 29	Health, Safety and Emergency Response Procedures
01 35 35	Fire Safety Requirements
01 35 43	Environmental Procedures
01 45 00	Quality Control
01 51 00	Temporary Utilities
01 52 00	Construction Facilities
01 55 26	Traffic Control
01 56 00	Temporary Barriers and Enclosures
01 61 00	Common Product Requirements
01 73 03	Execution
01 74 00	Cleaning and Waste Management
01 74 21	Construction/Demolition Waste Management and Disposal
01 78 00	Closeout Submittals
01 79 00	Demonstration and Training
<b>Division 3</b>	<b>Concrete</b>
03 10 00	Concrete Forming and Accessories
03 20 00	Concrete Reinforcing
03 30 00	Cast-in-Place Concrete
03 35 00	Concrete Finishing
03 35 33	Stamped Concrete Finishing
<b>Division 4</b>	<b>Masonry</b>
04 22 00	Masonry Veneer
<b>Division 5</b>	<b>Metals</b>
Not Used	
<b>Division 6</b>	<b>Wood, Plastics and Composites</b>
06 10 00	Rough Carpentry
06 18 00	Glued-Laminated Construction
<b>Division 7</b>	<b>Thermal and Moisture Protection</b>
07 21 13	Board Insulation
07 21 16	Blanket Insulation
07 26 00	Vapour Retarders
07 27 39	Vapour Permeable Air Barrier Membrane
07 41 13	Metal Roof Panels
07 46 23	Wood Siding

07 62 00	Sheet Metal Flashing and Trim
07 71 36	Metal Fascia, Gutters and Rainwater Goods
07 92 00	Joint Sealants

**Division 8 Doors and Windows**

08 11 00	Metal Doors and Frames
08 33 13	Overhead Coiling Counter Shutters
08 36 16	Sectional Overhead Insulated Metal Doors
08 51 13	Aluminum Windows
08 71 00	Door Hardware
08 80 00	Glazing

**Division 9 Finishes**

09 21 16	Gypsum Board Assemblies
09 70 10	Seamless Epoxy Coatings
09 91 00	Painting

**Division 10 Specialties**

10 28 00	Toilet and Bath Accessories
10 91 13	Miscellaneous Specialties

**Division 21 Fire Protection**

21 30 50	Portable Fire Extinguishers
----------	-----------------------------

**Division 22 Plumbing**

22 41 50	Plumbing Piping
22 42 00	Plumbing Specialties
22 44 00	Plumbing Fixtures

**Division 23 Heating, Ventilating and Air Conditioning (HVAC)**

23 01 00	Mechanical General Requirements
23 02 00	Testing, Adjusting and Balancing
23 10 00	Common Work Results
23 10 50	Mechanical Identification
23 15 00	Service Penetrations
23 16 00	Bases, Hangers and Supports
23 81 00	Ductwork
23 81 20	Ductwork Accessories
23 82 50	Fans
23 84 50	Grilles and Diffusers

**Division 26 Electrical**

26 05 00	General Electrical Requirements
26 05 05	Basic Materials and Methods
26 05 26	Grounding
26 05 43	Electrical Site Services and Underground Ducts
26 09 24	Lighting Control Devices
26 24 16.01	Panelboards and Circuit Breakers
26 50 00	Lighting

**Division 31 Earthwork**

31 11 00	Clearing and Grubbing
31 22 13	Rough Grading
31 23 16.26	Rock Removal
31 23 33	Excavation, Trenching and Backfilling

**Division 32 Exterior Improvements**

32 12 16	Asphalt Paving for Parking Lots and Driveways
32 16 26	Concrete Curbs and Sidewalks
32 91 19	Topsoil Placement and Grading
32 93 10	Landscape Maintenance
32 93 53	Planting of Trees, Shrubs and Groundcovers

**Division 33 Utilities**

33 11 16	Site Water Utility Distribution Piping
33 31 13	Public Sanitary Utility Sewerage Piping
33 36 00	Wastewater Utility Holding Tanks

**Appendices**

Appendix A.	GM BluePlan Engineering Geotechnical Investigation
-------------	--

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Title and description of work.
- .2 Work by others.
- .3 Work sequence.
- .4 Contractor use of premises.

**1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work covered by this Contract will include the construction of a multi-function visitor reception and washroom building. The building will include a bank of individual unisex washroom stalls, consisting of 6 basic stalls and 2 accessible stalls. Additional space will be allocated for a future 'tuck shop' and basic storage. The area shall include an overhead canopy providing an open air reception area with required facilities defining the welcoming space. The Canopy shall cover a semi-circular information desk. Additionally this work will include the demolition of the existing washroom building, removal of the existing septic holding tank and associated piping, installation of a new septic holding tank, bedrock removal, backfilling as necessary, restoration planting, utility implementations, grading works, wood privacy fencing and new building construction. Work in the new washroom building includes electrical solar power and lighting, mechanical and plumbing systems, architectural, structural and site work.
- .2 Please refer to the drawings.

**1.3 WORK BY OTHERS**

- .1 The following are specifically excluded from this Contract:
- .2 The supply and installation of furnishings and signs are not part of this contract unless specifically noted in the documents.
- .3 Site clearing shall be completed by Parks Canada staff.

**1.4 LOCATION OF THE SITE**

- .1 The Project Site is located at the north end of Cyprus Lake Road in the Bruce Peninsula National Park adjacent to P1 parking lot.
- .2 The Bruce Peninsula National Park is located on the east and west side of the Bruce Peninsula, approx. 19km from Tobermory, Ontario which is accessed off Highway 6 from Owen Sound.

**1.5 SITE ACCESS**

- .1 The site can only be accessed from land.

**1.6 WORK SEQUENCE**

- .1 Construct work in stages to accommodate Owner's Seasonal operation.
  - .1 Pre bid meeting shall be scheduled for August 28, 2018.
- .2 The Contractor shall have all work including and commissioning completed by May 31, 2019.
- .3 The construction schedule must be submitted by the Contractor and approved by the Parks Canada Department Representative.

**1.7 CONTRACTOR USE OF PREMISES**

- .1 Contractor has unrestricted use of the construction site until Substantial Performance.
- .2 Contractor shall limit use of premises for Work, to allow:
  - .1 Partial owner occupancy.
  - .2 Work by other contractors.

- .3 Coordinate use of the premises under direction of Department Representative.
- .4 Obtain and pay for use of additional storage or work areas needed for operation under this Contract.

#### 1.8 EXISTING SERVICES

- .1 Notify Consultant and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Consultant 48 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian and vehicular traffic.
- .3 Provide alternative routes for personnel and/or pedestrian and vehicular traffic if required.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify the Parks Canada Department Representative and Consultant of findings.
- .5 Submit schedule to and obtain approval from Consultant for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by the Parks Canada Department Representative/Consultant to maintain critical building and tenant systems.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .8 Where unknown services are encountered, immediately advise the Parks Canada Department Representative/Consultant and confirm findings in writing.
- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .10 Record locations of maintained, re-routed and abandoned service lines.
- .11 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

#### 1.9 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy 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.

#### 1.10 REFERENCES AND CODES

- .1 National Building Code of Canada (NBC) 2010 including all amendments up to closing date.
- .2 Ontario Provincial Standard Specifications (OPSS) including all amendments up to the closing date.

- .3 Perform work in accordance with National Building Code of Canada (NBC) and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .4 Meet or exceed requirements of:
  - .1 Contract documents.
  - .2 Specified standards, codes and referenced documents.

**1.11 HAZARDOUS MATERIAL DISCOVERY**

- .1 Asbestos: Demolition of spray or trowel-applied asbestos can be hazardous to health. Should material resembling spray or trowel-applied asbestos be encountered in course of demolition work, immediately stop work and notify the Parks Canada Department Representative.
- .2 Hazardous Substance report is available for inspection from the Department Representative.

**1.12 BUILDING SMOKING ENVIRONMENT**

- .1 Smoking is prohibited in all workplaces within Parks Canada buildings.
- .2 Although smoking is not permitted in hazardous areas, care must still be exercised in the use of smoking materials in non-restricted areas.

**1.13 WARRANTY**

- .1 Provide a 12 month (one year) warranty period on all materials and workmanship for all components included in this contract. The warranty period shall begin when the project construction and certification has been completed and Parks Canada accepts the project for its intended use.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

1.1 RELATED SECTIONS & DOCUMENTS

- .1 Section 01 29 83: Payment Procedures for Laboratory Testing
- .2 Section 01 31 00: Project Management and Coordination
- .3 Section 01 78 00: Closeout Submittals
- .4 Section 01 79 00: Demonstration & Training

1.2 SECTION INCLUDES

- .1 This section specifies the administrative and procedural requirements governing following:
  - .1 Payment
  - .2 Schedule of Values
  - .3 Application for Payment
  - .4 Holdback

1.3 PAYMENT

- .1 Method of Payment
  - .1 The supply of all materials, labour, tools, equipment, protection, transportation, customs, administrative costs, profits, financing, etc. as necessary to perform the work of this contract are included with the items listed on the tender form, unless otherwise indicated.
  - .2 Costs associated with work for Division 1 and mobilization & demobilization, shall be included in the costs for the items identified on the tender form.
  - .3 Contractors shall provide a schedule of values in the divisional master format per the spec sections and then provide supplemental unit rate adds and subtracts to items that are relevant.
  - .4 All items in this contract to be paid by costs included in the lump sum payments.
  - .5 The Lump Sum Items presented on the Schedule of Value bid form are:
    - .1 **Demolition & Removals:** The lump sum price bid shall include all costs to complete the works shown on the Removals Drawing (D1) including clearing and grubbing, rock excavation, top soil/organic material stripping, all removals, replacements, demolition, disposal and implementation of the erosion and control measures.
    - .2 **Site Related Implementation Items:** The installation of the regular and stamped concrete paving, wood fence, swales, excavation, backfill, grading, placement of fill, as shown on the drawings shall be lump sum price bid and shall include all costs to install the works noted above.
    - .3 **New Utility Servicing (Electrical and Water):** The lump sum price bid shall include all costs to install new services as shown on the drawings, including all connections and rock removal for solar powered electrical and water servicing.
    - .4 **Waste Water and Sanitary Servicing:** The lump sum price bid shall include all costs to extend the sanitary service from the washroom building to a new sanitary holding tank as shown on the drawings, including all connections, rock removal for tank installations and pipe extension to the layby for pump out purposes.
    - .5 **Construction of the New Visitor Reception and Washroom Building, Storage Area, Tuck Shop, and Breezeway:** The lump sum price bid shall include all costs for labour, material and equipment for the construction of the

building including excavation, backfill, foundation, framing, electrical, mechanical and finishes, as shown on the drawings. The lump sum price bid shall also include all costs for a fully functional and finished system in accordance with design contract drawings and specifications, all to the satisfaction of the Department Representative.

- .6 **Planting:** The lump sum bid price shall include all labour, materials, equipment and delivery of plant materials and plant mix to install all planting material as noted on the planting plans and details.

#### 1.4 SCHEDULE OF VALUES

- .1 Submit the initial Schedule of Values to the Parks Canada Department Representative at least two (2) weeks before the initial Application for Payment.
- .2 The Schedule of Values shall be broken down by Division or Specification or per the Tender Form. Use the Summary of Divisions and Specifications (Table of Contents) as a guide to determine the organization of the division names and numbers. The Schedule of Values shall be in a format acceptable to the Parks Canada Department Representative.
- .3 For each Division:
  - .1 For all work completed by the General Contractor, provide a line item description of the work, the dollar amount allocated and the actual amount expended.
  - .2 For each subcontract, provide an itemized listing of the subcontractor name, description of work and the contract amount.
- .4 Changes in the cost allocation shall be approved in writing by the Parks Canada Department Representative. Any approved changes shall be explicitly noted on the Schedule of Values. Include a copy of the Owner's written approval for such changes in the Application for Payment.
- .5 Provide a separate line item for each Change Order to the Contract. Do not allocate cost of change orders to the breakdown of the original contract.
- .6 The allocation of costs in the Schedule of Values must be approved by the Parks Canada Department Representative before an application for payment is made.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE**

- .1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by the Parks Canada Department Representative are specified under various sections.

**1.2 APPOINTMENT AND PAYMENT**

- .1 The Parks Canada Department Representative will appoint and pay for services of testing laboratory except as follows:
  - .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
  - .2 Inspection and testing performed exclusively for Contractor's convenience.
  - .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
  - .4 Mill tests and certificates of compliance.
  - .5 Tests specified to be carried out by Contractor under the supervision of the Parks Canada Department Representative.
  - .6 Additional tests specified in the following paragraph.
- .2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, Contractor to pay costs for additional tests or inspections as required by the Parks Canada Department Representative to verify acceptability of corrected work.

**1.3 CONTRACTORS RESPONSIBILITIES**

- .1 Provide labour, equipment and facilities to:
  - .1 Provide access to Work to be inspected and tested.
  - .2 Facilitate inspection and tests.
  - .3 Make good Work disturbed by inspection and test.
- .2 Notify the Parks Canada Department Representative sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by the Parks Canada Department Representative.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 PROJECT MEETINGS**

- .1 The Parks Canada Department Representative will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.

**1.2 ON-SITE DOCUMENTS**

- .1 Maintain at job site, one copy each of the following:
  - .1 Contract drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Reviewed shop drawings.
  - .5 Change orders.
  - .6 Other modifications to Contract.
  - .7 Field test reports.
  - .8 Copy of approved work schedule.
  - .9 Manufacturer's installation and application instructions.

**1.3 SCHEDULES**

- .1 Contractor to submit a construction progress schedule to the Parks Canada Department Representative within 10 working days of the Contract award and at least 10 working days prior to the submission of the first progress claim. The construction progress schedule must show anticipated progress stages as well as anticipated submittal dates for all samples, shop drawings etc. to be submitted and final completion of the work within the time periods required by the Contract documents.
- .2 During progress of Work revise and resubmit as directed by the Parks Canada Department Representative.

**1.4 CLOSEOUT PROCEDURES**

- .1 Notify the Department Representative when Work is considered ready for Substantial Performance.
- .2 Accompany the Parks Canada Department Representative on preliminary inspection to determine items listed for completion or correction.
- .3 Comply with the Parks Canada Department Representative's instructions for correction of items of Work listed in executed Certificate of Substantial Performance and for access to Owner-occupied areas.
- .4 Notify the Parks Canada Department Representative of completion of items of Work determined in the Department Representative's final inspection.

**1.5 PAYMENTS / SCHEDULE OF VALUES**

- .1 The Contractor shall submit a Schedule of Values to the Parks Canada Department Representative at least two (2) weeks prior to the first application for payment. Submit the Schedule of Values as per Section 01 29 00 Payment Procedures.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Shop drawings and product data.
- .2 Samples.

**1.2 ADMINISTRATIVE**

- .1 Submit to the Parks Canada Department Representative submittals listed for review. Submit with reasonable promptness and in orderly sequence so as not to cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to the Parks Canada Department Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated 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 shall be considered rejected.
- .6 Notify the Parks Canada Department Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by the Department Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by the Parks Canada Department Representative's review.
- .10 Keep one reviewed copy of each submission on site.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and **attachment or anchorage**, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where article or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 10 working days for the Parks Canada Department Representative's review of each submission.
- .4 Adjustments made on shop drawings by Reviewer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Parks Canada Department Representative prior to proceeding with Work.
- .5 Make changes in shop drawings as the Parks Canada Department Representative may require, consistent with Contract Documents. When resubmitting, notify the Parks Canada Department Representative in writing of any revisions other than those requested.
- .6 Delete information not applicable to project.
- .7 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.
- .8 Submissions shall include:
- .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
- .9 Submit an electronic copy of shop drawings for each requirement requested in specification Sections and as the Parks Canada Department Representative may reasonably request with the understanding the Parks Canada Department Representative will retain a copy of the reviewed submission.
- .10 Submit an electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by the Parks Canada Department Representative where shop drawings will not be prepared due to standardized manufacture of product, with the understanding the Parks Canada Department Representative will retain a copy of the reviewed submission.
- .11 Supplement standard information to provide details applicable to project.
- .12 If upon review by the Parks Canada Department 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.

- .13 The review of shop drawings by the Parks Canada Department Representative is for sole purpose of ascertaining conformance with the general concept. This review shall not mean that the Parks Canada Department Representative approves detail design inherent in shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents. Without restricting generally the 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 coordination of Work of all sub-trades.
- .14 After the Department Representative's review, distribute copies.

#### 1.4 SAMPLES

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

#### 1.5 MOCK-UPS

- .1 Erect mock-ups in accordance with 01 45 00 – Quality Control.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 REFERENCES**

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS)
- .3 Province of Ontario
  - .1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. [latest version].

**1.2 SUBMITTALS**

- .1 Make submittals 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 2 copies of Contractor's authorized representative's work site health and safety inspection reports to the Parks Canada Department Representative weekly for information and record purposes only.
- .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.
- .7 The Department Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to the Department Representative within 5 days after receipt of comments from the Parks Canada Department Representative.
- .8 The Parks Canada Department 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 the Parks Canada Department Representative.
- .10 On-site contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

**1.3 OF NOTICE**

- .1 File Notice of Project with Parks Canada Departmental Representative prior to beginning of Work.

**1.4 SAFETY ASSESSMENT**

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

**1.5 MEETINGS**

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

## 1.6 GENERAL REQUIREMENTS

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

## 1.7 RESPONSIBILITY

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

## 1.8 COMPLIANCE REQUIREMENTS

- .1 Comply with Ontario Health and Safety Act and Regulations for Construction Projects, R.S.O.
- .2 Comply with Occupational Health and Safety Regulations, 1996.
- .3 Comply with Canada Labour Code, Canada Occupational Health and Safety Regulations.

## 1.9 UNFORESEEN HAZARDS

- .1 When unforeseen peculiar safety-related factor, hazard or condition occurs 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 Department Representative verbally and in writing.

## 1.10 HEALTH AND SAFETY COORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
  - .1 Have working knowledge of occupational safety and health regulations.
  - .2 Be responsible for completing Contractor's Health and Safety training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .3 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
  - .4 Be on site during execution of Work and report directly to, and be under direction of, site supervisor.

## 1.11 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations and in consultation with the Parks Canada Department Representative.

## 1.12 CORRECTION OF NON-COMPLIANCE

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

**1.13 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.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 FIRE SAFETY BRIEFING**

- .1 Contractor will coordinate arrangements for briefing on Fire Safety at their pre-work conference with Parks Canada Department Representative before any work is commenced.

**1.2 REPORTING FIRES**

- .1 Know location of nearest fire alarm box and telephone, including emergency phone number.
- .2 Report immediately all fire incidents to Fire Department as follows:
  - .1 Activate nearest fire alarm box; or
  - .2 Telephone.
- .3 Person activating fire alarm box will remain at box to direct Fire Department to scene of fire.
- .4 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify location.

**1.3 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS**

- .1 Fire protection and alarm system will not be:
  - .1 Obstructed;
  - .2 Shut-off; and
  - .3 Left inactive at end of working day or shift without authorization from the Parks Canada Department Representative.
- .2 Fire hydrants, standpipes and hose systems will not be used for other than fire-fighting purposes unless authorized by the Parks Canada Department Representative.

**1.4 FIRE EXTINGUISHERS**

- .1 Supply fire extinguishers, necessary to protect work in progress and contractor's physical plant on site.

**1.5 BLOCKAGE OF ROADWAYS**

- .1 Advise the Parks Canada Department Representative of any work that would impede fire apparatus response. This includes violation of minimum overhead clearance, as prescribed by Department Representative, erecting barricades and digging of trenches.

**1.6 SMOKING PRECAUTIONS**

- .1 Smoking is prohibited in all work places within Parks Canada buildings.
- .2 Although smoking is not permitted in hazardous areas, care must still be exercised in the use of smoking materials in non-restricted areas.

**1.7 RUBBISH AND WASTE MATERIALS**

- .1 Rubbish and waste materials are to be kept to a minimum.
- .2 Burning of rubbish is prohibited.
- .3 Removal:
  - .1 Remove all rubbish from work site at end of work day or shift as directed.
- .4 Storage:
  - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
  - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove as required in Section 1.8.

## 1.8 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handling, storage and use of flammable and combustible liquids are to be governed by the current National Fire Code of Canada.
- .2 Flammable and combustible liquids such as gasoline, kerosene and naphtha will be kept for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires permission of the Parks Canada Department Representative.
- .3 Transfer of flammable and combustible liquids is prohibited within buildings or jetties.
- .4 Transfer of flammable and combustible liquids will not be carried out in vicinity of open flames or any type of heat-producing devices.
- .5 Flammable liquids having a flash point below 38°C such as naphtha or gasoline will not be used as solvents or cleaning agents.
- .6 Flammable and combustible waste liquids for disposal, will be stored in approved containers located in a safe ventilated area. Quantities are to be kept to a minimum and Fire Department is to be notified when disposal is required.

## 1.9 HAZARDOUS SUBSTANCES

- .1 Work entailing use of toxic or hazardous materials, chemicals and/or explosives, or otherwise creating hazard to life, safety or health, will be in accordance with National Fire Code of Canada.
- .2 Obtain from the Parks Canada Department Representative a "Hot Work" permit for work involving welding, burning or use of blow torches and salamanders in buildings or facilities.
- .3 When Work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the Department Representative. Contractors are responsible for providing fire watch service for work on a scale established and in conjunction with Parks Canada Department Representative at pre-work conference.
- .4 Where flammable liquids, such as lacquers or urethanes are to be used, proper ventilation will be assured and all sources of ignition are to be eliminated. The Parks Canada Department Representative is to be informed prior to and at cessation of such work.

## 1.10 QUESTIONS AND/OR CLARIFICATION

- .1 Direct any questions or clarification on Fire Safety in addition to above requirements to the Parks Canada Department Representative.

## 1.11 FIRE INSPECTION

- .1 Site inspection by the Parks Canada Department Representative will be coordinated through the Department Representative.
- .2 Allow Fire Chief unrestricted access to work site.
- .3 Cooperate with Department Representative during routine fire safety inspection of work site.
- .4 Immediately remedy all unsafe fire situations observed by Parks Canada Department Representative.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 FIRES**

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

**1.2 DISPOSAL OF WASTES**

- .1 Do not bury rubbish and waste materials on site unless approved by the Parks Canada Department Representative.
- .2 Do not dispose of waste or volatile materials such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

**1.3 DRAINAGE**

- .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .2 Do not pump water containing suspended materials into existing fen areas, sand dune areas, waterways, sewer or drainage systems.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

**1.4 SITE CLEARING AND PLANT PROTECTION**

- .1 Protect trees and all plants on site and adjacent properties where indicated.
- .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2m.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated or designated by the Parks Canada Department Representative.

**1.5 POLLUTION CONTROL**

- .1 Maintain temporary erosion and pollution control features installed under this contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- .5 Refuelling shall be completed on hard surfaces and a minimum of 50m from water bodies.
- .6 Equipment shall be maintained in good working order. Equipment and heavy machinery used shall meet or exceed all applicable emission requirements.
- .7 Ensure spill containment equipment is available on site.
- .8 Prevent any and all hydrocarbons from entering the ground.
- .9 Minimize noise levels from construction activities by using proper muffling devices; in addition to appropriate timing and location of these activities to reduce minimize the effect of noise on nearby residents, recreationists and wildlife.

## 1.6 WILDLIFE PROTECTION

- .1 Eastern Massassauga Rattlesnake, Northern Ribbon Snake and Eastern Milksnake are species at risk and cannot be harmed. If they are found on site, please relocate them away from the site (50m).
- .2 Turtles shall not be harmed, and should be carefully relocated to a gravel or sand area.

## 1.7 SUBMITTALS

- .1 Within 10 days prior to commencing construction activities or the delivery of materials to the site, provide an Environmental Protection Plan for the review and approval of the Parks Canada Department Representative. The Environmental Protection Plan shall include a comprehensive overview of known or potential environmental issues to be addressed during construction.
- .2 Address the topics at a level of detail relative with the environmental issue and required construction tasks.
- .3 The following shall be included in the Environmental Protection Plan:
  - .1 Names of persons responsible for ensuring adherence to the Environmental Protection Plan.
  - .2 Names and qualifications of persons who are responsible for the training of the site personnel.
  - .3 Erosion & Sediment Control Plan shall be followed as provided by Parks Canada including monitoring and reporting requirements to assure that control measures are in compliance with the erosion and sediment control plan.
  - .4 Spill Control Plan including procedures, instructions and reports to be used in the event of unforeseen spill of regulated substances.
  - .5 Contaminant Prevention Plan identifying potentially hazardous substances to be used on the job site; intended actions to prevent the introduction of hazardous substances into the air, water or ground; and detailing provisions for compliance with Federal, Provincial and Municipal laws and regulations for the storage and handling of these materials.

## 1.8 NOTIFICATION

- .1 The Department Representative will notify the Contractor in writing of any observed non-compliance with the Environmental Protection Plan, Federal, Provincial or Municipal Environmental laws or regulations, and permits.
- .2 After the receipt of such notification, the Contractor shall inform the Parks Canada Department Representative of the proposed corrective action and take such action for approval of the Parks Canada Department Representative.
- .3 The Parks Canada Departmental Representative will issue a stop work order until satisfactory corrective action has been taken.
- .4 No time extension will be granted or no equitable adjustments allowed to the Contractor for such suspensions.

## 2 Products

**Not Used**

## 3 Execution

### 3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
  - .1 Leave Work area clean at end of each day.

- .2 Bury rubbish and waste materials on site where directed after receipt of written approval from Parks Canada Departmental Representative.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .5 Waste Management: separate waste materials for reuse / recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Inspection and testing.
- .2 Tests and mix designs.
- .3 Mock-ups.
- .4 Mill tests.
- .5 Equipment and system adjust and balance.

**1.2 INSPECTION**

- .1 Allow the Parks Canada Department Representative access to Work. If part of Work is in preparation at location other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by the Parks Canada Department Representative instructions, or 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 The Parks Canada Department Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents.

**1.3 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged by the Parks Canada Department Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Owner.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, the appointed agency will request additional testing to ascertain full degree of defect. The Contractor shall correct defect and irregularities as advised by the Parks Canada Department Representative at no cost to Owner. The Contractor shall pay costs for retesting and re-inspection.

**1.4 ACCESS TO WORK**

- .1 Allow inspection/testing agencies access to Work, offsite manufacturing and fabrication plants.
- .2 Cooperate to provide reasonable facilities for such access

**1.5 PROCEDURES**

- .1 Notify appropriate agency and the Parks Canada Department Representative in advance of requirements for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay 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.

**1.6 REJECTED WORK**

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by the Parks Canada

Department Representative as failing to conform to Contract Documents. Replace or re- execute in accordance with Contract Documents.

- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in the opinion of the Parks Canada Department Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by the Parks Canada Department Representative.

#### **1.7 REPORTS**

- .1 Submit 4 copies of inspection and test reports to the Parks Canada Department Representative.
- .2 Provide copies to Subcontractor of work being inspected or tested and manufacturer or fabricator of material being inspected or tested.

#### **1.8 TESTS AND MIX DESIGNS**

- .1 Furnish mix results and test designs as may be requested.
- .2 The costs of test and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by the Parks Canada Department Representative and may be authorized as recoverable.

#### **1.9 MOCK-UPS**

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all sections required to provide mock-ups.
- .2 Construct in all locations acceptable to the Parks Canada Department Representative.
- .3 Prepare mock-ups for the Parks Canada Department Representative's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, the Parks Canada Department Representative will assist in preparing a schedule fixing dates for preparation.
- .6 Remove mock-up at conclusion of Work or when acceptable to.
- .7 Mock-ups may remain as part of Work.
- .8 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

#### **1.10 MILL TESTS**

- .1 Submit mill test certificates as requested or required of specification Sections.

#### **1.11 EQUIPMENT AND SYSTEMS**

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Temporary utilities.

**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.

**1.4 WATER SUPPLY**

- .1 Existing sources of water will not be made available to the Contractor. Arrange for connection and pay all costs for installation, maintenance and removal of water supply. Conversions or alterations to existing sources of water to meet construction requirements are the responsibility of the Contractor.
- .2 The points of delivery and limits on amount available will be determined on site by the Parks Canada Department Representative whose written permission must be obtained before any connection is made.

**1.5 TEMPORARY HEATING AND VENTILATION**

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted, unless prior approval is given by the Parks Canada Department Representative.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
  - .1 Facilitate progress of Work.
  - .2 Protect work and products against dampness and cold.
  - .3 Prevent moisture condensation on surfaces.
  - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
  - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10°C in areas where construction is in progress.
- .5 Ventilating:
  - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
  - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
  - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
  - .4 Ventilate storage spaces containing hazardous volatile materials.
  - .5 Ventilate temporary sanitary facilities.
  - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

- .6 Permanent heating system of building may not be used when available, unless there are savings to the contract price and the Parks Canada Department Representative's written permission is obtained stating conditions of use, provisions relating to guarantees on equipment and operation and maintenance of system. Be responsible for damage to heating systems if use is permitted.
- .7 On completion of Work for which permanent heating system is used, replace filters.
- .8 Ensure date of Substantial Performance and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by the Parks Canada Department Representative.
- .9 Pay costs for maintaining temporary heat, when using permanent heating system. The Parks Canada Department Representative will pay utility charges when temporary heat source is existing building equipment.
- .10 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform with applicable codes and standards.
  - .2 Enforce safe practices.
  - .3 Prevent abuse of services.
  - .4 Prevent damage to finishes.
  - .5 Vent direct-fired combustion units to outside,
- .11 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

#### **1.6 TEMPORARY POWER AND LIGHT**

- .1 Existing sources of electric power will not be made available to the Contractor. Conversions or alterations to existing sources of electric power to meet construction requirements are the responsibility of the Contractor.
- .2 The points of delivery and limits on amount available will be determined on site by the Parks Canada Department Representative whose written permission must be obtained before any connection is made.
- .3 The Contractor will be responsible for the installation of Service Entrance equipment including the meter base.
- .4 Electrical power and lighting systems under this Contract may be used for construction requirements only with prior approval of the Parks Canada Department Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.

#### **1.7 TEMPORARY COMMUNICATION FACILITIES**

- .1 Contractor shall provide and pay for temporary telephone, fax, data hook-up, lines and equipment necessary for own use.

#### **1.8 FIRE PROTECTION**

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

2 Products

**Not Used**

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 including dewatering 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.

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Construction aids.
- .2 Office and sheds.
- .3 Parking.
- .4 Project identification.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-Z321 Signs and Symbols for the Occupational Environment

**1.3 INSTALLATION AND REMOVAL**

- .1 Provide construction facilities in order to execute work expeditiously.
- .2 Remove from site all such work after use.

**1.4 SCAFFOLDING**

- .1 Provide scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs.

**1.5 HOISTING**

- .1 Provide, operate and maintain hoists and cranes required for moving workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.
- .2 Hoists and cranes shall be operated by qualified operator.

**1.6 SHORING AND BRACING**

- .1 Contractor is responsible for the design, supply, installation and maintenance of any shoring, bracing or similar type systems required during the execution of the Work. Coordinate use with the Parks Canada Department Representative.
- .2 Provide certification of any such shoring, bracing or similar type systems as directed by the Parks Canada Department Representative or as required by the Ministry of Labour, Ontario.

**1.7 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 a weight or force that will endanger the Work.

**1.8 CONSTRUCTION PARKING/MOBILE OFFICE TRAILER**

- .1 Parking will be permitted on site provided it does not disrupt performance of Work or public access to the existing campgrounds. Parks Canada Departmental Representative shall indicate location for parking and lay down areas.
- .2 Provide and maintain adequate access to project site.
- .3 Build or maintain temporary roads where indicated or directed by the Parks Canada Department Representative and provide snow removal during period of Work as deemed necessary.
- .4 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractor's use of roads.
- .5 Contractor to provide a construction trailer to conduct meetings with staff, consultants, Parks Canada staff etc. Furnish in the trailer a full size complete set of drawings, specifications, approved materials and mock ups if they can be accommodated in the trailer.

## 1.9 FIRST AID

- .1 Provide a clearly marked and fully stocked first-aid case in a readily available location.

## 1.10 EQUIPMENT, TOOL AND MATERIAL STORAGE

- .1 Provide and maintain, in a 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 a manner to cause least interference with work activities.

## 1.11 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take such precautions as required by local health authorities. Keep area clean and premises in sanitary condition.
- .3 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of the Parks Canada Department Representative.

## 1.12 CONSTRUCTION SIGNAGE

- .1 Direct requests for approval to erect a Contractor signboard to the Parks Canada Department Representative.
- .2 Signs and notices for safety and instruction shall be in both official languages. Graphic symbols shall conform to CAN3-Z321.
- .3 Maintain approved signs and notices in good condition for duration of project, and dispose of off-site on completion of project or earlier if directed by the Parks Canada Department Representative.

## 1.13 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 and parking lots during construction period except as otherwise specifically directed by Parks Canada 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: responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary.
- .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control: adequate to ensure safe operation at all times.
- .11 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .12 Provide snow removal during period of Work.

**1.14 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 and parking lots.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 DESCRIPTION**

- .1 This Specification includes the general description of the "TRAFFIC CONTROL" and the requirements of that plan. This specification applies to the furnishing of all labor, equipment, and materials and in performing all operations in connection with the "TRAFFIC CONTROL" in accordance with the plans and these specifications.

**1.2 SUBMITTALS**

- .1 The Contractor shall submit a "Traffic Control Plan" prior to commencing construction. All plans must be in accordance with the latest version of the Ministry of Transportation's Book 7: Ontario Traffic Manual – Temporary Conditions. No plan may be implemented until approved by the Parks Canada Department Representative.
- .2 The Contractor shall submit an updated "Traffic Control Plan" upon request of the Parks Canada Department Representative.

2 Products

**Not Used**

3 Execution

**3.1 CONSTRUCTION METHODS**

- .1 The "Traffic Control Plan" and the installation of all devices shall be continuously reviewed and updated to reflect the current stage of construction. The inspector may review minor changes; the Department Representative shall review major changes. The construction foreman shall provide the current "Traffic Control Plan" to the inspector upon request on the site at any time during the construction of the project.
- .2 The Contractor shall provide a minimum of 24 hours notification for any lane closures or disruptions to existing parking lots.
- .3 The Traffic Controls shall be implemented in conformance to the Ministry of Transportation's Book 7: Ontario Traffic Manual – Temporary Condition. The Contractor shall provide a minimum of two (2) flagmen to direct vehicles for all lane closures.

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Barriers.
- .2 Environmental Controls.
- .3 Traffic Controls.
- .4 Fire Routes.

**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 TEMPORARY SITE ENCLOSURE**

- .1 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel "T" bar fence posts spaced at 2.4 m oc. Pedestal style fence posts may be used on bedrock or on existing asphalt surfaces. Provide one lockable truck gate. Maintain fence in good repair. Requirement may be eliminated with the direction of the Parks Canada Department Representative subject to site conditions.
- .2 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

**1.4 GUARD RAILS AND BARRICADES**

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2 Provide as required by governing authorities.

**1.5 WEATHER ENCLOSURES**

- .1 Provide weather tight enclosures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

**1.6 DUST TIGHT SCREENS**

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

**1.7 ACCESS TO SITE**

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.
- .2 The Contractor is responsible for snow removal to access the site through the winter.

**1.8 PUBLIC TRAFFIC FLOW**

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights or lanterns as required to perform Work and protect the public on existing roadways and parking lots.

**1.9 FIRE ROUTES**

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

**1.10 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.

**1.11 PROTECTION OF BUILDING FINISHES**

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, coverings and hoardings.
- .3 Confirm with the Parks Canada Department Representative locations and installation. Schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Product quality, availability, storage, handling, protection and transportation.
- .2 Manufacturer's instructions.
- .3 Quality of Work, coordination and fastenings.
- .4 Existing facilities.

**1.2 QUALITY**

- .1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality, (compatible with specifications) 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 any dispute arise as to quality or fitness of products, decision rests strictly with the Parks Canada Department 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 any items. If delays in supply of products are foreseeable, notify the Parks Canada Department Representative of such, in order that substitution or other remedial action may be authorized in ample time to prevent delay on performance of Work
- .2 In event of failure to notify the Parks Canada Department Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Parks Canada Department 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 restore 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 in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

- .8 Remove and replace damaged products at own expense and to satisfaction of the Parks Canada Department Representative.
- .9 Touch-up damaged factory finished surfaces to the Parks Canada Department Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### **1.5 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation costs of products supplied by Owner will be paid for by the Parks Canada Department Representative. Unload, handle and store such products.

#### **1.6 MANUFACTURERS 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 daily from manufacturers.
- .2 Notify the Parks Canada Department Representative in writing, of conflicts between specifications and manufacturer's instructions, so that the Department Representative may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Parks Canada Department 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 the Parks Canada Department 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. The Parks Canada Department 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 the Parks Canada Department Representative, whose decision is final.

#### **1.8 COORDINATION**

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

#### **1.9 CONCEALMENT**

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform Parks Canada Department Representative if there is interference. Install as directed by the Parks Canada Department Representative.

#### **1.10 REMEDIAL WORK**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner as to neither damage nor put at risk any portion of Work.

#### **1.11 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform the Parks Canada Department Representative of conflicting installation. Install as directed.

### 1.12 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

### 1.13 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagonal heads, semi-finished unless otherwise specified. Use No. 316 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts,
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

### 1.14 PROTECTION OF WORK IN PROGRESS

- .1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, as directed by Parks Canada Department Representative, at no increase in Contract Price or Contract Time.
- .2 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of the Parks Canada Department Representative.

### 1.15 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum disturbance to Work, and/or 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.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Requirements and limitations for cutting and patching the Work.

**1.2 SUBMITTALS**

- .1 Submit written request and obtain the Parks Canada Department Representative's approval in advance of cutting or alteration which affects:
  - .1 Structural integrity of any element of Project.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance or safety of any operational element.
  - .4 Visual qualities of sight-exposed elements.

**1.3 PREPARATION**

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to ensure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which may be exposed by uncovering work. Maintain excavations free of water.

**1.4 EXECUTION**

- .1 Execute cutting, fitting and patching including excavation and fill, to complete Work.
- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- .11 At penetration of fire rated wall, ceiling or floor construction, completely seal voids with "ULC approved" firestopping material, full thickness of the construction element.
- .12 Refinish surfaces to match adjacent finishes: for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Progressive cleaning.
- .2 Final Cleaning.

**1.2 PROJECT CLEANLINESS**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at regularly scheduled times or dispose of as directed by the Parks Canada Department Representative. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building, bank/pile up 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.
- .6 Provide and use clearly marked separate bins for recycling.
- .7 Remove debris daily to a designated Landfill Site. The work site must be left clean and tidy upon completion, to the satisfaction of the Parks Canada Department Representative.
- .8 Contractors shall adhere to landfill site restrictions and specified dumping areas.
- .9 All materials shall be separated into the following categories:
  - .1 Clean wood products (ie. branches, logs, etc.).
  - .2 Dirty wood products (ie. building lumber with nails, metal, etc. attached).
  - .3 Concrete (max size 600mm x 600mm).
  - .4 Domestic garbage.
  - .5 Cardboard.
  - .6 Leaves, grass clippings etc.
  - .7 Asbestos materials.
  - .8 Metal products.
- .10 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.
- .11 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .12 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation system is not permitted for this purpose.
- .13 Use only cleaning materials recommended by manufacture of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .14 Schedule cleaning operation so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

**1.3 FINAL CLEANING**

- .1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

- .3 Prior to final review, remove surplus products, tools, construction machinery and equipment.
- .4 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls and floors.
- .6 Clean lighting reflectors, lenses and other lighting surfaces.
- .7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .8 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .11 Remove dirt and other disfiguration from exterior surfaces.
- .12 Clean and sweep roofs, gutters, areaways and sunken wells.
- .13 Sweep and wash clean paved areas.
- .14 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .15 Clean roofs, downspouts and drainage systems.
- .16 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .17 Remove snow and ice from access to building.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 WASTE MANAGEMENT GOALS**

- .1 Prior to start of Work conduct meetings with Departmental Representative to review and discuss Waste Management Goals.
- .2 Waste Management Goal is 75 percent of total project waste to be diverted from landfill sites. Provide Parks Canada Departmental Representative documentation that waste management, recycling, reuse of recyclable and reusable materials have been extensively practised.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environment damage.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00: Submittal Procedures
- .2 Section 01 74 00: Cleaning and Waste Management

**1.3 DEFINITIONS**

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
- .3 Demolition Waste Audit (DWA): relates to actual waste generated from project.
- .4 Inert Fill: inert waste- exclusively asphalt and concrete.
- .5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
  - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2 Returning reusable items including pallets or unused products to vendors.
- .10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .11 Separate Condition: refers to waste sorted into individual types
- .12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .13 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.

- .14 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WR W is based on information acquired from W A (Schedule A).

#### **1.4 DOCUMENTS**

- .1 Maintain at job site, one copy of following documents:
  - .1 Material Source Separation Plan (MSSP).

#### **1.5 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:
  - .1 Submit 2 copies of Materials Source Separation Program (MSSP) description
- .3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project.
  - .1 Failure to submit could result in holdback of final payment.
  - .2 Provide receipts, scale tickets and waybills and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
  - .3 For each material reused, sold or recycled from project, include amount in tonnes and the destination.
  - .4 For each material landfilled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

#### **1.6 WASTE AUDIT (W A)**

- .1 W A is not applicable for this project.

#### **1.7 WASTE REDUCTION WORKPLAN (WRW)**

- .1 WRW is not applicable for this project.

#### **1.8 DEMOLITION WASTE AUDIT (DWA)**

- .1 Prepare and submit a demolition waste audit 2 weeks before any work on site.
- .2 DWA to include an inventory of materials and quantities to be salvaged for reuse, recycling or disposal.

#### **1.9 COST/REVENUE ANALYSIS WORKPLAN (CRAW)**

- .1 CRAW is not applicable for this project.

#### **1.10 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)**

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Parks Canada Departmental Representative.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate Condition.

- .1 Transport to approved and authorized recycling facility and to users of material for recycling.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
  - .1 Ship materials to site operating under Certificate of Approval.
  - .2 Materials must be immediately separated into required categories for reuse or recycling.

#### 1.11 WASTE PROCESSING SITES

- .1 Name: St. Edmunds Landfill, Municipality of Northern Bruce Peninsula.
  - .1 Contact Name: Troy Cameron.
  - .2 Telephone: 519-793-3522 ext. 232
  - .3 Fax: 519-793-3823

#### 1.12 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Parks Canada Departmental Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Parks Canada Departmental Representative.
- .7 Protect surface drainage from damage and blockage.
- .8 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove co-mingled materials to off-site processing facility for separation.
  - .3 Provide waybills for separated materials.
- .9 Protective masks / respirators and gloves should be worn when handling asbestos and mould as per Regulation 278/05.

#### 1.13 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
  - .1 Number and size of bins.
  - .2 Waste type of each bin.
  - .3 Total tonnage generated.
  - .4 Tonnage reused or recycled.
  - .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly work progresses.
- .5 Disposal of asbestos shall conform to Ontario Regulation 278/05.

**1.14 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance to normal use of premises.

**1.15 SCHEDULING**

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

2 Products

**Not Used**

3 Execution

**3.1 APPLICATION**

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

**3.2 CLEANING**

- .1 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 Separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Parks Canada Departmental Representative, and consistent with applicable fire regulations.
  - .1 Mark containers or stockpile areas.
  - .2 Provide instruction on disposal practices.
- .2 On-site sale of salvaged, recovered, reusable or recyclable materials is not permitted.

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 As-built, samples and specifications.
- .2 Equipment and systems.
- .3 Product data, materials and finishes, and related information.
- .4 Operation and maintenance data.
- .5 Spare parts, special tools and maintenance materials.
- .6 Warranties and bonds.
- .7 Final site survey.

**1.2 SUBMISSION**

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 At least 2 weeks prior to scheduled commissioning activities, submit 2 copies of the DRAFT operating and Maintenance Manuals, for the Parks Canada Department Representative's review and use during the commissioning activities. After the completion of the commissioning activities, the Department Representative will return to the Contractor 1 DRAFT copy, with review comments, for revision. Submit 1 copy of the revised Operating and Maintenance Manual for approval prior to the production of FINAL copies. Prior to the issuance of the Final Certificate of Completion, and within 10 working days after the issuance of the Interim Certificate of Completion, submit 2 copies of the FINAL Operating and Maintenance Manuals.
- .3 Building will not be deemed ready for use unless the draft copies of the Operating and Maintenance Manuals and the "As-built" Record Documents have been submitted and reviewed by the Parks Canada Department Representative.
- .4 Building will not be deemed ready for use unless the completed and submitted Operating and Maintenance Manuals and "As-built" Record Documents have been accepted by the Parks Canada Department Representative.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

**1.3 FORMAT**

- .1 Organize data in the form of an instruction manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.

- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

#### 1.4 CONTENTS – EACH VOLUME

- .1 Table of Contents: provide title of project:
  - .1 Date of submission; names.
  - .2 Addresses and telephone numbers of Contractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product data: mark each sheet to clearly identify specific products and component parts of equipment and systems, to show control and flow diagrams.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 – Quality Control.
- .6 Training: Refer to Section 01 79 00 – Demonstration and Training.

#### 1.5 AS-BUILTS AND SAMPLES

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

#### 1.6 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of opaque drawings provided by the Parks Canada Department Representative.
- .2 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

- .3 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
  - .1 Measured depths of elements of foundation in relation to finish first floor datum.
  - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .4 Field changes of dimension and detail.
  - .5 Changes made by change orders.
  - .6 Details not on original Contract Drawings.
  - .7 References to related shop drawings and modifications.
- .4 Submit following drawings:
  - .1 Record changes in red. Mark on one set of prints and at completion of project prior to final inspection, neatly transfer as-built records to second set of white prints using fine red marker. Neatly print lettering and numbers in size to match original. Lines may be drawn free-hand but shall be neat and accurate. Annotate "AS-BUILT RECORD" in each drawing title block. Also, circle on List of Drawings each title and number of drawings marked with as-built records.
  - .2 At least 2 weeks prior to scheduled commission activities, submit one copy of the DRAFT "As-built" Project Record Documents for the Department Representative's review and use during the commission activities. After the completion of the commissioning activities, the Department Representative will return to the Contractor the DRAFT copy, with review comments, for revision. Prior to the issuance of the Final Certificate of Completion, and within 10 working days after the issuance of the Interim Certificate of Completion, submit 2 copies of the FINAL "As-built" Project Record Documents.
- .5 Specifications: legibly mark each item to record actual construction, including:
  - .1 Manufacturer, trade name and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by addenda and Change Orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

#### **1.7 FINAL SURVEY**

- .1 Final site survey certificate is not required for this project.

#### **1.8 EQUIPMENT AND SYSTEMS**

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operating characteristics, and limiting conditions. Include performance curves, with the Parks Canada Department Representative's 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. Include regulation, control, stopping, shut-down and emergency instructions. Include summer, winter and any special operating instructions.

- .5 Maintenance requirements: include routine procedures and guide for troubleshooting; disassembly, repair and reassembly instructions; and alignment, adjustment, balancing and checking instructions.
- .6 Provide servicing and lubrication schedule.
- .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 coordination 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 45 00 – Quality Control.
- .15 Additional requirements: As specified in individual specification sections.

#### **1.9 MATERIALS AND FINISHES**

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

#### **1.10 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 Spare parts as identified in individual sections are to be delivered to the Parks Canada Department Representative prior to the Contractor's submission for Interim Certificate of Completion.
- .4 Receive and catalogue all items. Submit inventory listing to the Parks Canada Department Representative. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

#### **1.11 MAINTENANCE MATERIALS**

- .1 Provide maintenance and extra materials, in quantities specified in specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Maintenance materials are to be delivered to the Parks Canada Department Representative prior to the Contractor's submission for Interim Certificate of Completion.
- .4 Receive and catalogue all items. Submit inventory listing to the Parks Canada Department Representative. Include approved listings in Maintenance Manual. Obtain receipt for delivered products and submit prior to final payment.

### 1.12 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 Special tools are to be delivered to the Parks Canada Department Representative prior to the Contractor's submission for Interim Certificate of Completion.
- .4 Receive and catalogue all items. Submit inventory listing to the Parks Canada Department Representative. Include approved listings in Maintenance Manual.

### 1.13 STORAGE, HANDLING AND PROTECTION

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

### 1.14 WARRANTIES AND BONDS

- .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 the applicable item of work.
- .4 Except for items put into use with Parks Canada Department Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined. 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.

### 1.15 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Consultant.
- .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.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Procedures for demonstration and instruction of equipment and systems to Parks Canada Department Representative.

**1.2 DESCRIPTION**

- .1 Demonstrate operation and maintenance of equipment and systems to Parks Canada Department Representative two weeks prior to date of final inspection.
- .2 Parks Canada Department Representative will provide list of personnel to receive instruction, and will coordinate their attendance at agreed upon time.

**1.3 QUALITY CONTROL**

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Parks Canada Department Representative and provide written report that demonstration and instruction have been completed.

**1.4 SUBMITTALS**

- .1 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for the Parks Canada Department Representative's approval.
- .2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

**1.5 CONDITIONS FOR DEMONSTRATIONS**

- .1 Equipment has been inspected and put into operation.
- .2 Testing, adjusting and balancing have been performed in accordance with Section 01 45 00 – Quality Control and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

**1.6 PREPARATION**

- .1 Verify that conditions for demonstration and instruction comply with requirements.
- .2 Verify that designated personnel are present.

**1.7 DEMONSTRATION AND INSTRUCTIONS**

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing and maintenance of each item of equipment at scheduled times, at the designated location.
- .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .3 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

**1.8 TIME ALLOCATED FOR INSTRUCTIONS**

- .1 Ensure amount of time required for instruction of each item of equipment or system as follows:
  - .1 Ventilation System: 1 hour of instruction.
  - .2 Control System: 1 hour of instruction.

- .3 Plumbing/Holding Tank: 1 hour of instruction.
- .4 Electrical System: 2 hours of instruction.

2 Products

**Not Used**

3 Execution

**Not Used**

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 01 11 00.
- .2 Read and conform to:
  - .1 Division 01 requirements and documents referred to therein.

**1.2 CONTRACTOR AND SUPPLIERS RESPONSIBILITY**

- .1 This Section of the specification defines the Contractor's responsibilities with respect to the commissioning process. Each contractor, sub-contractor and supplier shall review this Section, and shall include in their bids for carrying out the work described, as it applies to each Division and Section of these specifications, individually and collectively.

**1.3 DESCRIPTION OF WORK**

- .1 The purpose of the commissioning process is to provide the owner/operator of the facility with assurance that the mechanical and solar powered electrical systems have been installed according to the contract documents, and operate within the performance guidelines set out in the design intent documents and these specifications. The commissioning process does not take away or reduce the responsibility of the installing contractors to provide a finished product, installed and fully functional in accordance with the contract documents.
- .2 Commissioning is intended to enhance the quality of system start up and aid in the orderly completion and transfer of systems for beneficial use of owner. The GC will be the leader of the commissioning team, planning and coordinating all commissioning activities in conjunction with the design professionals, construction manager, subcontractors, manufacturers and equipment suppliers.
- .3 The General Contractor, Mechanical Contractor, all Divisions 22, 23 and 26 sub-contractors and suppliers, the Controls Contractor and the Electrical Contractor are responsible for cooperating, and co-ordinating their work together. They shall also be responsible for carrying out all the physical activities required for installation of components and systems, and operating them during the commissioning process as required in this Section.

**1.4 REFERENCES**

- .1 National Building Code
- .2 Ontario Building Code (OBC).

**1.5 SYSTEM TO BE COMMISSIONED**

- .1 The following Common Elements of Work shall be commissioned as part of the work of this contract;
  - .1 confirmation of pressure tests and documentation
  - .2 confirmation of Testing, Adjusting and Balancing completion and documentation
- .2 The following HVAC systems shall be commissioned as part of the Work of this contract:
  - .1 Ductwork and air handling systems

2 Products

**2.1 COMMISSIONING TEAM**

- .1 The commissioning team shall consist of representatives of the following:
  - .1 Owner and the Owner's Operating and Maintenance Staff
  - .2 Architect

- .3 Mechanical Design Engineer
- .4 Electrical Design Engineer
- .5 General Contractor
- .6 Mechanical Subcontractor
- .7 Electrical Subcontractor
- .8 Testing, Adjusting and Balancing Agency
- .9 Related Subcontractors and Suppliers

## **2.2 SYSTEM START-UP / VERIFICATION CHECKLIST**

- .1 This specification section contains the system start-up and verification checklists as listed below:
  - .1 Piping
  - .2 Ductwork Systems
  - .3 Solar powered electrical systems

## **2.3 FUNCTION PERFORMANCE TEST CHECKLIST**

- .1 This specification contains functional performance test checklists as listed below:
  - .1 Piping
  - .2 Ductwork Systems
  - .3 Solar powered electrical systems

## **3 Execution**

### **3.1 SUBMITTALS**

- .1 Divisions 22, 23, and 26 Contractors and Subs shall supply one (1) copy of all shop drawings marked “for CA” to the GC at the same time as provided to other designers for review, including all controls and shop drawings and narrative description of each control sequence for each piece of equipment or system controlled.
- .2 Contractors and Subs shall comply with specific requests for submittal documentation from the GC in a timely fashion to ensure commissioning work continues as scheduled. At a minimum, the request will include the manufacturer’s printed installation and start-up procedures, O&M data and manuals, final shop drawings, power and control field wiring drawings, sequences of operation, and results of required tests.
- .3 Final completion of the O&M manuals including all required submittals is the responsibility of the Contractor. The CA will review and forward comments to the engineer of record for follow-up.
- .4 TAB contractor shall supply an extra copy of the preliminary and the final TAB report marked “for CA” for review. The CA will review and forward comments to the engineer of record for follow-up.
- .5 Contractor shall provide an extra set of O&M manuals, as built drawings and field power wiring diagrams to the GC. The GC will review and forward comments to the engineer of record for follow-up.

### **3.2 FUNCTIONAL PERFORMANCE TESTING (FPT)**

- .1 In general, functional performance testing is conducted after Start-up and Installation Verification have been satisfactorily completed, the control system is fully operational, and TAB is complete.
- .2 The installing Contractor or Sub-contractor, under the direction of the GC, shall execute all FPT and shall maintain responsibility for all equipment tested.
- .3 In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part-load, full-load). Proper responses to such modes and

emergency conditions (e.g., power failure, freeze condition, no flow, equipment failure, etc.) shall be verified.

- .4 FPT verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The GC will determine which method is most appropriate.
- .5 The GC will schedule FPTs through the affected Contractors and Subs.
- .6 Corrections of minor deficiencies identified during FPT may be made by the Contractor or Sub during the tests.
- .7 Where a deficiency cannot be corrected immediately, the Contractor or Sub shall provide a reasonable timeline for correction. The GC shall document the deficiency and reschedule the FPT.
- .8 Where there is a dispute regarding whether a problem is a deficiency or who is responsible, the deficiency shall be documented and resolution attempted by parties in attendance. Final acceptance of proposed resolution lies with the Owner or designated representative.
- .9 The burden of responsibility to solve and correct deficiencies lies with the A/M/E, manufacturers, vendors, GC, Contractors, and Subs. The GC may recommend solutions to problems in consultation with these parties.
- .10 Cost of Retesting:
  - .1 If the Contractor or Sub is responsible for a deficiency then they shall carry the cost to rework the deficiency and complete the Start-up and Installation Verification or FPT.
  - .2 The GC will direct the first retesting of the equipment at no charge.
  - .3 If corrections of deficiencies have been reported to be successfully completed but are determined during testing to be faulty or otherwise incomplete, the time for the consultant to direct second or subsequent retests will be charged back.

### 3.3 TRAINING OF OWNER PERSONNEL

- .1 The contractor supplying each piece of equipment shall be responsible for providing complete and satisfactory training on that piece of equipment. Training may be performed by the contractor, supplier, manufacturer or others as the contractor may decide best able to provide that training.
- .2 Owner personnel shall be provided with completed O&M Manuals at least 1 week prior to training. In addition, up to five (5) copies of the related maintenance booklet and wiring as-built shall be provided to owner personnel for the purpose of training.
- .3 The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.
- .4 Basic training for each piece of equipment shall include the following items at a minimum:
  - .1 General description of the system and its operation (Design Intent)
  - .2 Detailed itemization and identification of major components and access to same
  - .3 Review of the O&M manuals for identification of service requirements, procedures, wiring diagrams, parts identification, safety procedures, etc.
  - .4 Review of system drawings and schematics
  - .5 Review of control drawings and schematics
  - .6 Operational review for
    - .1 Start-up
    - .2 Normal operation
    - .3 Shut down

- .4 Unoccupied operation
- .5 Seasonal changeover
- .6 Manual operation
- .7 Controls set-up and programming
- .8 Troubleshooting
- .7 Interactions with other systems
- .8 Adjustments and optimizing methods for energy conservation
- .9 Health and safety issues
- .10 Regular maintenance requirements including frequency, parts and equipment, and tools needed, replacement parts sources
- .11 Special maintenance needs
- .12 Discussion of environmentally responsible system features
- .13 Identification of contacts for service support and maintenance parts

### 3.4 MECHANICAL ENGINEER'S RESPONSIBILITIES

- .1 The Mechanical and Electrical Engineer will review the commissioning plan, and will participate, as appropriate, in on-site commissioning meetings.
- .2 During the acceptance phase of the commissioning process, the Mechanical and Electrical Engineer may be on site to review commissioning documentation, to witness functional performance tests, and to analyze the installation and its performance.

### 3.5 OWNER'S RESPONSIBILITIES

- .1 The Owner will ensure the availability of operating staff for all scheduled instructions and demonstration sessions. This staff will possess sufficient skills and knowledge to operate and maintain the installation following attendance at these sessions. The owner will also ensure the appropriate involvement of the Electrical Engineer, Architect, and any other consultants as required, in the commissioning process.

### 3.6 GENERAL CONTRACTOR'S RESPONSIBILITIES

- .1 The General Contractor has responsibility to ensure the overall completion of the work. In this regard, he shall;
  - .1 Participate as required in the Mechanical Systems Commissioning process,
  - .2 ensure the mechanical contractor performs all assigned commissioning responsibilities as specified in 3.5,
  - .3 ensure the testing, adjusting and balancing agency performs all assigned commissioning responsibilities as specified in 3.6,
  - .4 ensure the controls contractor performs all assigned commissioning responsibilities as specified in 3.7,
  - .5 ensure the electrical contractor performs all assigned commissioning responsibilities as specified in 3.8,
  - .6 ensure the cooperation and participation in the commissioning process of all other subcontractors as applicable.

### 3.7 MECHANICAL SUBCONTRACTOR

- .1 The mechanical contractor, and all the sub-contractors and suppliers within Divisions 22 and 23, shall cooperate with the commissioning agency (CA), and other commissioning team members, to facilitate the successful completion of the commissioning process.

- .2 The contractor shall assign a representative to the commissioning team, and submit the person's name to the commissioning agency, within one (1) month of the award of the contract. The representative shall have the authority to make decisions on behalf of the mechanical contractor as they relate to the organization and scheduling of HVAC commissioning. The representative shall ensure communications between Divisions 22 and 23 contractors and suppliers and all other commissioning team members, and shall foster the necessary cooperative action. One specific responsibility shall be to attend commissioning meetings, and ensure action items arising from them are attended to as required to allow the commissioning process to proceed on schedule.
- .3 The Mechanical Contractor, and all mechanical sub-contractors and supplies, shall cooperate with the Commissioning Agency in carrying out the HVAC commissioning process. In this context, the mechanical Contractor shall:
  - .1 Each contractor and sub-contractor in this division shall include in their quotes the cost of participating in the commissioning process as specified herein.
  - .2 Ensure the automatic temperature controls (ATC) contractor performs HVAC commissioning responsibilities as listed in 3.5.
  - .3 Provide instruction and demonstrations for the Owner's designated operating staff, in conjunction with the commissioning agency and mechanical engineer, and with the participation of qualified technicians from major equipment suppliers and the controls contractor.
  - .4 Include requirements for submittal data. O&M data, and training information in each purchase order or sub-contract written.
  - .5 Ensure cooperation and participation of specialty sub-contractors such as sheet metal, piping, refrigeration, and water treatment as applicable.
  - .6 Ensure participation of major equipment manufacturing in appropriate start-up, testing and training activities.
  - .7 Attend commissioning meetings scheduled by the CA.
  - .8 Notify the CA a minimum of two weeks in advance of scheduled equipment and system start-ups, so that the CA may witness system verifications, and equipment and system start-ups.
  - .9 Provide sufficient personnel to assist the CA as required during system verification and functional performance testing.
  - .10 Prior to set-up, inspect, check and confirm the correct and complete installation of all equipment and systems for which system verification checklists are included in the commissioning plan. Document the results of all inspections and checks on the checklists and sign them. If deficient or incomplete work is discovered, ensure corrective action is taken and re-check until the results are satisfactory and the system is ready for safe start-up.
  - .11 Notify the CA a minimum of two weeks in advance, of the time for start of the TAB work. Attend the initial TAB meeting for review of the TAB procedures.
  - .12 Provide equipment and systems start-up resources as specified and required. If during an attempted equipment or system start-up, deficient or incomplete work is discovered that would preclude safe operation, the start-up shall be aborted until corrective action has been taken. Ensure such action is taken and verified before re-scheduling a new start-up. Those responsible for deficient or incomplete work will be responsible for costs in accordance with 3.2 in this Section.
  - .13 Carry-out performance checks to ensure that all equipment and systems fully functional and ready for the CA to witness formal functional performance tests (FPTs).
  - .14 Operate equipment and systems for FPTs in accordance with the commissioning plan and as directed by the commissioning agency. If improper functionality, incomplete work, or other deficiencies affecting system performance are discovered, the FPTs will be

stopped by the CA. Those responsible for deficient or incomplete work will be responsible for costs in accordance with 3.2 in this Section. Ensure that all corrections necessary for full and complete system operation as specified are completed; then with the ATC contractor and other applicable sub-contractors, carry-out functional performance checks to confirm correct operation before applying to the CA to re-schedule the FPTs for the system in question.

- .15 Prepare preliminary schedule for mechanical system orientation and inspections. O&M Manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up TAB, and task completion for use by the CA. Update schedule as appropriate throughout the construction period.
- .16 Attend initial O&M staff training session.
- .17 Conduct mechanical system orientation and inspection at the equipment placement completion stage.
- .18 Update drawings to as-built condition and review with the CA.
- .19 Gather O&M data on all equipment, and assemble in binders as required by the commissioning specification. Submit to CA prior to the completion of construction.
- .20 Participate in, and schedule vendors and contractors to participate in the O&M staff training sessions as set-up by the CA.
- .21 Provide written notification to the general contractor (or construction manager) and CA that the following work has been completed in accordance with the contract documents and the equipment, systems and sub-systems are operating as required;
  - .1 HVAC equipment including all fans, air handling units, ductwork, dampers, terminals and all Division 23 equipment.
  - .2 Refrigeration equipment, pumping systems and heat rejection equipment.
  - .3 Fire-stopping in the fire-rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
  - .4 Fire detection and smoke detection devices furnished under other divisions of this specification as they affect the operation of the smoke control systems.
  - .5 That the building control system is functioning to control mechanical equipment and smoke control systems as specified.
- .22 Provide a complete set of as-built drawings and O&M manuals to the CA.

### **3.8 TESTING, ADJUSTING AND BALANCING SUBCONTRACTOR**

- .1 With respect to HVAC commissioning, the TAB agency shall:
  - .1 Include costs for HVAC commissioning requirements in the quoted price.
  - .2 Attend commissioning meetings scheduled by the CA prior to , and during, on-site TAB work being done
  - .3 Submit proposed TAB procedures to the CA and mechanical engineer for review and acceptance.
  - .4 Attend the TAB planning meeting scheduled by the CA. Be prepared to discuss the procedures that shall be followed in testing, adjusting and balancing the HVAC system.
  - .5 At the completion of the TAB work, submit the final TAB report to the mechanical contractor, submittal will be to the mechanical contractor, with general contractor, CA, and mechanical engineer notified.
  - .6 Participate in verification of the TAB report by the CA for verification or diagnostic purposes. This will consist of repeating a sample (normally 10% to 20%) of the measurements contained in the TAB report as directed by the CA.

- .7 Participate in O&M personnel training sessions as scheduled by the CA.

### 3.9 CONTROLS SUBCONTRACTOR

- .1 With respect to HVAC commissioning, the controls contractor shall:
  - .2 Review design for controllability with respect to equipment selected for the project;
    - .1 Review and confirm in writing that a proper hardware specification exists to permit functional performance testing as required by specification and sequence of operation.
    - .2 Review and confirm in writing that proper safeties and interlocks are included in design.
    - .3 Ensure the proper selection of sensor ranges, and include data with submittal to mechanical engineer.
    - .4 Clarify all questions concerning sequences of operation with the mechanical engineer.
  - .3 Attend commissioning meetings scheduled by the CA.
  - .4 Provide the following submittals to the CA for review:
    - .1 Hardware and software submittals.
    - .2 Control panel construction shop drawings.
    - .3 Diagrams showing all control points, sensor locations, point names, actuators, controllers and where necessary, points of access, all superimposed on diagrams of the physical equipment.
    - .4 Narrative description of all control sequences for each piece of equipment controlled.
    - .5 Logic diagrams showing the logic flow of all control sequences.
    - .6 A list of all control points, including analog inputs, analog outputs, digital inputs and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.
    - .7 A complete control language program listing including all software routines employed in operating the control system. Also, provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and subroutine. It should also explain individual math or logic operations that are not clear from reading the software listing.
    - .8 Hardware operation and maintenance manuals.
    - .9 Application software and project applications code manuals.
- .5 Inspect, check, and confirm the proper installation and performance of controls/BAS hardware and software provided by others.
- .6 Integrate installation and programming scheduling with construction and commissioning schedules.
- .7 Inspect, check and confirm the correct installation and operation of input and output field points and devices through documented and signed off point-to-point checkouts.
- .8 Provide thorough training to operating personnel on hardware operations and programming, and the application program for the system, in accordance with the O&M staff training program in the commissioning plan.
- .9 In conjunction with the mechanical contractor, demonstrate system performance to the CA including all modes of system operation (e.g. occupied, unoccupied, emergency) during the functional performance tests (FPTs). If improper functionality, incomplete work, or other deficiencies affecting system performance are discovered, the FPTs will be stopped by the CA. Those responsible for deficient or incomplete work will be responsible for costs in accordance with 3.2 in this Section.

- .10 Provide control system technician to assist during system verification and functional performance testing.
- .11 Provide support and coordination with TAB contractor on all interfaces between controls and TAB scopes of work. Provide, at no additional cost to the TAB and commissioning agencies, all devices, such as portable operator's terminals and all software for the TAB agency to use in completing TAB procedures.

### 3.10 ELECTRICAL SUBCONTRACTOR

- .1 The electrical contractor shall:
  - .1 Include cost for HVAC commissioning requirements in the quoted price.
  - .2 Review design with respect to providing power to the HVAC equipment:
    - .1 Verify that proper hardware specifications exist for functional performance and sequence of operation required by specification.
    - .2 Verify that proper safeties and interlocks are included in the design of electrical connections for HVAC equipment.
  - .3 Attend commissioning meetings scheduled by the CA.
  - .4 Schedule work so that required electrical installations are completed, and systems verification checks and functional performance tests can be carried out on schedule.
  - .5 Inspect, check and confirm in writing the proper installation and performance of all electrical services provided.
  - .6 Provide electrical system technicians to assist during system verification and functional performance testing as required by the CA.
  - .7 Correct all deficiencies found during Installation Verification Inspection, start-up, TAB and FPT to ensure all equipment and systems are fully functional and in complete and proper working order.
  - .8 Prepare O&M manuals and supplementary information on all equipment as directed by CA and assemble in binders tabbed and indexed. Supplementary information may include, but is not limited to, such items as power/control field wiring diagrams, equipment maintenance schedule, vendor and maintenance contact lists. Submit to CA when requested.
  - .9 Provide electrical system technicians to assist during system verification and functional performance testing as required by the CA.
  - .10 Provide a complete set of as-built record drawings and schematics with a copy to the CA.
  - .11 Return to site with the GC and CA approximately 10 months after the start of the warranty period to review system operation and to address operational issues.

### 3.11 DEFERRED TESTING

- .1 If any check or test cannot be completed due to weather conditions, the building structure, required occupancy condition or other deficiency, execution of Start-up and Installation Verification and/or FPT may be delayed upon approval of the Owner

### 3.12 POST-OCCUPANCY REVIEW

- .1 The CA, GC/CM, mechanical, electrical, and controls sub-contractors shall return to the building approximately 10 months after the start of the warranty period to review system operation, owner concerns, unresolved deficiencies or warranty issues and to address any outstanding operational issues.
- .2 The exact date and time of this meeting is to be coordinated by the CA.
- .3 CA will provide site report to the consultants and owner for review, acceptance and formal issue to the appropriate parties

END OF SECTION

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 33 00: Submittal Procedures
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 55 26: Traffic Control
- .5 Section 01 56 00: Temporary Barriers and Enclosures
- .6 Section 01 61 00: Common Product Requirements
- .7 Section 01 74 00: Cleaning and Waste Management
- .8 Section 01 74 21: Construction Demolition Waste Management and Disposal
- .9 Section 03 20 00: Concrete Reinforcing
- .10 Section 03 30 00: Cast-In-Place Concrete
- .11 Section 03 35 00: Concrete Finishing

**1.2 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA-O86S1-05, Supplement No. 1 to CAN/CSA-O86-01, Engineering Design in Wood.
  - .3 CSA O121-M1978 (R2003), Douglas Fir Plywood.
  - .4 CSA O151-04, Canadian Softwood Plywood.
  - .5 CSA O153-M1980 (R2003), Poplar Plywood.
  - .6 CAN/CSA-O325.0-92(R2003), Construction Sheathing.
  - .7 CSA O437 Series-93(R2006), Standards for OSB and Waferboard.
  - .8 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
  - .9 CAN/CSA-S269.3-M92(R2003), Concrete Formwork, National Standard of Canada
- .2 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit shop drawings for formwork and falsework.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets.
- .4 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 CAN/CSA-S269.3 for formwork drawings.
- .5 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

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.
  - .2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.
  - .3 Rigid insulation board: to CAN/ULC-S701.
- .2 Tubular column forms: round, spirally wound laminated fibre forms, internally treated with release material.
  - .1 Spiral pattern not to 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 High density overlay Douglas Fir.
- .5 Form release agent: non-toxic.
- .6 Form stripping agent: colourless mineral oil, free of kerosene, with viscosity between 15 to 24mm<sup>2</sup>/s at 40 degrees C, flashpoint minimum 150 degrees C, open cup.
- .7 Falsework materials: to CSA-S269.1.
- .8 Sealant: to Section 07 92 00- Joint Sealants.

3 Execution

**3.1 FABRICATION AND ERECTION**

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Fabricate and erect falsework in accordance with CSA S269.1.
- .3 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .4 Do not place shores and mud sills on frozen ground.
- .5 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .6 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.
- .7 Align form joints and make watertight.
  - .1 Keep form joints to minimum.
- .8 Locate horizontal form joints for exposed columns 2400 mm above finished floor elevation.
- .9 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

- .11 Construct forms for architectural concrete, and place ties as directed.
  - .1 Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- .12 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
  - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .13 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 33 00: Submittal Procedures
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 55 26: Traffic Control
- .5 Section 01 56 00: Temporary Barriers and Enclosures
- .6 Section 01 61 00: Common Product Requirements
- .7 Section 01 74 00: Cleaning and Waste Management
- .8 Section 01 74 21: Construction Demolition Waste Management and Disposal
- .9 Section 03 10 00: Concrete Forming and Accessories
- .10 Section 03 30 00: Cast-In-Place Concrete
- .11 Section 03 35 00: Concrete Finishing

**1.2 REFERENCE STANDARDS**

- .1 American Concrete Institute (ACI)
  - .1 SP-66-04, ACI Detailing Manual 2004.
- .2 ASTM International
  - .1 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - .2 ASTM A143/A143M-07, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
  - .3 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
  - .4 ASTM A775/A775M-07b, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- .3 CSA International
  - .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CAN/CSA-A23.3-04(R2010), Design of Concrete Structures.
  - .3 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
  - .4 CSA-G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .5 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .6 CSA W186-M1990(R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 Reinforcing Steel Institute of Canada (RSIC)
  - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
- .3 Shop Drawings:
  - .1 Submit drawings for review.
    - .1 Indicate placing of reinforcement and:
      - .1 Bar bending details.
      - .2 Lists.
      - .3 Quantities of reinforcement.
      - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Consultant and Parks Canada Representative, with identifying code marks to permit correct placement without reference to structural drawings.
  - .2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

#### 1.4 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 45 00- Quality Control and as described in PART 2 - SOURCE QUALITY CONTROL.
  - .1 Mill Test Report: upon request, provide Parks Canada Representative and Consultant with certified copy of mill test report of reinforcing steel.
  - .2 Upon request submit in writing to Parks Canada Representative and Consultant proposed source of reinforcement material to be supplied.

#### 1.5 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 off ground in dry location and in accordance with manufacturer's recommendations.
  - .2 Replace defective or damaged materials with new.

### 2 Products

#### 2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Parks Canada Representative and Consultant.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.
- .4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.
- .5 Welded steel wire fabric: to ASTM A185/A185M.
  - .1 Provide in flat sheets only.
- .6 Epoxy Coating of non-prestressed reinforcement: to ASTM A775/A775M.
- .7 Galvanizing of non-prestressed reinforcement: to CAN/CSA-G164, minimum zinc coating 610g/m<sup>2</sup>.

- .1 Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.
- .2 If chromate treatment is carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.
  - .1 Temperature of solution equal to or greater than 32 degrees and galvanized steels immersed for minimum 20 seconds.
- .3 If galvanized steels are at ambient temperature, add sulphuric acid as bonding agent at concentration of 0.5% to 1%.
  - .1 In this case, no restriction applies to temperature of solution.
- .4 Chromate solution sold for this purpose may replace solution described above, provided it is of equivalent effectiveness.
  - .1 Provide product description as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .8 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .9 Mechanical splices: subject to approval of Parks Canada Representative and Consultant.
- .10 Plain round bars: to CSA-G40.20/G40.21.

## 2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
  - .1 SP-66 unless indicated otherwise.
- .2 Obtain Parks Canada Representative and Consultant written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Parks Canada Representative and Consultant, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
  - .1 Ship epoxy coated bars in accordance with ASTM A775A/A775M.

## 2.3 SOURCE QUALITY CONTROL

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

## 3 Execution

### 3.1 PREPARATION

- .1 Galvanizing to include chromate treatment.
  - .1 Duration of treatment to be 1 hour per 25 mm of bar diameter.
- .2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.

### 3.2 FIELD BENDING

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

### 3.3 PLACING REINFORCEMENT

- .1 Place reinforcing steel in accordance with CSA-A23.1/A23.2.
- .2 Use plain round bars as slip dowels in concrete.
  - .1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.
  - .2 When paint is dry, apply thick even film of mineral lubricating grease.
- .3 Prior to placing concrete, obtain Parks Canada Representative and Consultant's approval of reinforcing material and placement.
- .4 Ensure cover to reinforcement is maintained during concrete pour.

### 3.4 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

### 3.5 CLEANING

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

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 33 00: Submittal Procedures
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 55 26: Traffic Control
- .5 Section 01 56 00: Temporary Barriers and Enclosures
- .6 Section 01 61 00: Common Product Requirements
- .7 Section 01 74 00: Cleaning and Waste Management
- .8 Section 01 74 21: Construction Demolition Waste Management and Disposal
- .9 Section 03 10 00: Concrete Forming and Accessories
- .10 Section 03 20 00: Concrete Reinforcing
- .11 Section 03 35 00: Concrete Finishing

**1.2 REFERENCES**

- .1 Abbreviations and Acronyms:
  - .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.
    - .1 Type GU, GUb and GUL - General use cement.
    - .2 Type MS and MSb - Moderate sulphate-resistant cement.
    - .3 Type MH, MHb and MHL - Moderate heat of hydration cement.
    - .4 Type HE, HEb and HEL - High early-strength cement.
    - .5 Type LH, LHb and LHL - Low heat of hydration cement.
    - .6 Type HS and HSb - High sulphate-resistant cement.
  - .2 Fly ash:
    - .1 Type F - with CaO content less than 15%.
    - .2 Type CI - with CaO content ranging from 15 to 20%.
    - .3 Type CH - with CaO greater than 20%.
  - .3 GGBFS - Ground, granulated blast-furnace slag.
- .2 Reference Standards:
  - .1 ASTM International
    - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
    - .2 ASTM C309-07, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - .3 ASTM C494/C494M-10a, Standard Specification for Chemical Admixtures for Concrete.
    - .4 ASTM C1017/C1017M-07, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

- .5 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- .6 ASTM D624-00(2007), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
- .7 ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .8 ASTM D1752-04a(2008), 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 CSA International
  - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A283-06, Qualification Code for Concrete Testing Laboratories.
  - .3 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .3 Concrete hauling time: provide for review by Parks Canada Representative and Consultant, deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.
- .4 Provide two copies of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures.

### 1.4 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Provide Parks Canada Representative and Consultant, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
  - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
- .3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Consultant on following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
  - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.

.6 Formwork removal.

.7 Joints.

## 1.5 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.

.1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative, Consultant and laboratory representative and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by Departmental Representative and Consultant.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

.2 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 2 Products

### 2.1 DESIGN CRITERIA

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

### 2.2 PERFORMANCE CRITERIA

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

### 2.3 MATERIALS

.1 Portland Cement: to CSA A3001, Type GU.

.1 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCMs) Mix, as percentage.

.2 Blended hydraulic cement: Type GUB to CSA A3001.

.3 Portland-limestone cement: Type GUL to CSA A23.1.

.4 Supplementary cementing materials: with minimum 20% N, by mass of total cementitious materials to CSA A3001.

.5 Water: to CSA A23.1.

.6 Aggregates: to CSA A23.1/A23.2.

.7 Admixtures:

.1 Air entraining admixture: to ASTM C260.

.2 Chemical admixture: to ASTM C494 ASTM C1017. Parks Canada Departmental Representative and Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.

.8 Shrinkage compensating grout: premixed compound consisting of metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.

.1 Compressive strength: 35 MPa at 28 days.

- .9 Non premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand.
- .10 Curing compound: to CSA A23.1/A23.2 white ASTM C309, Type 1-chlorinated rubber.
- .11 Mechanical waterstops: ribbed extruded PVC, of sizes indicated with pre-welded corner and intersecting pieces with legs not less than 150 mm long:
  - .1 Elongation: to ASTM D412, method A, Die "C", minimum 250%.
  - .2 Tear resistance: to ASTM D624, method A, Die "B", minimum 30 kN/m.
- .12 Pre-moulded joint fillers:
  - .1 Bituminous impregnated fiber board: to ASTM D1751.
  - .2 Sponge rubber: to ASTM D1752, Type I, flexible grade.
  - .3 Standard cork: to ASTM D1752, Type II.
- .13 Weep hole tubes: galvanized steel.
- .14 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.
- .15 Dampproof membrane:
  - .1 Kraft/polyethylene membrane:
    - .1 Plain: .10 mm thick polyethylene film bonded to asphalt treated creped kraft.
    - .2 Reinforced: two.05 mm thick polyethylene films bonded each side of asphalt treated creped kraft paper, reinforced with 13 x 13 mm fibreglass scrim.
    - .3 Membrane adhesive: as recommended by membrane manufacturer.
- .16 Dampproofing:
  - .1 Emulsified asphalt, mineral colloid type, unfilled: to CAN/CGSB-37.2, and to Section 07 11 13 - Bituminous Dampproofing.
- .17 Polyethylene film: 6 mm thickness to CAN/CGSB-51.34.

## 2.4 MIXES

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative and Consultant performance criteria to CSA A23.1/A23.2.
  - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
  - .2 Provide concrete mix to meet following plastic state requirements:
    - .1 Workability: free of surface blemishes.
  - .3 Provide concrete mix to meet following hard state requirements:
    - .1 Durability and class of exposure: C-XL.
    - .2 Compressive strength at 28 age: 35 Mpa minimum.
  - .4 Provide quality management plan to ensure verification of concrete quality to specified performance.
  - .5 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

3 Execution

**3.1 PREPARATION**

- .1 Obtain Parks Canada Departmental Representative and Consultant's written approval before placing concrete.
  - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 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.
- .3 Pumping of concrete is permitted only after approval of equipment and mix.
- .4 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .5 Prior to placing of concrete obtain Parks Canada Departmental Representative and Consultant'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 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
  - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with shrinkage compensating grout to anchor and hold dowels in positions as indicated.
- .10 Do not place load upon new concrete until authorized by Parks Canada Departmental Representative and Consultant.

**3.2 INSTALLATION/APPLICATION**

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Sleeves and inserts:
  - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Parks Canada Departmental Representative and Consultant.
  - .2 Where approved by Parks Canada Departmental Representative and Consultant, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
  - .3 Sleeves and openings greater than 100 x 100mm not indicated, must be reviewed by Parks Canada Departmental Representative and Consultant.
  - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Parks Canada Departmental Representative and Consultant before placing of concrete.
  - .5 Confirm locations and sizes of sleeves and openings shown on drawings.
  - .6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Anchor bolts:
  - .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.

- .2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Parks Canada Departmental Representative and Consultant.
  - .1 Formed holes: 100mm minimum diameter.
  - .2 Drilled holes: to manufacturers' recommendations.
- .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
- .4 Set bolts and fill holes with shrinkage compensating grout epoxy grout.
- .5 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 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 and curing:
  - .1 Finish concrete to CSA A23.1/A23.2.
  - .2 Use procedures as reviewed by Parks Canada Departmental Representative and Consultant, or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
  - .3 Use curing compounds compatible with applied finish on concrete surfaces.
  - .4 Provide screed finish where floor tile is to be applied.
  - .5 Provide float finish unless otherwise indicated.
  - .6 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
- .7 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 Parks Canada Departmental Representative and Consultant.
- .8 Joint fillers:
  - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Parks Canada Representative and Consultant.
  - .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 isolation and construction 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.

- .9 Dampproof membrane:
  - .1 Install dampproof membrane under concrete slabs-on-grade inside building.
  - .2 Lap dampproof membrane minimum 150 mm at joints and seal.
  - .3 Seal punctures in dampproof membrane before placing concrete.
  - .4 Use patching material at least 150 mm larger than puncture and seal.

### **3.3 SURFACE TOLERANCE**

- .1 Concrete tolerance to CSA A23.1 Straightedge Method FF = 3.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .1 Concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 7 and 28 7 and 56 days.
  - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Parks Canada Departmental Representative and and Consultant for review to CSA A23.1/A23.2.
  - .1 Ensure testing laboratory is certified to CSA A283.
- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Parks Canada Representative and Consultant.
- .4 Departmental Representative will pay for costs of tests.
- .5 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .6 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .7 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 33 00: Submittal Procedures
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 55 26: Traffic Control
- .5 Section 01 56 00: Temporary Barriers and Enclosures
- .6 Section 01 61 00: Common Product Requirements
- .7 Section 01 74 00: Cleaning and Waste Management
- .8 Section 01 74 21: Construction Demolition Waste Management and Disposal
- .9 Section 03 10 00: Concrete Forming and Accessories
- .10 Section 03 20 00: Concrete Reinforcing
- .11 Section 03 30 00: Cast-In-Place Concrete

**1.2 REFERENCE STANDARDS**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .2 CSA International
  - .1 CAN/CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction//Methods of Test for Concrete.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Provide two copies of WHMIS MSDS. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content in g/L.
    - .2 Include application instructions for concrete floor treatments.

**1.4 ENVIRONMENTAL REQUIREMENTS**

- .1 Temporary lighting:
  - .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
- .2 Electrical power:
  - .1 Provide sufficient electrical power to operate equipment normally used during construction.
- .3 Work area:
  - .1 Make work area water tight protected against rain and detrimental weather conditions.
- .4 Temperature:

- .1 Maintain ambient temperature of not less than 10 degrees C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.
- .5 Moisture:
  - .1 Ensure concrete substrate is within moisture limits prescribed by manufacturer.
- .6 Safety:
  - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
  - .1 Ventilate enclosed spaces in accordance with Section 01 51 00- Temporary Utilities.
  - .2 Provide continuous ventilation during and after coating application.

### 1.5 DELIVERY, STORAGE AND HANDLING

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

## 2 Products

### 2.1 PERFORMANCE REQUIREMENTS

- .1 Product quality and quality of work in accordance with Section 01 61 00- Common Product Requirements.
- .2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.

### 2.2 CHEMICAL HARDENERS

- .1 Type 1 - Sodium silicate.
- .2 Water: potable.

### 2.3 SEALING COMPOUNDS

- .1 Surface sealer: to CAN/CGSB-25.20, Type 2 - water based, clear.

### 2.4 CURING COMPOUNDS

- .1 Select water-based curing compounds.

### 2.5 CONCRETE STAINS

- .1 Select water-based concrete stains.

### 2.6 MIXES

- .1 Mixing ratios in accordance with manufacturer's written instructions.

## 3 Execution

### 3.1 EXAMINATION

- .1 Verify that slab surfaces are ready to receive work and elevations are as indicated on drawings.

**3.2 PREPARATION OF EXISTING SLAB**

- .1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radiused edges unless otherwise indicated.
- .2 Saw cut control joints to CAN/CSA-A23.1, 24 hours maximum after placing of concrete.

**3.3 APPLICATION**

- .1 Apply concrete finishing floor hardener in accordance with manufacturer's written instructions.
- .2 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.
- .3 Apply floor treatment in accordance with Sealer manufacturer's written instructions.
- .4 Clean over spray. Clean sealant from adjacent surfaces.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .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 00 – Cleaning and Waste Management.

**3.5 PROTECTION**

- .1 Protect finished installation in accordance with manufacturer's instructions.

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Stamped concrete finishing.

**1.2 RELATED SECTIONS**

- .1 Section 03 30 00: Cast-in-Place Concrete.

**1.3 REFERENCES**

- .1 ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .2 ASTM C979 - Standard Specification for Pigments for Integrally Coloured Concrete.

**1.4 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data: Manufacturer's data sheets on each product to be used, including:
  - .1 Preparation instructions and recommendations.
  - .2 Storage and handling requirements and recommendations.
  - .3 Installation methods.
- .3 Selection Samples: For each finish product specified, two complete sets of colour chips representing manufacturer's full range of available colours and patterns.
- .4 Verification Samples: For each finish product specified, two samples, minimum size 305 mm (12") square representing actual product, colour, and patterns.
- .5 Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- .6 Applicator's Project References: Submit applicator's list of successfully completed stamped concrete projects, including project name and location, name of Consultant, and type and quantity of materials applied.

**1.5 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Experience manufacturing similar products.
- .2 Installer Qualifications: Experience installing similar products.
  - .1 Regularly engaged in application of stamped concrete of similar type to that specified.
  - .2 Employ persons trained for application of stamped concrete.
- .3 Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - .1 Construct Mock-ups of Stamped Concrete:
    - .1 Use same materials and methods for use in the Work.
    - .2 Location: Determined by Consultant.
    - .3 Minimum Size: 1219 mm by 1219 mm, (4 feet by 4 feet).
  - .2 Receive approval of mock-ups by Consultant for patterns, colours, textures, finishing, curing, cleaning, sealing, special effects, and workmanship before application of stamped concrete.
  - .3 Approved Mock-ups:

- .1 Standard for patterns, colours, textures, finishing, curing, sealing, special effects, and workmanship of stamped concrete.
- .2 Retain through completion of Work for use as quality standard.

#### 1.6 PRE-INSTALLATION MEETINGS

- .1 Convene minimum two (2) weeks prior to starting work of this Section.
  - .1 Require attendance of parties directly affecting work of this section, including:
    - .1 Contractor.
    - .2 Landscape Architect.
    - .3 Applicator.
    - .4 Manufacturer's representative.
    - .5 Departmental Representative
  - .2 Review:
    - .1 Mock-ups.
    - .2 Materials.
    - .3 Preparation.
    - .4 Application.
    - .5 Finishing.
    - .6 Curing.
    - .7 Cleaning.
    - .8 Sealing.
    - .9 Protection.
    - .10 Coordination with other work.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Storage and Handling Requirements:
  - .1 Store and handle materials in accordance with manufacturer's instructions.
  - .2 Keep materials in manufacturer's original, unopened containers and packaging until application.
  - .3 Store materials in clean, dry area indoors.
  - .4 Store materials out of direct sunlight.
  - .5 Keep materials from freezing.
  - .6 Protect materials during storage, handling, and application to prevent contamination or damage.

#### 1.8 PROJECT CONDITIONS

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- .2 Apply materials when air and surface temperatures are between 13 deg C (55 degrees F) and 27 deg C, (80 deg F).

- .3 Do not apply materials when rain, snow, or excessive moisture is expected during application or within 24 hours after application.

## 1.9 SEQUENCING

- .1 Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

## 2 Products

### 2.1 MANUFACTURERS

- .1 Acceptable Manufacturer: Brickform, 11061 Jersey Boulevard, Rancho Cucamonga, California 91730. Toll Free 800-483-9628. Phone 909-484-3399. Fax 909-484-3318. Website [www.brickform.com](http://www.brickform.com).
- .2 Requests for substitutions will be considered in accordance with provisions of Section 01 61 00 - Product Requirements.

### 2.2 MATERIALS

- .1 Day 1 Finishing:
- .2 Dry Integral Concrete Colour: BRICKFORM "Powdered Colour".
  - .1 Compliance: ASTM C979.
  - .2 Colour: Shadow Grey or approved equivalent.
- .3 Antique Release:
  - .1 Product ID:RA by BRICKFORM or approved equivalent.
    - .1 Colour: Charcoal.
- .4 Colourless Bond Breaker.
  - .1 Colourless Bond Breaker: BRICKFORM "Liquid Release".
- .5 Seamless Skins: BRICKFORM Seamless Skins™ are feathered-edged skins that produce continuous texture with no grout or joint lines.
  - .1 Model Number: FM-C.
  - .2 Pattern: Rough Stone Texture characterized by a continuous coarse surface with several distinguishing veins.
- .6 Curing Compound:
  - .1 Clear, non-yellowing, non-staining, breathable, UV stable.
  - .2 Compliance: ASTM C309.
  - .3 Compatible with coloured concrete.
- .7 Concrete Cleaner: BRICKFORM "Antique Release/Efflorescence Remover".
  - .1 Biodegradable.
- .8 Sealer: Low-Sheen Sealer with Traction Grip: BRICKFORM "Safety-Seal".
  - .1 Slip-resistant, UV-resistant, lacquer-based, acrylic, clear sealer.

## 3 Execution

### 3.1 EXAMINATION

- .1 Examine surfaces to receive stamped concrete.

- .2 Notify Landscape Architect of conditions that would adversely affect application or subsequent use.
- .3 Do not begin preparation or application until unacceptable conditions are corrected.

### 3.2 PREPARATION

- .1 Protection of In-Place Conditions: Protect adjacent surfaces, areas, adjoining walls, and landscaping from contact with stamped concrete materials.
- .2 Preparation of Subgrade:
  - .1 Ensure subgrade is uniformly graded, compacted, and moistened.
  - .2 Ensure subgrade is free of standing water.
  - .3 Do not place concrete over soft, frozen, or muddy subgrade.
- .3 Concrete:
  - .1 Specified in Section 03 30 00 - Cast-in-Place Concrete, unless otherwise specified in this section.
  - .2 Cement Content: Minimum 8 sacks per cubic meter.
  - .3 Slump: Maximum 100 mm.
  - .4 Calcium Chloride: Do not use calcium chloride or admixtures containing calcium chloride.
  - .5 Fine and Course Aggregates:
    - .1 Non-reactive.
    - .2 Free of deleterious material.

### 3.3 APPLICATION

- .1 Apply stamped concrete materials in accordance with manufacturer's instructions at locations indicated on the Drawings.
- .2 Integrally Coloured Concrete: Design mix, batch, add colourant, place, finish, and cure concrete in accordance with integral concrete colour manufacturer's instructions.
- .3 Colourless Bond Breaker:
  - .1 Apply colourless bond breaker in accordance with manufacturer's instructions to bottom of stamping mats and on concrete surface, when concrete has reached plastic stage desirable for imprinting.
  - .2 Do not trowel or mix colourless bond breaker into plastic concrete surface.
- .4 Seamless Skins:
  - .1 Utilize seamless skins in accordance with manufacturer's instructions into concrete that has reached plastic stage desirable for imprinting.
  - .2 Use seamless skins to create patterns in concrete as indicated on the Drawings.
- .5 Approved Mock-ups: Match approved mock-ups for patterns, colours, textures, finishing, curing, cleaning, sealing, special effects, and workmanship.

### 3.4 CURING

- .1 Cure concrete in accordance with manufacturer's instructions.
- .2 Apply curing compound in accordance with manufacturer's instructions.
- .3 Do not cure concrete using materials or methods harmful to concrete surface, including:
  - .1 Low-pressure or high-pressure steam.
  - .2 Burlap.

- .3 Plastic sheeting.
- .4 Membrane paper.
- .5 Water misting.
- .6 Sodium-silicone-type hardeners.

### 3.5 CLEANING

- .1 Clean concrete in accordance with manufacturer's instructions.
- .2 Apply concrete cleaner in accordance with manufacturer's instructions to remove:
  - .1 Excess coloured bond breaker/antiquing release agent.
  - .2 Efflorescence.
  - .3 Cement scale.
- .3 Apply concrete cleaner before sealing concrete surface.

### 3.6 SEALING

- .1 Seal concrete surfaces in accordance with manufacturer's instructions.
- .2 Apply sealer to clean and dry concrete surfaces in accordance with manufacturer's instructions after concrete has cured a minimum of 28 days.
- .3 Apply sealer uniformly over entire stamped concrete surface.
- .4 Do not allow traffic on finished sealed surfaces for the following periods after application:
  - .1 Foot Traffic: Minimum 24 hours.
  - .2 Heavy Traffic: Minimum 72 hours.

### 3.7 PROTECTION

- .1 Exterior Surfaces: Protect applied stamped concrete to ensure that, except for normal weathering, concrete will be without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

1 General

**1.1 SUMMARY**

- .1 This Section includes supply and installation of unit masonry and dimensional stone veneer cladding coordinate with structural general notes and drawings
- .2 assemblies consisting of the following:
- .3 Concrete Masonry Units (CMUs)
- .4 Fire Rated Concrete Masonry Units (CMUs)
- .5 Dimensional Stone Veneer Cladding
- .6 Mortar, and Grout
- .7 Reinforcing steel
- .8 Masonry joint reinforcement
- .9 Ties and anchors
- .10 Embedded flashing
- .11 Miscellaneous masonry accessories

**1.2 RELATED REQUIREMENTS**

- .1 General Requirements shall apply.
- .2 Review and comply with N.B.C. Section 9.20. Above Grade Masonry, and CAN3- S304 Masonry Design for Buildings. These material and performance standards shall apply as if repeated here.
- .3 Related Work:
  - .1 Coordinate with structural general notes & drawings
  - .2 Section 05 50 00 - Metal Fabrications
  - .3 Section 07 26 00 - Vapour Retarders (Air Barriers)
  - .4 Section 07 21 13 - Board Insulation
  - .5 Section 07 62 00 - Sheet Metal, Flashing and Trim
  - .6 Section 07 84 00 - Fire Stopping and Smoke Seals
  - .7 Section 07 92 00 - Joint Sealants
  - .8 Section 08 11 00 - Metal Door and Frames
  - .9 Section 08 51 13 - Windows (Aluminum)
  - .10 Section 09 90 00 - Painting
- .4 Tolerances:
  - .1 Planes within 3mm perm under straight edge
  - .2 Plumb within 6mm in 3m, or in 6m at external corners
  - .3 Level within 6mm in 6m
  - .4 Joints as indicated but in no case greater than 12mm
- .5 Store and handle masonry units to protect from ground contact and other materials until laid to prevent staining Cover masonry unit stock piles, to prevent exposure to weather.

.7 References:

- .1 CAN/CSA A165 SERIES, CSA Standards on Concrete Masonry Units, covers: A165.1, A165.2, A165.3.
- .2 CAN/CSA A371, Masonry Construction for Buildings.
- .3 CSA S304.1, Design of Masonry Structures.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings: conduct pre-installation meeting in accordance with Section 04050 – Common Work Results for Masonry to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and data sheet. Indicate VOC's for joint fillers and sealants.
- .2 Manufacturer's Instructions:
  - .1 Provide manufacturer's installation instructions.
- .3 Shop Drawings:
  - .1 Provide drawings indicating sizes and sections of stone, arrangements of joints and bonding, anchoring, dowelling and cramping.
- .4 Samples:
  - .1 Provide 2 samples of all materials.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data:
  - .1 Provide maintenance data for incorporation into manual specified in Division 1.

**1.6 QUALITY ASSURANCE**

- .1 Quality Control
  - .1 Obtain stone from single quarry source with resources to provide materials of specified consistent quality.
  - .2 Obtain mortar ingredients of uniform quality and from a single manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.
  - .3 Obtain each type of stone accessory, sealants and other materials from a single manufacturer for each product.
- .2 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01450 – Quality Control and to requirement of Section 04050 – Common Work Results for Masonry , supplemented as follows:
  - .2 Erect an independent sample of exterior masonry, showing finished colour of unit and mortar, type of unit, joint, coursing, 2 m x 1 m, complete with all accessories. Mock-up to include corner condition and sill. Obtain Department Representative's approval. This sample is to remain intact until work of this Section is complete. Perform test cleaning on mock-up to ensure desired result as per article 3.14 Cleaning.

## 1.7 SITE CONDITIONS

- .1 Ambient Conditions:
  - .1 Cold Weather Requirements: IMIAC - Recommended Practices and Specifications for Cold Weather Masonry Construction.
- .2 Field Measurements:
  - .1 Make field measurements necessary to ensure the proper fit of all members.

## 2 Products

### 2.1 DIMENSION CULTURED STONE VENEER CLADDING

- .1 Manufacturers
  - .1 Shouldice or approved equal. Stone to match Campground Reception Building located in the Cyprus Lake Campground, Tobermory Ontario.
- .2 Design Criteria
  - .1 General: design, fabricate and install stonework to withstand normal loads from wind, gravity, movement of building structure, seismic forces and thermally induced movement, as well as to resist deterioration under conditions of normal use including exposure to weather, without failure.
  - .2 Retain services of cladding engineer, as described below, to design the cladding support and retention system. Cladding engineer will prepare engineering calculations for justification of principal stonework, units, fasteners, and anchorage components for compliance with performance criteria.
  - .3 Engineering Calculations: base calculations on design loads, material properties, and applicable safety factors, in compliance with applicable codes and Building Standards. Include following information as part of calculations:
    - .1 Stone loads and allowable loads,
    - .2 Stone thicknesses,
    - .3 Support and anchorage loads, stresses, safety factors, design loads, and allowable loads, Support and anchorage sizes.
  - .4 Design connections and attachments for limestone to CAN/CSA A370.
  - .5 Design, detail and fabricate connections to provide allowance for fabrication tolerances, erection tolerances and structural deflections. Refer to CAN/CSA A370 and CAN/CSA A371 ASTM C 1242.
  - .6 Control of Corrosion: prevent galvanic and other forms of corrosion by insulating metals and other materials from direct contact with non-compatible materials, or by suitable coating.
- .3 Stone Materials
  - .1 Stone material to match installed stone on the Cyprus Lake Campground Reception Building. Final stone material to be approved by AECOM and Parks Canada.
- .4 Fabrication
  - .1 Cut stone to shape and dimensions and full to square with joints as indicated.
  - .2 Dress exposed faces true.
  - .3 Cut stone for sills and lintels to lay on its natural quarry bed.
  - .4 Execute profiled work from full size details and templates.

- .5 Make exposed arises in true alignment and ease slightly to prevent snipping.
- .6 Back-check stone contacting structural members as indicated.
- .7 Allow minimum of 25 mm clearance between back of stone and concrete block.
- .8 Shape beds of stone resting on structural work to fit supports.
- .9 Cut stones for anchors, cramps, dowels and support systems.
- .10 Provide Lewis pin and clamp holes in pieces which cannot be manually lifted.
- .11 Do not cut holes in exposed surfaces.
- .12 Finish exposed faces and edges of stones to comply with requirements indicated for finish and to match approved samples and field-constructed mock-up.

## **2.2 THROUGH WALL FLASHING**

- .1 Flexible Flashing: Blueskin reinforced membrane through-wall flashing.
- .2 Sheet Metal: Prefinished.

## **2.3 BACK PRIMING FOR FLASHING**

- .1 Bituminous paint, alkali resisting, CGSB1-GP-1 08.

## **2.4 LAP CEMENT**

- .1 CGSB 37-GP-4 Tremco Acoustical Sealant.

## **2.5 JOINT REINFORCEMENT**

- .1 Standard weight by Blok-Lok Limited, galv. Finish to ASTM A 116 Class 3.

## **2.6 MASONRY MORTAR**

- .1 CAN3-A8-M colour to be to Department Representative's selection and shall depend on final brick and block selection. Intent is to match existing as closely as possible.
  - .1 Exterior Above Grade: Type N.

## **2.7 PRECAST STONE SILL**

- .1 Pre-cast concrete exterior grade sill as per contract drawings.

## **2.8 CAULKING**

- .1 Sika or approved equal.

## **2.9 STAINLESS STEEL VENEER ANCHORS**

- .1 Masonry veneer to wood stud: Wrap Tie system by Fero Connectors
- .2 Masonry veneer to concrete block back-up: Wrap Tie system by Fero Connectors
- .3 Where no rigid insulation to be Cat Tie System with AB clip and 'V' tie .4
- .4 Where cavity wall use Wrap Tie System by Fero Connectors with 'L' plate,V' tie and insulation support .
- .5 Note, where anchors have been specified by Structural, Structural specifications shall take precedence.

## **2.10 JOINT BREATHERS**

- .1 P.V.C. Brick Vent by Goodco Limited or Block-Lok Limited.

## **2.11 CONTROL JOINT**

- .1 To meet quality standard of Blok-Tite by Blok-Lok limited and be located as per drawings or at 6m intervals.

3 Execution

**3.1 EXAMINATION**

- .1 Verify that site conditions are ready to receive work.
- .2 Inspect materials for fit and finish prior to installation. Do not set unacceptable units.
- .3 Beginning of installation means acceptance of site conditions.

**3.2 LAY-UP**

- .1 Lay-up of the stone to have random pattern as per manufacturer's installation guide.
- .2 Dressing of the stone (bellies) to be no greater than 35 percent of the total.
- .3 Undressed stone to have 20 percent of the stone facing standing proud 25 mm – 50 mm on full coursing runs to create three (3) dimensional depth and shadowing.

**3.3 PREPARATION**

- .1 Waterproof exterior slabs on back prior to setting.
- .2 Clean stone surfaces by washing with stiff fibre brush and water.

**3.4 INSTALLATION/TOLERANCES**

- .1 Variation from Plumb: plus or minus 6 mm per 3 metres maximum.
- .2 Variation from Level: plus or minus 13 mm per 6 metres maximum.
- .3 Variation from Linear Building Line: plus or minus 13 mm per 6 metres maximum.
- .4 Variation in Cross-Sectional Dimensions: plus 13 mm or minus 6 mm.

**3.5 SETTING STONE - GENERAL**

- .1 Construction in accordance with CAN/CSA A371.
- .2 Set stones plumb, true, and level, to requirements as indicated and approved shop drawings.
- .3 Align stone edges and faces according to established relationships and indicated tolerances.
- .4 Provide movement joints of widths and at locations indicated. Ensure movement joints are kept free of mortar.

**3.6 SETTING STONE WITH MORTAR**

- .1 Set stones in full bed of mortar with vertical joints buttered and placed full, except where otherwise specified.
  - .1 Completely fill anchor, dowel and lifting holes.
- .2 Lay stone in random ashlar bond.
  - .1 Connect stone veneer to structural back-up with approved wall ties, spaced not more than 405 mm horizontally and 610 mm vertically.
  - .2 Shim and adjust supports to set stones accurately in locations indicated with uniform joints of widths indicated.
- .3 Make joints 6 mm thick.
- .4 Embed only ends of lugged sills and steps in mortar.
  - .1 Leave balance of joint open for final pointing.
- .5 Place setting buttons under stones to maintain joint thickness.
- .6 Install Precast Concrete Sills and Precast Concrete Bands where shown on Drawings.
- .7 Use soaked softwood wedges to support stone in proper alignment until mortar has set.

- .1 Remove wedges when dry and without breaking them off, fill voids with pointing mortar.
- .8 Install through-wall flashing membranes steel lintels, ledges and similar obstructions to the downward flow of water.
- .9 Install weep hole vents at 800 mm on centre horizontally above through-wall flashing, above shelf angles and at bottom of walls.
- .10 Tool joints after initial set has occurred.
- .11 Rake out joints to 25 mm depth and make ready for pointing with pointing mortar.
  - .1 Sponge stone face along joints and remove droppings and splashed mortar immediately.
- .12 Grouting: pack ends of exposed joints with plastic foam joint filler and after wetting ends of stone, fill joint with grouting mortar to within 19 mm of top.
  - .1 Grout vertical joints of copings, projecting belt courses, steps and platforms.
  - .2 After grout has set, remove packing for pointing.
- .13 Pointing: remove dirt and loose mortar from joints by using pressurized airstream.
  - .1 Wet joints for mortar pointing. Dry joints for sealant pointing.
  - .2 Point joints with pointing mortar in three stages. Rub smooth with appropriate tool to slightly concave joint.
  - .3 Point control joints with sealant. Do work in accordance with Section 07900 -Sealants.

### 3.7 CLEANING

- .1 Clean stone as work progresses.
  - .1 Allow mortar droppings on stone to partially dry then remove by means of brushing with a stiff fibre brush.
- .2 Post-Construction: Clean 10 m<sup>2</sup> area of wall designated by Engineer as directed below and leave for one week. If no harmful effects appear and after mortar has set and cured, clean masonry as follows:
  - .1 Protect windows, sills, doors, trim and other work from damage.
  - .2 Remove large particles with stiff fibre brushes and/or wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
  - .3 Scrub with solution of 25 mL trisodium phosphate and 25 mL household detergent dissolved in 1 litre of clean water using stiff fibre brushes, then clean off immediately with clean water using hose or as recommended by manufacturer.
  - .4 Repeat cleaning process as often as necessary to remove mortar and other stains.
- .3 Use alternative cleaning solutions and methods for difficult to clean stone only after consultation with masonry unit manufacturer.

### 3.8 PROTECTION

- .1 Protect stone from damage resulting from subsequent construction operations.
- .2 Use protection materials and methods which will not stain or damage stone.
- .3 Remove protection materials upon Substantial Performance of Work, or when risk of damage is no longer present.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 20 00 – Finish Carpentry.

**1.2 REFERENCES**

- .1 American National Standards Institute/National Particleboard Association (ANSI/NPA)
  - .1 ANSI/NPA A208.1-2009, Particleboard.
- .2 ASTM International
  - .1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
  - .3 ASTM C578-11a, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - .4 ASTM C1289-11, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - .5 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.
  - .6 ASTM D1761-06, Standard Test Methods for Mechanical Fasteners in Wood.
  - .7 ASTM D5055-11, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
  - .8 ASTM D5456-11, Standard Specification for Evaluation of Structural Composite Lumber Products.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-11.3-M87, Hardboard.
  - .2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
  - .3 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.
  - .4 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .4 CSA International
  - .1 CAN/CSA-A123.2-03(R2008), Asphalt Coated Roofing Sheets.
  - .2 CAN/CSA-A247-M86(R1996), Insulating Fiberboard.
  - .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .4 CSA O112.9-10, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
  - .5 CSA O121-08, Douglas Fir Plywood.
  - .6 CAN/CSA O122-06(R2011), Structural Glued-Laminated Timber.
  - .7 CSA O141-05(R2009), Softwood Lumber.
  - .8 CSA O151-09, Canadian Softwood Plywood.
  - .9 CSA O153-M1980(R2008), Poplar Plywood.
  - .10 CSA O325-07, Construction Sheathing.

- .11 CSA O437 Series-93(R2011), Standards on OSB and Waferboard.
- .12 CAN/CSA-Z809-08, Sustainable Forest Management.
- .5 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber 2010.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings indicating framing layout.

### 1.4 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood and wood based composite panels in accordance with CSA and ANSI standards.

### 1.5 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 off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wood from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 2 Products

### 2.1 FRAMING STRUCTURAL AND PANEL MATERIALS

- .1 Description:
  - .1 Sustainability Characteristics:
    - .1 Lumber, Finger Jointed Lumber, Trusses, SCL, CAN/CSA-Z809 or FSC or SFI certified.
    - .2 Plywood, Particleboard and OSB urea-formaldehyde free, CAN/CSA-Z809 or FSC or SFI certified.
- .2 Lumber: softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
  - .1 CSA O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.

- .3 Glued end-jointed (finger-jointed) lumber NLGA Special Products Standard.
- .4 Light-frame trusses in accordance with "Truss Design and Procedures for Light Metal Connected Wood Trusses", The Truss Plate Institute of Canada.
- .5 Structural Composite Lumber (SCL) in accordance with ASTM D5456.
- .6 Framing and board lumber: in accordance with NBC.
- .7 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
  - .1 Board sizes: "Standard" or better grade.
  - .2 Dimension sizes: "Standard" light framing or better grade.
  - .3 Post and timbers sizes: "Standard" or better grade.
- .8 Plywood, OSB and wood based composite panels: to CSA O325.
- .9 Douglas fir plywood (DFP): to CSA O121, standard construction.
- .10 Canadian softwood plywood (CSP): to CSA O151, standard construction.
- .11 Poplar plywood (PP): to CSA O153, standard construction.
- .12 Gypsum sheathing: to ASTM C1396/C1396M.

## 2.2 ACCESSORIES

- .1 Polyethylene film: to CAN/CGSB-51.34, Type 1, 0.15 mm thick.
- .2 Roll roofing: to CAN/CSA A123.2, Type S.
- .3 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
  - .1 Sealants: VOC limit 250 g/L maximum.
- .4 Subflooring adhesive: to CAN/CGSB-71.26, cartridge loaded.
  - .1 Adhesives: VOC limit 120 g/L maximum.
- .5 General purpose adhesive: to CSA O112.9.
  - .1 VOC limit 200 g/L maximum.
- .6 Nails, spikes and staples: to CSA B111.
- .7 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .8 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .9 Joist hangers: minimum 1 mm thick sheet steel, galvanized ZF001 coating designation.
- .10 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, formed to prevent dishing. Bell or cup shapes not acceptable.
- .11 Roof sheathing H-Clips: formed "H" shape, thickness to suit panel material, extruded 6063-T6 aluminum alloy type approved by Consultant.
- .12 Fastener Finishes:
  - .1 Galvanizing: to ASTM A123/A123M ASTM A653, use galvanized fasteners for exterior work interior highly humid areas pressure-preservative fire-retardant treated lumber.
- .13 Wood Preservative:
  - .1 Preservative: in accordance with manufacturer's recommendations for surface conditions:
    - .1 Preservative: VOC limit 350 g/L maximum.
    - .2 Coatings: VOC limit 350 g/L maximum.

3 Execution

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant 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 Consultant.

**3.2 PREPARATION**

- .1 Treat surfaces of material with wood preservative, before installation.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.
- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
- .4 Treat material as follows:
  - .1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.
  - .2 Wood furring for exterior wall siding framing.
  - .3 Wood sleepers supporting wood subflooring over concrete slabs in contact with ground or fill.

**3.3 MATERIAL USAGE**

- .1 Roof Insulation Sheathing:
  - .1 Plywood, DFP or CSP sheathing grade or PP standard sheathing grade, pressure treated, T G square edge, 19 mm thick.
- .2 Exterior wall sheathing:
  - .1 16 mm plywood, as indicated in Section 09 21 16.
- .3 Blocking:
  - .1 Wood blocking for all wall mounted fixtures and accessories as indicated.

**3.4 INSTALLATION**

- .1 Install members true to line, levels and elevations, square and plumb.
- .2 Construct continuous members from pieces of longest practical length.
- .3 Install spanning members with "crown-edge" up.
- .4 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .5 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding electrical equipment mounting boards, and other work as required.
- .6 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.
  - .1 Align and plumb faces of furring and blocking to tolerance of 1:600.

- .7 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .8 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.
- .9 Install sleepers as indicated.
- .10 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.
- .11 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .12 Countersink bolts where necessary to provide clearance for other work.
- .13 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

### **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 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.

### **3.6 PROTECTION**

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

**END OF SECTION**

1 General

**1.1 SUMMARY**

- .1 Supply all labour, materials, equipment, services and perform all operations required to complete all glued-laminated construction, including modifications to existing glued-laminated members, including the complete installation of all hardware all other items, to the full intent of the drawings and as herein specified herein.
- .2 Cooperate with other trades for satisfactory completion of the Work.

**1.2 RELATED REQUIRMENTS**

- .1 Section 07 62 00: Sheet Metal Flashing and Trim
- .2 Section 06 10 00: Rough Carpentry
- .3 Contract Drawings: Structural General Notes & Wood Canopy Design Loads

**1.3 QUALITY ASSURANCE**

- .1 Certification:
  - .1 The glued-laminated elements shall be fabricated and erected by a manufacturing plant certified by the Canadian Standards Association in the appropriate category(ies) according to CSA Standard 0177-06 (R2011), Class X, Qualification Code for Manufacturers of Structural Glued-Laminated Timber.
  - .2 The glued-laminated timber manufacturer shall be certified in accordance with CSA's certification procedures for glued-laminated timber plants prior to submitting his tender and shall specifically verify as part of his tender that his plant is currently certified in the appropriate category(ies).
  - .3 Only glued-laminated elements fabricated in such certified plants shall be acceptable to the Owner and plant certification shall be maintained for the duration of the fabrication and erection for this project.
- .2 Contractor executing work of this section shall have continuous Canadian experience in successful manufacture/fabrication and installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.
- .3 Follow applicable requirements of CSA Standard 0122-06 (R2011) Structural Glued-Laminated Timber, including all supplements and modifications.
- .4 Structural steel elements shall conform to requirements of CAN/CSA-S16-09, Design of Steel Structures, and CAN/CSA-S136-07, Cold Formed Steel Structural Members.
- .5 Any organization undertaking to weld under this contract shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.1-09 and W55.3-08.
- .6 Supplements and modifications to the above standards as indicated on the drawings or as specified herein shall govern work of this section.
- .7 Regular site reviews of the erection must be performed by the stamping shop drawing engineer and reports outlining and deficiencies and corrective measures to be provided to AECOM for review.

**1.4 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Shop Drawings:
  - .1 Prepare and submit shop and erection drawings which conform to the requirements of the General Instructions, CAN3-086M, and as specified herein.

- .2 Shop drawings for glued-laminated structural units shall indicate the size, stress grade, service grade, and appearance grade, shop applied finishes, camber, cuts, holes and connection details. Include necessary plans, elevations and details. Indicate size and type of fastening. For weld connections use welding symbols in compliance with AWS and indicate clearly net weld lengths.
  - .3 Submit typical details of connections and any special connections for approval before preparation of shop drawings.
  - .4 Shop drawings submitted shall bear the seal of a Registered Professional Engineer, licensed in the place of the Work, responsible for the design of items supplied by the manufacturer.
  - .5 Review of shop drawings by the Consultant will not absolve the Contractor from the responsibility of providing materials and equipment to complete and finish the work in accordance with the architectural and structural drawings. Departures or differences from the referenced drawings shall be approved in writing by the Consultant.
  - .6 The Subcontractor shall include in his delivery schedule a minimum of two (2) weeks for Consultant review of shop drawings.
- .3 Samples:
- .1 Submit two (2) samples of glued-laminated material showing quality, texture, finish and colour, representative of proposed glued-laminated members, for approval prior to fabrication.

## 1.5 DELIVERY, STORAGE, HANDLING & PROTECTION

- .1 Coordinate deliveries to comply with construction schedule and arrange ahead for strategic off-the-ground, under cover storage locations. Do not load any area beyond the design limits.
- .2 Wrap glued-laminated members prior to leaving the plant with a suitable non-staining, waterproof covering.
- .3 Materials shall be carefully checked, unloaded, stored and handled to prevent damage. Use padded non-marring slings for handling glued-laminated members. Protect corners from crushing with wood blocking.
- .4 Store glued-laminated members, blocked off the ground and separated with wood strips away from high traffic areas. Ensure air may circulate around all faces of members.
- .5 Slit underside of waterproof covering during storage on site. Do not deface member.
- .6 Unsatisfactory materials shall be promptly removed from the site.
- .7 Maintain waterproof coverings until members are completely installed, then remove coverings, completely.
- .8 Adequately protect the structure and work of other sections during delivery, storage, handling and execution of the work of this section.
- .9 Provide tools, plant and other equipment required for the proper execution of the work of this section.

## 2 Products

### 2.1 MATERIALS

- .1 Glued-laminated timbers:
  - .1 Unless otherwise indicated on drawings, all glued-laminated timber shall be the highest quality appearance grade, stress grade as required, in accordance with CSA standards and treated for exterior applications.
- .2 Steel for connections: to CSA G40.21-04 (R2009), Type 300W. Galvanizing for steel: hot dipped, minimum zinc coating of 600 g/sq.m.

## 2.2 FABRICATION AND WORKMANSHIP

- .1 Work shall be executed by skilled workers under the supervision of a competent foreman. All items shall be shop assembled, insofar as is practical.
- .2 Make thorough examination of drawings and details, check anchorage, interfacing with work of other Sections and other factors influencing the installation of the work, and be fully cognizant of requirements.
- .3 Glued-Laminated Timbers:
  - .1 Finished glued-laminated timbers shall be free from bruises, blemishes, mineral marks, knots, shakes and other defects and shall be selected for uniformity of colour, grain and texture.
  - .2 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other sections.
  - .3 Machine dressed work shall be properly machined, using sharp cutters, the finished work shall be free from drag, feathers, slivers or roughness of any kind. Remove machine marks by sanding.
  - .4 Finished glued-laminated timbers shall be carefully sanded after fabrication to remove roughness and planer marks to leave a smooth scratch-free surface suitable to receive the stain/natural finishes to be applied over as specified in Section 09 90 00.
- .4 Connectors and anchorage:
  - .1 Fabricate work to be concealed in final assembly where possible and where exposed, to be neat appearance, laid out in uniform and consistent manner acceptable to Consultant.

## 2.3 MOISTURE CONTENT

- .1 Moisture content of glued-laminated timbers shall be between 7% and 15%.

## 2.4 FINISHES

- .1 Wood items provided under this section shall be finished as part of the work of this section.
- .2 All finishes and colours to be approved by Parks Canada and AECOM.
- .3 Finish all exterior glued-laminated members as recommended by manufacturer for exterior applications. Provide transparent colour with low sheen finish.
- .4 Apply oil or stain to items providing uniform required colour(s).

## 3 Execution

### 3.1 PREPARATION RELATED TO OTHER TRADES

- .1 As the work of the other trades progresses, supply anchor bolts, bearing plates and other members required to be built-in with the work of other trades.
- .2 Give necessary instructions to other trades for setting bearing plates, anchor bolts and other members to be built in with the work of other trades.

### 3.2 CONDITION OF SURFACES

- .1 Inspect and verify the locations and elevations and check surfaces of elements which the work of this Section is dependent for any irregularities detrimental to the application and performance of the work. Notify Consultant in writing of all conditions which are at variance with those on the Contract Documents and/or detrimental to the proper and timely installation of the work of this section. The decision regarding correct measures shall be obtained from the Consultant prior to proceeding with the affected work.
- .2 Commencement of work indicates acceptance of surfaces and conditions.

### 3.3 INSTALLATION - GENERAL

- .1 Make adequate provision for horizontal and vertical erection loads and for sufficient temporary bracing to keep structural glue-laminated timbers plumb and in true alignment until the completion of erection and installation of other work and roof decks which provide the necessary permanent bracing. Any failure to make proper and adequate provisions for erection stresses shall be entirely at the risk and responsibility of the Contractor.
- .2 The erection sequence shall not place undue or eccentric stresses on the connections.
- .3 When temporary members are required for erection purposes, such members shall be provided, and removed when no longer required.
- .4 Do not field cut or alter members without Design Consultants written approval.
- .5 Handle and store structural glued-laminated members on the job site in such a manner that no damage shall be caused to the material, or the structure.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 07 21 16: Blanket Insulation
- .3 Section 07 46 23: Wood Siding
- .4 Section 09 21 16: Gypsum Board Assemblies

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM C208-12, Standard Specification for Cellulosic Fiber Insulating Board.
  - .2 ASTM C591-13, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - .3 ASTM C612-14, Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
  - .4 ASTM C726-12, Standard Specification for Mineral Fiber Roof Insulation Board.
  - .5 ASTM C1126-14, Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
  - .6 ASTM C1289-14, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - .7 ASTM E96/E96M-13, Standard Test Methods for Water Vapour Transmission of Materials.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 71-GP-24M-AMEND-77(R1983), Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
  - .2 CAN/ULC-S702-2012, Standard for Mineral Fibre Insulation for Buildings.
  - .3 CAN/ULC-S704-11, Standard for Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced.

**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 board insulation and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures. Indicate VOC's during application and curing.
- .3 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

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

### 2 Products

#### 2.1 INSULATION

- .1 Perimeter and Underslab Insulation Board:
  - .1 Closed-cell, cellular, foamed, smooth skin, extruded expanded polystyrene, having 30 psi compressive strength, thicknesses as indicated on drawings and specified herein, conforming to CAN/ULC S701, Type IV.
  - .2 Provide underslab insulation board with shiplapped edges.

#### 2.2 ADHESIVE

- .1 Trowelable Polystyrene Insulation Adhesive: Trowel consistency, synthetic rubber based insulation adhesive compatible with polystyrene insulation in accordance with CGSB 71 GP 24M; suitable for application to temperature of -10 deg C or lower, as approved by insulation board supplier.

#### 2.3 ACCESSORIES

- .1 Insulation clips: impale type, perforated 50 x 50mm cold rolled carbon steel 0.8mm thick, adhesive back, spindle of 2.5mm diameter annealed steel, length to suit insulation, 25mm diameter washers of self-locking type.
- .2 Mechanical Fasteners: High quality, impact resistant plastic fastener system specifically designed for installation of board insulation materials; 38mm (1-1/2") diameter, shaft length to suit insulation thickness and hot dipped galvanized fastener to suit substrate.

### 3 Execution

#### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for board insulation application in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant 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 Consultant.

### 3.2 INSTALLATION

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .4 Offset both vertical and horizontal joints in multiple layer applications.
- .5 Do not enclose insulation until it has been inspected and approved by Consultant.

### 3.3 RIGID INSULATION INSTALLATION

- .1 Apply adhesive to insulation board and substrate at rate of recommended by the manufacturer, by notched trowel.
- .2 Imbed insulation boards into vapour barrier type adhesive, applied as specified, prior to skinning of adhesive.
- .3 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150 mm wide 0.15 mm modified bituminous membrane over expansion and control joints using compatible adhesive and primer before application of insulation.

### 3.4 PERIMETER FOUNDATION INSULATION

- .1 Interior application: extend boards as indicated, vertically below bottom of finish floor slab, installed on inside face of perimeter foundation walls.
- .2 Exterior application: extend boards to top of footing. Install on exterior face of perimeter foundation wall with adhesive.
- .3 Under slab application: extend boards as indicated, in from perimeter foundation wall. Lay boards on level compacted fill.

### 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 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**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00: Rough Carpentry.
- .2 Section 07 21 13: Board Insulation.
- .3 Section 07 26 00: Vapour Retarders.
- .4 Section 09 21 16: Gypsum Board Assemblies.

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM C553-13, Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .2 ASTM C665-12, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - .3 ASTM C1320-10, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
- .2 CSA Group
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .2 CSA B149 PACKAGE-10, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code.
- .3 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S702-2012, Standard for Mineral Fibre Insulation for Buildings.

**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 blanket insulation and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with 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 off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect specified materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse by manufacturer and return of padding, packaging materials crates, pallets, in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 Products

**2.1 ACCEPTABLE PRODUCTS**

.1 Mineral Fibre Batt Insulation:

.1 Un-faced, preformed mineral slag batt insulation in accordance with CAN/ULC S702-09, Type 1; having a nominal RSI of 0.67/25 mm; rated non-combustible in accordance with CAN/ULC S114-05 and having a flame spread rating of 5 or less in accordance with CAN/ULC S102; square edges, thickness as required to meet design insulation values indicated on drawings or as required to fill insulated spaces where not indicated.

.2 Basis of Design Materials:

.1 Roxul Inc., Roxul Safe and Sound

3 Execution

**3.1 EXAMINATION**

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for blanket insulation application in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant 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 Consultant.

**3.2 INSULATION INSTALLATION**

.1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to ASTM C1320.

.2 Install insulation with factory applied vapour barrier facing warm side of building spaces and vapour permeable membrane facing cold side. Lap ends and side flanges of membrane over framing members. Retain in position with staples installed as recommended by manufacturer. Tape seal butt ends and lapped side flanges. Do not tear or cut vapour barrier.

.3 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.

.4 Do not compress insulation to fit into spaces.

.5 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures.

.6 Do not enclose insulation until it has been inspected and approved by Consultant.

**3.3 CLEANING**

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 07 21 16: Blanket Insulation

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
  - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

**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 vapour retarders and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures.
- .3 Certificates:
  - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 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, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect specified materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse by manufacturer and return of crates, padding, packaging materials pallets, in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 Products

**2.1 SHEET VAPOUR BARRIER**

- .1 Polyethylene film: to CAN/CGSB-51.34, 0.10 mm thick. (6 mil. Poly minimum)

**2.2 ACCESSORIES**

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

- .2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer. To Section 07 92 00 - Joint Sealants.
- .3 Staples: minimum 6 mm leg stainless steel.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

### 3 Execution

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder on warm side of exterior wall, and ceiling, prior to installation of gypsum board to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

#### 3.3 EXTERIOR SURFACE OPENINGS

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

#### 3.4 PERIMETER SEALS

- .1 Seal perimeter of sheet vapour barrier as follows:
  - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
  - .2 Lap sheet over sealant and press into sealant bead.
  - .3 Install staples through lapped sheets at sealant bead into wood substrate.
  - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

#### 3.5 LAP JOINT SEALS

- .1 Seal lap joints of sheet vapour barrier as follows:
  - .1 Attach first sheet to substrate.
  - .2 Apply continuous bead of sealant over solid backing at joint.
  - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
  - .4 Install staples through lapped sheets at sealant bead into wood substrate.
  - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

#### 3.6 ELECTRICAL BOXES

- .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
  - .1 Install moulded box vapour barrier.

- .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

### 3.7 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.
  - .1 Remove insulation material spilled during installation and leave work area ready for application of wall board.
- .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**

1 General

**1.1 GENERAL REQUIREMENTS**

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

**1.2 SUMMARY**

.1 Supply labour, materials, plant, tools and equipment to complete the Work as shown on the Drawings and as specified herein, including, but not limited to the following:

- .1 Materials and installation methods of vapour permeable air barrier membrane system.
- .2 Materials and installation methods to bridge and seal the following air leakage pathways and gaps:
  - .1 Connections of the walls to the roof air barrier. Connections of the walls to the foundations, seismic and expansion points, openings and penetrations of window frames, store front, and other envelope systems, door frames, piping, conduit, duct and similar penetrations, masonry ties, screws, bolts and similar penetrations. All other leakage pathways in the building envelope.

**1.3 RELATED REQUIREMENTS**

- .1 Section 04 22 00: Masonry
- .2 Section 07 21 13: Board Insulation
- .3 Section 07 21 16: Blanket Insulation
- .4 Section 07 92 00: Joint Sealants
- .5 Section 08 11 00: Metal Doors and Frames
- .6 Section 08 51 13: Aluminum Windows
- .7 Section 09 21 16: Gypsum Wallboard
- .8 Contractor shall be responsible for co-ordinating this section with all related sections.

**1.4 PERFORMANCE REQUIREMENTS**

- .1 Provide a vapour permeable air barrier constructed to perform as a continuous air and vapour barrier, and as liquid water drainage plane flashed to discharge any incidental condensation or water penetration.
- .2 The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space.
- .3 The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
  - .1 Foundations and walls.
  - .2 Walls and windows or doors.
  - .3 Different wall systems.
  - .4 Wall and roof.
  - .5 Wall and roof over unconditioned space.
  - .6 Walls, floor and roof across construction, control and expansion joints.
  - .7 Walls, floors and roof to utility, pipe and duct penetrations.
  - .8 All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

## 1.5 QUALITY ASSURANCE

- .1 Work in this Section is to be carried out by a skilled applicator approved by manufacturer and in strict accordance with manufacturer's printed instructions. Upon request, provide written confirmation or certification from the vapour permeable air barrier manufacturer that the installer has been trained and is recognized by the manufacturer as suitable for the execution of the work.
- .2 Perform Work in accordance with the manufacturer's written instructions of the air barrier membrane and this specification.
- .3 Maintain one (1) copy of the manufacturer's written instructions on site.
- .4 Compounds used in this section shall be sourced from one (1) manufacturer, including sheet membrane, air barrier sealants, primers, mastics and adhesives.
- .5 Pre-Installation Conference:
  - .1 Convene a pre-installation conference two (2) weeks prior to commencing work of this section. Require attendance of parties directly affecting work of this section, including, but not limited to, the Owner's representative, Consultant, General Contractor, vapour permeable air barrier membrane contractor, vapour permeable air barrier membrane manufacturer's representative and substrate installer.
  - .2 Contact Consultant two (2) weeks prior to pre-installation conference to confirm schedule.
  - .3 Review preparation and installation procedures and co-ordinating and scheduling required with related work.
  - .4 Record discussions of conference and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. Review foreseeable methods and procedures related to the vapour permeable air barrier membrane, including the following:
    - .1 Tour, inspect and discuss condition of substrate, penetrations and preparatory work performed by other trades.
    - .2 Review surface preparation, minimum curing period and installation procedures.
    - .3 Review special details and flashings.
    - .4 Review required submittals, both completed and yet to be completed.
    - .5 Review and finalize construction schedule related to work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
    - .6 Review required inspections, testing, protection and repair procedures.
    - .7 Review weather and forecasted weather conditions, and procedures for coping with unfavourable conditions.
- .6 Arrange for a Manufacturer's Representative to:
  - .1 Visit the site and discuss any special requirements, procedures and unique conditions, prior to commencement of work.
  - .2 Inspect substrate surfaces and recommend solutions to accommodate adverse conditions.
  - .3 Periodically visit and inspect the installation and report unsatisfactory conditions to the Contractor.
  - .4 Attend final inspection and to submit written certification that the products, systems and assemblies have been installed in accordance with the manufacturer's requirements.
- .7 Inspection and Testing:

- .1 Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed vapour permeable air barrier membrane until any required inspections, testing approvals have been completed.

## 1.6 SUBMITTALS

- .1 Submit submittals in accordance with the General Conditions and Section 01 33 00.
- .2 Documentation:
  - .1 Prior to commencing the Work, submit documentation from an approved independent testing laboratory certifying that the air leakage and vapour permeance rates of the air barrier membranes, including primary membrane and transition sheets, exceed the requirements of the NBC.
  - .2 Prior to commencing the Work submit copies of manufacturer's current ISO certification. Membrane, primers, sealants, adhesives and associated auxiliary materials shall be included.
  - .3 Prior to commencing the Work submit references clearly indicating that the membrane manufacturer/installer has successfully completed projects on an annual basis of similar scope and nature for a minimum of fifteen (15) years. Submit references for a minimum of ten (10) projects.
  - .4 Prior to commencing the Work submit manufacturer's complete set of standard details for the air barrier membrane system showing a continuous plane of air tightness throughout the building envelope.
  - .5 Prior to commencing work provide a material checklist, complete with application rates and minimum thickness of primary membranes.
- .3 Samples:
  - .1 Submit to Consultant for approval, samples of materials and components to be used in vapour permeable air barrier system, prior to fabrication of work together with name of manufacturer and technical literature. Submit 305mm x 305mm (12" x 12") samples of vapour permeable air barrier membrane.
- .4 Safety Data Sheets:
  - .1 Submit WHMIS safety data sheets for inclusion with project record documents. Keep one copy of WHMIS safety data sheets on site for reference by workers.

## 1.7 ENVIRONMENTAL CONDITIONS

- .1 Vapour permeable air barrier membrane is not to be applied to surfaces that are either wet, oily, frosted, dirty or contaminated in any way.
- .2 Maintain surface of substrates and ambient temperatures constantly between 38 degree C and 5 degree C during application and curing of primers and adhesives for flexible vapour permeable air barrier membrane flashings, except as permitted otherwise by Consultant in writing.

## 1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Coordinate deliveries with construction schedule and arrange for proper storage areas.
- .2 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
- .3 Store materials in a clean, dry and protected area, off the floor or ground, in their original containers, sealed and undamaged. Manufacturer's labels are to be easily visible and undamaged. Store rolled materials on end.
- .4 Store liquid membrane materials, adhesives and primers at minimum 5 degree C, and store away from open flames, sparks and excessive heat as liquid membrane materials and primers are flammable because of solvent content.

- .5 Care and precaution are to be exercised by the applicator so as not to damage the work of other trades. Applicator is responsible to take all necessary precautions to protect work of other trades during application.
- .6 In addition to the above, store modified bituminous sheet type flexible vapour permeable air barrier membrane flashings as follows;
  - .1 Store rolls of membrane tape in accordance with manufacturers written instructions.
  - .2 Store materials away from direct heat or open flame.
  - .3 Store rolls away from direct sunlight until ready for use.
  - .4 For installation in cold weather, store rolls of membrane in heated storage trailer for minimum of 24-hours with the temperature kept at 21 degree C and remove for application with as little exposure as possible to low ambient temperatures.
- .7 The vapour permeable air barrier membrane is not designed for permanent exposure, but can be left exposed for up to a maximum of thirty (30) days. As soon as possible after the membrane has cured, protect vapour permeable air barrier membrane from damage by work of other Sections.

## 1.9 WARRANTY

- .1 Warrant the work of this Section against defects in materials and workmanship in accordance with the General Conditions, but for a period of two (2) years and agree to repair and replace faulty materials or work which becomes evident during the warranty period, without cost to the Owner. Provide the Owner with a written warranty to this effect.

## 2 Products

### 2.1 MATERIALS

- .1 Flexible Vapour Permeable Air Barrier:
  - .1 Sheet-applied, self-adhering vapour permeable membrane bonded with permeable adhesive layer and split-back poly-release film.
    - .1 Basis of Design Product: Blueskin VP160 by Henry Bakor.
- .2 Flexible Air Barrier Membrane Flashing Primer:
  - .1 Water based, polymer emulsion type.
    - .1 Basis of Design Product: Blueskin Aquaprime by Henry Bakor Inc.
- .3 Flexible Air Barrier Membrane Flashings (Transition Flashings):
  - .1 40 mils (1mm) thick x width to suit, strips of self-adhering, SBS rubberized asphalt laminated to a cross-laminated, high density polyethylene film with a silconized release liner.
    - .1 Basis of Design Product: Blueskin TWF by Henry Bakor
- .4 Reinforcing Fabric (Joint Treatment Mesh):
  - .1 150mm (6") wide, open weave 20/10 mesh, glass fibre yarn saturated with synthetic resins, reinforcing fabric fabric weighing minimum of 2.5 oz/sq.yd., and conforming to CGSB 37-GP-63M
    - .1 Basis of Design Product: Yellow Jacket 990-06 by Henry Bakor
- .5 Air Barrier Sealant:
  - .1 High solids, high flexibility, polymer modified, rubberized asphalt type sealant, compatible to vapour permeable air barrier membrane and conforming to CAN/CGSB-37.29-M.
    - .1 Basis of Design Product: Polybitume Sealing Compound by Henry Bakor

- .6 Substrate Cleaners:
  - .1 Petroleum spirits thinner or low flash petroleum spirits (mineral spirits) conforming to CAN/CGSB-1.4-2000, or xylene thinner (xylol) conforming to CAN/CGSB-1.49-M.
- .7 Packing Insulation:
  - .1 Loose, glass fibre or mineral fibre insulation, 1.0 lbs./cu.ft. density, and conforming to CAN/CGSB-51.11.

### 3 Execution

#### 3.1 EXAMINATION

- .1 The installer shall examine conditions of substrates, areas and other conditions under which the vapour permeable air barrier system will be applied for compliance with requirements.
- .2 Verify that surfaces and conditions are ready to accept the Work of this section. Surfaces shall be sound, dry, even and free of oil, grease, dirt, excess mortar or other contaminants. Concrete surfaces shall be cured and dry, smooth without large voids, spalled areas or sharp protrusions. Masonry joints shall be flush and completely filled with mortar, and all excess mortar sitting on masonry ties shall have been removed. Verify substrate is visibly dry and free of moisture.
- .3 Notify the Consultant in writing of any discrepancies. Commencement of work or any parts thereof shall mean acceptance of the prepared substrate.
- .4 Do not proceed with application of vapour permeable air barrier membrane when rain is expected within 16-hours.

#### 3.2 GENERAL

- .1 Ensure continuity of the air seal throughout the scope of this section.
- .2 Components and membrane materials must be obtained as a single-source from the membrane manufacturer to ensure total system compatibility and integrity.
- .3 Install all materials in accordance with the manufacturer's written directions, unless otherwise specified herein.

#### 3.3 SURFACE PREPARATION

- .1 Clean, prepare and treat substrates according to manufacturer's written instructions. Surfaces to be coated must be smooth, clean, dry, firm to the touch and free from oil, grease, dirt, excess mortar and other contaminants. Brushing and/or scraping of substrates may be required to adequately prepare surface. Thoroughly wash metal surfaces with mineral spirits or xylol and wipe dry with clean rags.
- .2 Vapour permeable air barrier membrane is not to be applied over lightweight, cast-in-place concrete containing high moisture or certain curing compounds. Cast-in-place concrete should be cured for a minimum of two (2) weeks prior to application of vapour permeable air barrier membrane.
- .3 Concrete surfaces shall be free of large voids and spalled areas. Fill all spalled concrete areas, form-tie holes/voids and open mortar joints in concrete block with mortar to produce a smooth, even surface. Allow to cure properly before proceeding.

#### 3.4 JOINT AND PROTRUSION TREATMENTS

- .1 Prepare only enough vapour permeable air barrier membrane compound as required for joint and protrusion treatments and can be used within compound's usable pot life. Mix vapour permeable air barrier membrane with a double blade agitator attached to a 13mm (1/2") drill in strict accordance with the manufacturer's written instructions.
- .2 Exterior sheathing board inside/outside corners: Embed minimum 305mm (12") wide, continuous strip of reinforcing fabric in vapour permeable air barrier membrane, centred over corner.

- .3 Fill joints up to 6mm (1/4") wide in exterior grade sheathing board and joints in between panels of exterior grade plywood with trowel application of vapour permeable membrane or mastic as recommended by manufacturer ensuring that joints are completely filled.
- .4 Where joints in exterior grade sheathing board are over 6mm (1/4") wide, ensure joints are completely filled with a vapour permeable membrane or mastic and apply continuous flexible air barrier membrane flashing or mesh as specified herein, lapped a minimum of 75mm (3") and fully adhered to both sides of substrate.
- .5 Where joints/cracks up to 6mm (1/4") wide occur in concrete or masonry, fill joints/cracks with a thick trowel application of vapour permeable air barrier membrane or mastic, ensuring that joints are completely filled.
- .6 Where joints/cracks in concrete or masonry are over 6mm (1/4") wide, apply a vapour permeable membrane or mastic as recommended by manufacturer ensuring that joints are completely filled.
- .7 Ensure continuity of air barrier membrane by working air barrier membrane over all exterior sheathing board fasteners and around all masonry ties and anchors and other items.

### 3.5 APPLICATION - FLEXIBLE AIR BARRIER MEMBRANE FLASHINGS

- .1 Apply primer to all substrate areas where flexible air barrier membrane flashings are to be applied. Apply primer using lambs wool roller at rate 100 sq.ft. to 300 sq.ft./gallon (2.044 to 6.131 sq.m./gallon) depending on porosity of substrates. Allow primer to "tack up" for approximately 30-minutes prior to application of flexible air barrier membrane flashings.
- .2 Do not use solvent-based primer where it may be in contact with polystyrene insulation.
- .3 Install flexible air barrier membrane flashings in strict accordance with the manufacturer's written instructions unless otherwise specified herein.
- .4 Ensure a uniform, continuous air barrier effect. Where air barrier membranes are to be provided under other Sections, co-ordinate the work such that air barrier membrane continuity is achieved.
- .5 Provide air tight seals at penetrations in flexible air barrier membrane flashings.
- .6 Apply flexible air barrier membrane flashings to extend air barrier membrane at peripheries of the installation as required to facilitate joining and sealing of the air barrier provided in adjacent construction, lapping joints minimum of 75mm (3"), extending membrane onto adjacent concrete/metal substrates not less than 150mm (6"), centred over joints.
- .7 Apply continuous flexible air barrier membrane flashings at expansion and deflection joints within framing members, lapping joints minimum of 75mm (3"), extending membrane onto adjacent concrete/metal substrates which have no applied air barrier not less than 150mm (6"), centred over joints.
- .8 Flexible Weather Barriers:
  - .1 Provide continuous 457mm (18") side flexible weather barrier membrane in exterior masonry cavity walls at expansion joints.
  - .2 Install flexible weather barrier membrane to substrate with adhesive, in strict accordance with manufacturer's instructions.
  - .3 Loop down flexible weather barrier into expansion/control joints approximately two (2) times the width. Lap joints minimum 150mm (6") and seal. Ensure that flexible weather barrier lap joints which are looped into expansion /control joints are sealed with adhesive. Seal tops and bottoms of membrane barrier at change in construction to present continuous, uninterrupted flexible weather barrier.
  - .4 Pack joint with loose batt insulation with face of insulation down two (2) times the width of expansion from face interior width.

### 3.6 APPLICATION - VAPOUR PERMEABLE AIR BARRIER MEMBRANE - SHEET APPLIED

- .1 Apply self-adhering water resistive air barrier membrane complete and continuous to substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.
  - .1 Align and position self-adhering membrane to substrate, remove top panel of protective release film and press firmly into place.
  - .2 Ensure alignment, hold membrane in place to avoid wrinkles and sequentially remove remaining panels of protective film and press firmly into place.
  - .3 Ensure minimum 75mm (3") overlap at all end and 50mm (2") side laps of subsequent membrane applications.
  - .4 Apply pressure to all membrane surfaces, laps and flashings using an appropriate roller to provide best possible surface adhesion.

### 3.7 PROTECTION AND CLEAN-UP

- .1 Protect membrane to avoid damage from other trades, and construction materials during subsequent operations.
- .2 If the vapour permeable air barrier cannot be covered within thirty (30) days after installation, apply temporary UV protection such as dark plastic sheet or tarpaulins. Contact material manufacturer for further recommendations.
- .3 Clean spillage and soiling on adjacent construction that will be exposed in the finished work using cleaning agents and procedures recommended by the manufacturer of the affected construction.
- .4 Remove any masking materials after installation.
- .5 Applicator is responsible for the removal of surplus and waste material incurred during application.
- .6 Equipment and tools can be cleaned using mineral spirits or xylol.

**END OF SECTION**

1 General

**1.1 SUMMARY**

- .1 This Section includes requirements for supply and installation of factory formed, site assembled, non-structural, concealed fastener, architectural metal roofing system; including accessories required for weather tight installation; job site manufactured materials will not be acceptable for this project.
- .2 Drawings indicate size, profiles, and dimensional requirements of metal roofing system and are based on the specific system indicated; do not modify intended aesthetic effects.

**1.2 RELATED REQUIREMENTS**

- .1 Section 07 21 00 Building Insulation and Vapour Barriers
- .2 Section 07 62 00 Prefinished Metal Flashing and Trim.
- .3 Section 07 71 36 Soffits, Gutters and Rainwater Goods
- .4 Section 07 92 00 Joint Sealants

**1.3 REFERENCE STANDARDS**

- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  - .2 Design of cladding system in accordance to the latest edition of:
    - CSA-S136 for the design of Cold Formed Steel Structural Members
    - Canadian Sheet Steel Building Institute Standards 10M and 20M.
    - National Building Code of Canada
  - .3 ASTM A755/A755M-11, Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
  - .4 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- .2 Canadian General Standards Board (CGSB):
  - .1 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing
- .3 Canadian Standards Association (CSA):
  - .1 CSA A123.3-05 (R2010), Asphalt or Tar Saturated Roofing Felt
  - .2 CSA S136-07, North American Specification for the Design of Cold Formed Steel Structural Members
- .4 Canadian Sheet Steel Building Institute (CSSBI):
  - .1 CSSBI 20M-99, Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications

**1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Construction Meeting: Arrange a pre-construction meeting in accordance with Section 01 31 00 – Project Meetings at project site with Contractor, Subcontractor and Consultant present before starting roof construction; purpose of meeting is to review methods and procedures related to roof construction and metal roofing system including; but not limited to, the following:

- .1 Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - .2 Review methods and procedures related to metal roofing system installation, including manufacturer's written instructions.
  - .3 Examine wood decking or sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
  - .4 Review structural loading limitations of wood decking and sheathing during and after roofing.
  - .5 Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roofing system.
  - .6 Review temporary protection requirements for metal roofing system during and after installation.
  - .7 Review roof observation and repair procedures after metal roofing system installation.
  - .8 Inspection agency will document proceedings, including corrective measures and actions required, and furnish copy of record to each meeting participant.
- .2 Coordination:
- .1 Coordinate metal roofing system with rain drainage work, flashing, trim, and construction of decks, parapets, walls, and other adjoining work to provide a leak proof, secure, and non-corrosive installation.

## 1.5 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittals.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
  - .1 Product Data: Submit product data including; but not limited to, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roofing system and accessory.
  - .2 Shop Drawings: Submit shop drawings indicating fabrication and installation layouts of metal roofing system; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details, identify between factory and site assembled work, include details for the following:
    - .1 Flashing and trim
    - .2 Gutters
    - .3 Pre-finished metal vandal and dent resistant downspouts
    - .4 Roof curbs
    - .5 Snow guards
- .3 Drawings shall be signed and sealed by a Professional Engineer licenced in the province of Ontario, attesting to the ability of the metal panels assembly to withstand the specified loads.
- .4 Samples: Submit two (2) samples for each type of exposed finish required for Consultant's and Owner's verification of finishes, full size physical samples required.
- .5 Informational Submittals: Provide the following submittals when requested by the Consultant:
  - .1 Coordination Drawings: Coordination drawings indicating locations of penetrations and roof mounted items including; but not limited to, the following:
    - .1 Roof systems and attachments.
    - .2 Pipe supports and penetrations
    - .3 Lighting fixtures

- .4 Snow guards
- .5 Items mounted on roof curbs

#### 1.6 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit manufacturers written maintenance data for metal roofing system, include name of original installer and contact information for inclusion in maintenance manuals in accordance with Section 01 77 19 Close-Out Requirements.

#### 1.7 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Consultant:
  - .1 Manufacturer: Obtain each type of metal roofing system through one source from a single manufacturer.
  - .2 Installer: Use only installers that are trained and qualified by factory formed roofing panel manufacturer, and who have experience in projects of similar complexity and scope.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver components, metal roofing system, and other manufactured items to prevent damage or deformation; package metal roofing system for protection during transportation and handling.
- .2 Storage and Handling Requirements: Unload, store, and erect metal roofing system in a manner to prevent bending, warping, twisting, and surface damage, and as follows:
  - .1 Protect metal roofing system to prevent wetting of materials, and as follows:
    - .1 Stack metal roofing system on platforms or pallets, covered with suitable weather tight and ventilated covering.
    - .2 Do not store metal roofing system in contact with other materials that might cause staining, denting, or other surface damage.
  - .2 Protect strippable protective covering on metal roofing system from exposure to sunlight and high humidity, except to extent necessary for period of metal roofing system installation.
  - .3 Protect foam plastic insulation from surface degradation, and as follows:
    - .1 Do not expose to sunlight, except to extent necessary for period of installation and concealment.
    - .2 Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
    - .3 Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

#### 1.9 SITE CONDITIONS

- .1 Site Measurements: Verify locations of roof framing and roof opening dimensions by site measurements before metal roofing system fabrication and indicate measurements on shop drawings.
- .2 Established Dimensions: Establish framing and opening dimensions and proceed with fabricating metal roofing system without site measurements where site measurements cannot be made without delaying the Work, or allow for site trimming of panels; coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.
- .3 Ambient Conditions: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roofing system in accordance with manufacturers' written instructions and warranty requirements.

## 1.10 WARRANTY

- .1 Provide manufacturer's standard form of warranty stating that manufacturer agrees to repair or replace components of metal roofing system that fail in materials or workmanship within specified warranty period; failures will be considered to include; but are not limited to, the following:
  - .1 Structural failures, including rupturing, cracking, or puncturing.
  - .2 Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - .3 Deterioration of finishes, peeling or cracking of coating, failure to adhere to bare metal, colour fading and chalking.
- .2 Warranty Period:
  - .1 Material & Finishes: Forty (40) years from date of Substantial Performance.
  - .2 Weather Tightness: Five (5) years from date of Substantial Performance stating that manufacturer agrees to repair or replace metal roofing system failing to remain weather tight; including leaks, within specified warranty period.
  - .3 Vicwest TRADITIONAL150: {WeatherX™ (Siliconized Polyester - SMP) will not crack, chip, or peel (lose adhesion) for forty (40) years from date of installation (40.5 yrs from application).

## 2 Products

### 2.1 MANUFACTURERS

- .1 Basis of Design and approve roofing system
  - .1 Vicwest Steel Inc. – Tradition150 or approved equal

### 2.2 PERFORMANCE REQUIREMENTS

- .1 Design and construct roof so that completed installation will not leak.
- .2 Structural Design Performance:
  - .1 Design Roof System to Resist:
    - .1 Maximum deflection not to exceed  $l/180$  under system's own weight plus wind load (positive and negative) loads acting normal to the plane in accordance with the Building Code Climatic Data, wind load 1:50 years.
    - .2 Design the systems so that there is no air or water infiltration under the positive and negative forces imposed by wind and gravity loads. Provide means of draining space between insulation and exterior skin, in accord with NRC Rain Screen Principles.
  - .2 Thermal movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
    - .1 Temperature change (range): 20 deg C, ambient; 40 deg C, material surfaces.

### 2.3 FABRICATION

- .1 Fabricate and finish metal roofing system and accessories at the factory to greatest extent possible, using manufacturer's standard procedures and processes to obtain the indicated profiles and meeting dimensional and structural requirements for the Project.

### 2.4 FINISHES, GENERAL

- .1 Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- .2 Variations in appearance of abutting or adjacent pieces are acceptable if they are within ½ the range of reviewed samples:
  - .1 Noticeable variations in the same piece are not acceptable.
  - .2 Variations in appearance of other components are acceptable if they are within the range of reviewed samples and are assembled or installed to minimize contrast.

### 3 Execution

#### 3.1 EXAMINATION

- .1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roofing system supports, and other conditions affecting performance of work.
- .2 Examine primary and secondary roof framing to verify that angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roofing system manufacturer.
- .3 Examine roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roofing system manufacturer.
- .4 Examine roughing-in for components and systems penetrating metal roofing system to verify actual locations of penetrations relative to seam locations of metal roofing system before metal roofing system installation.
- .5 Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- .1 Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
- .2 Install auxiliary levelling substrate boards over metal deck; attach with mechanical fasteners into top flutes of steel to prevent wind uplift.
- .3 Install flashings and other sheet metal in accordance with requirements specified in Section 07 62 00.
- .4 Install eave angles, furring, and other miscellaneous roof system support members and anchorage in accordance with metal roofing system manufacturer's written recommendations.

#### 3.3 INSTALLATION

- .1 Air/Vapour Barrier:
  - .1 Install self adhering sheet ice and water shield, wrinkle free, on roof sheathing.
  - .2 Apply primer if required by manufacturer and install in accordance with temperature restrictions of ice and water shield manufacturer; use primer rather than nails for installing ice and water shield at low temperatures.
  - .3 Apply over entire roof in shingle fashion to shed water, with end laps of not less than 150mm (6") staggered 610mm (24") between courses and as follows:
    - .1 Overlap side edges not less than 89mm (3-1/2").
    - .2 Extend ice and water shield into gutter trough.
    - .3 Roll laps with roller.
    - .4 Cover ice and water shield within 14 days.
  - .4 Install flashings to cover ice and water shield in accordance with requirements specified in Section 07 62 00.
- .2 Thermal Insulation: Extend insulation in thickness indicated to cover entire roof in accordance with manufacturer's installation requirements.

- .3 Metal Roofing System:
  - .1 Install metal roofing system in accordance with manufacturer's written instructions.
  - .2 Install exterior prefinished roof panels on panel support clips, using manufacturer's proper construction procedure. Ensure batten is positively locked for full length of roof. Close interlocking side joints by using a purpose-made seaming machine, as supplied by the manufacturer.
  - .3 Where indicated on approved shop drawings, secure the end-lap of metal roofing sheets in accordance with the manufacturer's specifications and details to provide a weather-tight seal. Exposed fasteners to match colour of the roof sheet.
  - .4 Provide notched and formed closures, sealed against weather penetration, at changes in pitch, and at ridges and eaves, where required.
  - .5 Use concealed fasteners when possible. Exposed fasteners to match colour of roof sheet.
  - .6 Lock all end joints and install gaskets, joint fillers, and sealants where required for weatherproof performance of metal roofing system; include types of gaskets, fillers, and sealants recommended by metal roofing system manufacturer.
  - .7 Use stainless steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.
  - .8 Protect against galvanic action where dissimilar metals contact each other or corrosive substrates, by painting contact surfaces with bituminous coating, by applying rubberized asphalt ice and water shield to each contact surface, or by other permanent separation as recommended by metal roofing system manufacturer.
  - .9 Provide metal soffit panels full width of soffits and install panels perpendicular to support framing; flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

### 3.4 ACCESSORY INSTALLATION

- .1 Install accessories with positive anchorage to building and weather tight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
- .2 Install components required for a complete metal roofing system assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- .3 Install flashing and trim in accordance with performance requirements, manufacturer's written installation instructions, and SMACNA recommendations; provide concealed fasteners where possible, and set units true to line and level; install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- .4 Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
- .5 Provide for thermal expansion of exposed flashing and trim:
  - .1 Space movement joints at equally spaced intervals to a maximum of 3050mm (10') feet on centre with no joints allowed within 610mm (24") of corner or intersection.
  - .2 Form expansion joints of intermeshing hooked flanges, not less than 25mm (1") deep, filled with mastic sealant concealed within joints where lapped or bayonet type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof.
- .6 Provide seamless continuous gutter:
  - .1 Attach gutters to eave with gutter hangers spaced not more than 1220mm (48") on centre using manufacturer's standard fasteners.

- .2 Provide end closures and seal watertight with sealant.
- .3 Provide for thermal expansion.
- .7 Provide seamless continuous downspout sections with telescoping joints:
  - .1 Provide fasteners designed to hold downspouts securely 25mm (1") away from walls.
  - .2 Locate fasteners at top and bottom and at approximately 1524mm (5') on centre between top and bottom fasteners.
  - .3 Provide dent and vandal resistant elbows at base of downspouts to direct water away from building.
- .8 Install roof curbs at locations indicated on Drawings; install flashing around bases where they meet metal roofing system.
- .9 Attach snow guards to metal roofing system as recommended by snow guard manufacturer; do not use fasteners that will penetrate metal roofing system.
- .10 Form flashing around pipe penetration and metal roofing system; fasten and seal to metal roofing system as recommended by manufacturer.

### **3.5 ERECTION TOLERANCES**

- .1 Shim and align metal roofing system units within installed tolerance of 6mm (1/4") in 6m (20') on slope and location lines as indicated and within 3mm (1/8") offset of adjoining faces and of alignment of matching profiles.

### **3.6 SITE QUALITY CONTROL**

- .1 Engage a factory authorized service representative to inspect completed metal roofing system installation, including accessories and to report results in writing to Owner and Consultant.
- .2 Remove and replace applications of metal roofing system where inspections indicate that they do not comply with specified requirements.
- .3 Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### **3.7 CLEANING AND PROTECTION**

- .1 Remove temporary protective coverings and strippable films, if any, as metal roofing system are installed, unless otherwise indicated in manufacturer's written installation instructions.
- .2 Clean finished surfaces as recommended by metal roofing system manufacturer upon completion of metal roofing system installation; maintain in a clean condition during remainder of construction.
  - .1 Replace metal roofing system components that become damaged or have deteriorated beyond successful repair by finish touch-up or similar minor repair procedures.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 07 21 16: Blanket Insulation
- .3 Section 07 26 00: Vapour Retarders
- .4 Section 07 92 00: Joint Sealants
- .5 Section 08 11 00: Metal Doors and Frames
- .6 Section 09 21 16: Gypsum Board Assemblies

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI A135.6-06, Hardboard Siding Standard.
- .2 ASTM International
  - .1 ASTM D5116-10, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
- .4 CSA International
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .2 CSA O121-08, Douglas Fir Plywood.
  - .3 CSA O151-09, Canadian Softwood Plywood.
  - .4 CAN/CSA-Z809-08, Sustainable Forest Management.
- .5 Environmental Choice Program (ECP)
  - .1 CCD-045-95, Sealants and Caulking Compounds.
- .6 National Lumber Grading Authority (NLGA)
  - .1 NLGA Standard Grading Rules for Canadian Lumber 2010.
- .7 Sustainable Forestry Initiative (SFI)
  - .1 SFI-2010-2014 Standard.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood siding and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures. Indicate VOC's for caulking materials during application and curing.
- .3 Shop Drawings:
  - Submit drawings indicating all material sizes, elevation layout and all intended details in accordance with material suppliers installation guide.

- .4 Samples:
  - .1 Submit duplicate 305 x 305 mm size profile specified.

#### 1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

#### 1.5 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.
  - .1 Storage and Handling Requirements:
    - .2 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .3 Store and protect wood siding from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 2 Products

### 2.1 MATERIALS

- .1 Hardboard siding:
  - .1 Approved Manufacturer: Maibec EM+ or equal and approved.
  - .2 Finish: Textured and brushed-face, pre-finished.
  - .3 Width: 150mm (6")
  - .4 Fastening: Concealed fastening EM+.
  - .5 Colour: As selected by Departmental Representative.
  - .6 Installation: Vertical.
- .2 Accessories: closures, cap pieces of manufacturer's standard; Finish: To match siding colour, as approved by the Departmental Representative.
- .3 Wood Soffit:
  - .1 Cedar T&G V- groove finished to match glulam canopy. Profile and colour as approved by the Departmental Representative.
- .4 Fasteners: nails to CSA B111, hot galvanized steel, sized as required, spiral type with flat head.
- .5 Staples: As recommended by the Siding Manufacturer.
- .6 Sealants: As indicated in Section 07 92 00.

3 Execution

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant 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 Consultant.

**3.2 MANUFACTURER'S INSTRUCTIONS**

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

**3.3 INSTALLATION**

- .1 Install siding to manufacturers' written instructions.
- .2 Install sill flashings, wood starter strips, inside corner flashings, edgings and flashings over openings.
- .3 Fasten wood siding in straight, aligned lengths to furring using two nails or approved staples at each fixing location. Intermediate butt joints are not permitted. Stagger joints not less than 800 mm and distribute evenly over wall faces. Seal cut surfaces.
- .4 Fasten plywood siding so that edges are supported. Maintain 1.5 mm wide gap between sheets. Nail at 300 mm on centre along intermediate supports and 150 mm along edges. Caulk vertical joints.
- .5 Fasten fascia and soffit, as indicated on drawings to provide a complete installation. Nail at 300 mm on centre along intermediate supports and 150 mm along edges.

**3.4 CLEANING**

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

**3.5 PROTECTION**

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

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 18 00: Glued-Laminated Construction
- .2 Section 07 46 23: Wood Siding

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A167-99(2004), Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .2 ASTM A240/A240M-07e1, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .3 ASTM A606-04, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
  - .4 ASTM A653/A653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .5 ASTM A792/A792M-06a, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .6 ASTM B32-04, Standard Specification for Solder Metal.
  - .7 ASTM B370-03, Standard Specification for Copper Sheet and Strip for Building Construction.
  - .8 ASTM D523-89(1999), Standard Test Method for Specular Gloss.
  - .9 ASTM D822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .2 Canadian Roofing Contractors Association (CRCA)
  - .1 Roofing Specifications Manual.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
  - .2 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 43 - Environmental Procedures.
- .3 Shop Drawings:

- .1 Shop drawings: Indicating size, colour and location of all flashing and sheet metal details.
- .4 Samples:
  - .1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
  - .2 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.

#### 1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative Departmental Representative to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's installation instructions and warranty requirements.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### 2 Products

#### 2.1 PREFINISHED STEEL SHEET

- .1 Prefinished steel with factory applied polyvinylidene fluoride.
  - .1 Class F1S.
  - .2 Colour: As selected by Departmental Representative from manufacturer's standard range.
  - .3 Specular gloss: 30 units +/- in accordance with ASTM D523.
  - .4 Coating thickness: not less than 22 micrometres.
  - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
    - .1 Outdoor exposure period 5000 hours.
    - .2 Humidity resistance exposure period 5000 hours.

#### 2.2 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Plastic cement: to CAN/CGSB 37.5.
  - .1 Maximum VOC limit 50 g/L.

- .3 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .4 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .5 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .6 Solder: to ASTM B32.
- .7 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.
- .8 Touch-up paint: as recommended by prefinished material manufacturer.
  - .1 Maximum VOC limit 150 g/L.

### 2.3 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in 2400 mm maximum lengths.
  - .1 Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 12 mm.
  - .1 Mitre and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

### 2.4 METAL FLASHINGS

- .1 Form flashings, and copings to profiles indicated of 24 gauge thick prefinished steel.

### 2.5 EAVES TROUGHS AND DOWNPIPES

- .1 Form eaves troughs and downpipes from prefinished steel to match flashing and trim.
- .2 Sizes and profiles as indicated.
- .3 Provide goosenecks, outlets, strainer baskets and necessary fastenings.

## 3 Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 INSTALLATION

- .1 Use concealed fastenings except where approved before installation.
- .2 Counter flash bituminous flashings at intersections of roof with vertical surfaces and curbs.
  - .1 Flash joints using standing seams forming tight fit over hook strips, as detailed.
- .3 Lock end joints and caulk with sealant.
- .4 Turn top edge of flashing into cap flashing minimum of 25 mm. Lead wedge flashing securely into joint.
- .5 Caulk flashing at cap flashing with sealant.
- .6 Install pans, where shown around items projecting through roof membrane.

### 3.3 EAVES TROUGHS AND DOWNPIPES

- .1 Install eaves troughs and secure to building at 750 mm on centre with eaves trough spikes through spacer ferrules.
  - .1 Slope eaves troughs to downpipes as indicated.
  - .2 Seal joints watertight.
- .2 Install downpipes and provide goosenecks back to wall.
  - .1 Secure downpipes to wall with straps at 1800 mm on centre; minimum two straps per downpipe.
- .3 Install splash pans as indicated.

### 3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
  - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### 3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 General Conditions, Supplementary Conditions and Division 01 apply to this section.
- .2 Description of Work:
  - .1 Supply and install all prefinished metal soffits, fascia, gutters and rainwater goods as indicated on the drawings and specified herein.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Section 07 62 00: Sheet Metal Flashing and Trim
- .2 Section 07 92 00: Joint Sealants

**1.3 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Manufacturer and tradesmen executing the work of this section shall have had continuous Canadian experience in successful manufacture and installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.
  - .2 Erection of metal soffits, gutters and rainwater goods shall be by workers especially trained and experienced in this type of work. Have a senior, qualified representative at the job site to direct the work of this section at all times.

**1.4 SUBMITTALS**

- .1 Submit submittals in accordance with the General Conditions and Section 01 33 00.
- .2 Shop Drawings:
  - .1 Submit fully dimensional shop drawings to Consultant showing construction, assembly, elevations, sections and interfacing with work of other sections.
  - .2 No work of this section shall be fabricated until shop drawings and all other related submittals, documentation, certifications and samples as required by this section, have been reviewed by the Consultant.
  - .3 Details shall indicate metal thicknesses, areas to be sealed and sealant materials, gaskets, type of joints, flashings, trim, finishes, fasteners and all anchorage assemblies and components and erection details.
- .3 Samples:
  - .1 Submit to the Consultant for approval, samples of materials and components to be used in the system, prior to fabrication of work together with name of manufacturer and technical literature. Submit 300mm x 300mm samples of prefinished metal.

**1.5 DESIGN REQUIREMENTS**

- .1 Design gutters and rainwater goods to contain volume rainwater coming off sloped roof areas in compliance with the requirements of the local Building Code and the requirements of all authorities having jurisdiction.
- .2 Design total systems, confirm adequacy of design, proper provision for and use of all proprietary materials and components from other suppliers forming part of the work of this section.
- .3 Co-ordination:
  - .1 Co-ordinate the work of this section with related trades to ensure best quality installation.

## 1.6 WORKMANSHIP

- .1 Joints and intersecting members shall be accurately fitted, in true planes, square, plumb, straight, true with tight joints and intersections. Provide adequate reinforcing, anchorage and fastenings.
- .2 Execute the work of this section in accordance with the recognized highest standards of workmanship of the industry.
- .3 Exposed steel surfaces shall be smooth and free from imperfections such as warping, buckling, scratches, dents and abrasion.
- .4 Thickness of metal shall be adequate for various conditions and to ensure dent and vandal resistance.
- .5 Isolate where necessary to prevent electrolysis due to dissimilar metal to metal contact or metal to masonry or concrete. Use bituminous paint or other approved divorcing membrane.
- .6 Ensure proper use of proprietary materials in strict accordance with the material manufacturer's directions.

## 1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

- .1 Co-ordinate deliveries to comply with construction schedule and arrange ahead for off-the-ground, under cover storage locations. Do not load any area beyond the design limits.
- .2 Adequately protect and crate all components against damage, dirt, disfigurement and weather.
- .3 Assembled units and/or their component parts shall be transported, handled and stored in a manner to preclude damage. Accessory materials required for erection at the site shall be delivered to the site in manufacturer's labelled containers. Remove all units or components which are cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace with new.
- .4 Provide safe and adequate equipment on the Site to execute the work of this section, hoisting, scaffolding, staging, safety protection equipment, tools, plant and other equipment required for the completion of the work of this section.
- .5 Delivered damaged materials or materials which do not comply with this section shall be rejected by Consultant, removed from the Site and replaced with acceptable materials at Contractor's expense.
- .6 Adequately protect the structure and work of all other trades during delivery, storage, handling and erection of the work of this section.
- .7 Components being hoisted to the working level shall be adequately banded and carefully slung employing steel wire rope.
- .8 Bundles shall be tag lined during the ascent of the hoisting operation. Precaution shall be taken to avoid damage to metal components and to prevent marring of exposed surfaces.
- .9 Metal components, after being positioned, shall be adequately secured in place as quickly as possible and prior to leaving the job site at the end of the working day.
- .10 Loose bundles of metal components shall be adequately secured at the completion of each working day.
- .11 Scaffolds, platforms, ladders, and the like, required by the erector for installation of metal components shall be properly secured to prevent accidental movement or collapse.

## 2 Products

### 2.1 MATERIALS

- .1 Steel / Aluminum:

- .1 Sheet metal conforming to ASTM A653/A653M-11, structural quality, Grade 'A' with a minimized spangle zinc coating of Z275 conforming to ASTM A653/A653M-11, shall be used for preformed metal soffits, trims, fascias, gutters, rainwater goods and flashings.
- .2 Preformed metal shall be minimum 22 gauge required base steel nominal thickness or thicker, to meet design requirements.
- .3 Metal fascias and flashings shall be minimum 22 gauge required base steel nominal thickness or thicker, to meet design requirements.
- .4 Metal gutters and rainwater goods shall be heavy duty thick gauge to ensure they are dent and vandal resistant to meet design requirements
- .5 Preformed metal fascia, gutters, rainwater goods and metal flashings shall be prefinished coil coated material in accordance with Technical Bulletin No. 7 "Prefinished and Post Painted Galvanized Sheet Steel for Exterior Building Products" of the Canadian Sheet Steel Building Institute. (CSSBI), in CSSBI 5,000 Series finish and in colours as later selected by Consultant from manufacturer's full available colour range including extended colour range.
- .6 Flatstock Material:
  - .1 Minimum thickness to suit design requirements, coil coated sheet steel, prefinished to CSSBI 5,000 Series requirements. Colour shall be as selected later by Consultant.
- .2 Soffit Vent Strip:
  - .1 Continuous Stainless steel or aluminum linear soffit vent strip, installed within wood soffit as shown on the drawings. Fabricated from minimum 20. gauge stainless sheet steel, having multiple row vent slots which provide minimum vented area.
  - .2 Colour: Brushed stainless steel finish.
- .3 Roofing Cement:
  - .1 Cut back asphalt plastic cement conforming to CAN/CGSB-37.5
- .4 Lap Cement:
  - .1 Fibrated cut back asphalt plastic cement conforming to CAN/CGSB-37.4
- .5 Bituminous Paint:
  - .1 Conforming to CAN/CGSB-1.108
- .6 Sealant:
  - .1 Multi-component, chemical curing epoxidized polyurethane conforming to CAN/CGSB-19.24, 'Dymeric 240' by Tremco (Canada) Ltd. Colour as selected later by Consultant.
  - .2 Primers: As recommended by sealant manufacturer to suit applicable conditions.
- .7 Recessed Reglets:
  - .1 Preformed 0.70mm prefinished galvanized steel channel with face and ends covered with plastic tape.
- .8 Eavestrough Brackets:
  - .1 3mm x 38mm prefinished galvanized steel straps.
- .9 Eavestrough Spacers:
  - .1 2mm x 38mm prefinished galvanized steel straps.
- .10 Eavestrough Anchors:
  - .1 10mm diameter x 150mm long galvanized lag screws and ferrules.
- .11 Downspouts:

- .1 Heavy gauge 75mm dia. galv. steel pipe complete with painted finish.
- .2 Provide appropriate hardware and angled pipe fittings as required.
- .3 Direct outlets away from building and provide concrete splash pad.
- .4 Refer to drawings for locations.

## 2.2 FABRICATION

- .1 Form metal rake and eave edge flashings from 0.55mm thick prefinished galvanized steel.
- .2 Form curb metal flashings from 0.55mm thick prefinished galvanized steel.
- .3 Form eavestroughs and downspouts from prepainted galvanized sheet steel. Form eavestroughs of 100mm widths using continuous rolling process. Downspouts shall be corrugated type for ogee profile eavestroughs and rectangular box type for rectangular profile eavestroughs. Eavestroughs of different profiles and girths shall require different metal thicknesses as follows:

Rectangular Profile	Girth Thickness	Nominal Size
100mm	510mm	.55mm

- .4 Fabricate all flashings components to maximum length of 2400mm.
- .5 Form rake edge flashing with 100mm wide deck flange and minimum 100mm deep fascia flange with 15mm x 45E doubled drip edge.
- .6 Form eave edge flashing with 100mm wide deck flange and minimum 100mm deep fascia flange.
- .7 Overbrake rake and eave flashings slightly so that when installed, fascia flashings are sprung tightly to fascia boards or wall fascia panels.
- .8 Form flashing and counterflashing for penetrations from 0.70mm thick prefinished galvanized sheet steel.

## 3 Execution

### 3.1 EXAMINATION AND PREPARATION

- .1 Inspect areas of the Work over which the work of this section is dependent for any irregularities detrimental to the application and performance of the work of this section.
- .2 Notify Consultant in writing of all conditions which are at variance with those in the Contract Documents and/or detrimental to the proper and timely installation of the work of this section. The decision regarding corrective measures shall be obtained from the Departmental Representative/Consultant prior to proceeding with the affected work of this section.
- .3 Coordinate work of this section with work of other sections.
- .4 Commencement of work of this section implies acceptance of surfaces and conditions.

### 3.2 INSTALLATION

- .1 Join all prefinished steel components with sealant and cadmium plated screws.
- .2 Lap flashing joints 50mm and seal both sections along lap with sealant. Nail joints securely.
- .3 Backpaint sheet metal with bituminous paint.
- .4 Where reglet detail is indicated or required, insert metal flashing into reglet to form tight fit. Seal flashing into reglet with sealant.
- .5 Set edge flashing on deck along rake and eave edges.

- .6 Nail deck flange to deck with two rows of annular ringed nails. Set one row 25mm from fascia board with nails at 200mm O.C. Set second row 25mm from cut edge of metal with nails at 400mm O.C., staggered with first row.
- .7 Secure 100mm wide eavestroughs to building with galvanized lag screws through spacer sleeves at 750mm O.C.
- .8 Secure eavestroughs over 100mm wide with brackets at 750mm O.C. Install spacer bars at 750mm O.C. Stagger position of brackets and spacer bars.
- .9 Slope eavestroughs to downspouts.
- .10 Install continuous eaves troughs. Close ends of each length. Install to each section at least one downspout.
- .11 Install "ells" and "tees" as required, and secure downspouts to wall with pre-painted galvanized heavy duty sheet steel straps at 1500mm O.C., minimum 2 straps per downspout.
- .12 Install prefinished wood soffit panels complete with all edge trims level to within 3mm in 2400mm.
- .13 Install continuous, stainless steel or aluminum linear soffit vents as indicated on the drawings to provide ventilation of concealed spaces in accordance with NBC requirements.

### **3.3 CLEAN UP AND REPAIRS**

- .1 Clean and make good to the Consultant's approval, surfaces soiled or otherwise damaged in connection with the work of this section. Pay the cost of replacing finishes or materials that cannot be satisfactorily cleaned, without additional cost the Owner.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 46 23: Wood Siding
- .2 Section 07 62 00: Sheet Metal Flashing and Trim
- .3 Section 08 11 00: Metal Doors and Frames
- .4 Section 09 21 16: Gypsum Board Assemblies

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM C919-08, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
  - .2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
  - .3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
  - .4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
  - .5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**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 joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Manufacturer's product to describe:
    - .1 Caulking compound.
    - .2 Primers.
    - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
  - .3 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures.
- .3 Samples:
  - .1 Submit 2 samples of each type of material and colour.
  - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .4 Manufacturer's Instructions:
  - .1 Submit instructions to include installation instructions for each product used.

#### 1.4 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.

#### 1.5 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 off ground, and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect joint sealants from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

#### 1.6 SITE CONDITIONS

- .1 Ambient Conditions:
  - .1 Proceed with installation of joint sealants only when:
    - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
    - .2 Joint substrates are dry.
    - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
  - .1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
  - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

#### 1.7 ENVIRONMENTAL REQUIREMENTS

- .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 (MSDS) acceptable to Health Canada.

#### 2 Products

#### 2.1 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.
- .3 Where sealants are qualified with primers use only these primers.

## 2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Sealant Type "A" – Joints around Interior Door Frames, Windows and Under Exterior Thresholds:
  - .1 One-part, low or medium modulus, neutral curing 100% silicone joint sealant, conforming to ASTM C920-11, Type S, Grade NS, Class 35.
- .2 Sealant Type "B" – Expansion / Control Joints:
  - .1 One-part, ultra low modulus, non-staining neutral curing 100% silicone joint sealant, conforming to ASTM C920-11, Type S, Grade NS, Class 50.
- .3 Sealant Type "F" – Glazing Joints:
  - .1 Silicone Sealant: Butt glazing, one part, moisture curing, shore A hardness 15 25, conforming to CAN/CGSB 19.13 M, Classification C 1 40 B N and C 1 25 B N and ASTM C920-11, Type S, Grade NS, Class 25, use NT, G, A, O; Colour: clear (translucent):
- .4 Sealant Type "G" – Exterior Wall Joints:
  - .1 Air seal sealant: One part, silicone, shore A hardness 15-25, conforming to CGSB 19 GP 13M, classification C 1 40 B N and C 1 25 B N and ASTM C920-11, Type S, Grade NS, Class 25. Use NT, M, G, A and O:
- .5 Sealant Type "H" – Saw Cut Sealant:
  - .1 Multi component, self levelling, conforming to ASTM D2240-05(2010):
- .6 Preformed Compression Seal:
  - .1 Compartmental open cell neoprene extrusion type conforming to ASTM C509-06(2011), complete with liquid lubricant adhesive recommended by manufacturer.

## 2.3 JOINT CLEANER

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.
- .2 Primer: in accordance with sealant manufacturer's written recommendations

## 3 Execution

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant 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 Consultant.

### 3.2 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.

- .5 Prepare surfaces in accordance with manufacturer's directions.

### 3.3 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

### 3.4 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

### 3.5 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

### 3.6 APPLICATION

- .1 Sealant:
  - .1 Apply sealant in accordance with manufacturer's written instructions.
  - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
  - .3 Apply sealant in continuous beads.
  - .4 Apply sealant using gun with proper size nozzle.
  - .5 Use sufficient pressure to fill voids and joints solid.
  - .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
  - .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
  - .8 Remove excess compound promptly as work progresses and upon completion.
- .2 Curing:
  - .1 Cure sealants in accordance with sealant manufacturer's instructions.
  - .2 Do not cover up sealants until proper curing has taken place.

### 3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean adjacent surfaces immediately.
  - .3 Remove excess and droppings, using recommended cleaners as work progresses.
  - .4 Remove masking tape after initial set of sealant.
- .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.

### 3.8 PROTECTION

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

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 08 11 00: Metal Doors and Frames
- .2 Section 08 71 00: Door Hardware
- .3 Section 08 80 50: Glazing

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A653/A653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
  - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
  - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
  - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.
- .5 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S701-01, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .2 CAN/ULC-S702-97, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
  - .3 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

**1.3 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.
  - .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
  - .3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 for ratings specified or indicated.
  - .4 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, and listed by nationally recognized agency having factory inspection services.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

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

- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, arrangement of hardware fire rating and finishes.
  - .3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings, reinforcing, fire rating, and finishes.
  - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
  - .5 Submit test and engineering data, and installation instructions.
- .4 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 2 Products

### 2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.
- .3 Cast or rolled pure sheet lead: to ASTM B29, thickness 16 gauge.

### 2.2 DOOR CORE MATERIALS

- .1 Door Core Construction:
- .2 Interior Door: Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m<sup>3</sup> minimum sanded to required thickness.
- .3 Exterior Door: Rigid extruded, closed cell insulation, fire retardant treated meeting the requirements of ULC S701-11, Type 4, minimum thermal resistance R-Value 4.5/1" thickness.

### 2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (poly-chloroprene) based, low viscosity, contact cement.
- .2 Adhesive: maximum VOC content 50 g/L.
- .3 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
- .4 Lock-seam doors: fire resistant, resin reinforced poly-chloroprene, high viscosity, sealant/adhesive.

### 2.4 PRIMER

- .1 Touch-up prime CAN/CGSB-1.181.

## 2.5 PAINT

- .1 Field paint steel doors and frames in accordance with Sections 09 91 00 - Painting. Protect weather strips from paint. Provide final finish free of scratches or other blemishes.

## 2.6 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .3 Door bottom seal: As indicated in Section 08 71 00.
- .4 Metallic paste filler: to manufacturer's standard.
- .5 Fire labels: metal riveted.
- .6 Glazing: As indicated in Section 08 80 50.
- .7 Make provisions for glazing as indicated and provide necessary glazing stops.
  - .1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.
  - .2 Design exterior glazing stops to be tamperproof.

## 2.7 FRAMES FABRICATION GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Exterior frames: 16 gauge welded type construction.
- .4 Interior frames: 1.2mm welded type construction.
- .5 Blank, reinforce, drill and tap frames for mortised, templated hardware, electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .6 Protect mortised cut-outs with steel guard boxes.
- .7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .8 Manufacturer's nameplates on frames and screens are not permitted.
- .9 Conceal fastenings except where exposed fastenings are indicated.
- .10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .11 Insulate exterior frame components with polyurethane insulation.

## 2.8 FRAME ANCHORAGE

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

## 2.9 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.
- .7 Securely attach lead to inside of frame profile from return to jamb soffit (inclusive) on door side of frame only.

### 3 Execution

#### 3.1 MANUFACTURER'S INSTRUCTIONS

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

#### 3.2 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.

#### 3.3 FRAME INSTALLATION

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent material.
- .6 Maintain continuity of air barrier and vapour retarder.

#### 3.4 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
  - .1 Hinge side: 1.0 mm.
  - .2 Latch side and head: 1.5 mm.
  - .3 Finished floor, and thresholds: 13 mm.
- .3 Adjust operable parts for correct function.

#### 3.5 FINISH REPAIRS

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

#### 3.6 GLAZING

- .1 Install glazing for doors and frames in accordance with Section 08 80 50 - Glazing.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Sections of Division 1 apply to work of this Section.

**1.2 REFERENCES**

- .1 ASTM A123 - Standard specification for Zinc (hot-dipped galvanized) coating on iron and steel products.
- .2 ASTM A229 - Standard specification for Steel wire, oil-tempered for mechanical springs.
- .3 ASTM A653 - Standard specification for Steel sheet, zinc-coated (galvanized) by the hot-dipped process, commercial quality.
- .4 ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .5 ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .6 ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

**1.3 SYSTEM DESCRIPTION**

- .1 Wind Loads: Completed work shall withstand positive and negative wind pressure loads normal to plane required by the governing building code.

**1.4 QUALITY ASSURANCE**

- .1 Installer: Trained and approved by the manufacturer and having experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.
- .2 Maintenance Seminars: Engage a factory authorized service representative to train Owner's maintenance personnel on proper maintenance procedures.
- .3 Pre-Installation Meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Consultant of the date and time of the meeting.
- .4 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

**1.5 SUBMITTALS**

- .1 Product Data: Manufacturer's data sheets on each product to be used, including:
- .1 Preparation instructions and recommendations.
- .2 Storage and handling requirements and recommendations.
- .3 Details of construction and fabrication.
- .4 Installation methods.
- .2 Shop Drawings: Indicate each type of coiling doors, arrangement of hardware, operating mechanism and required clearances.

- .3 Maintenance Data: Provide operation and maintenance data for coiling doors for incorporation into Maintenance Manual.

## 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Store products in manufacturer's unopened packaging until ready for installation.
- .2 Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- .3 Store materials in a dry, warm, ventilated weathertight location.

## 1.7 COORDINATION

- .1 Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

## 2 Products

### 2.1 COILING METAL COUNTER DOORS

- .1 Basis of Design Material: ESC20 Rolling Counter Door by Cornell Cookson, or accepted equivalent, as approved by the Consultant.
- .2 Curtains:
  - .1 Material: Flat faced, 2", No. 17 slats fabricated of stainless steel 20 gauge.
  - .2 Alternate slats will be fitted with end locks to hold curtain in alignment.
  - .3 Bottom of curtain finished with an extruded, tubular, or single angle bottom bar fitted with a continuous vinyl bumper to protect counter top.
- .3 Guides: Extruded aluminum. Continuous strips of wool pile are inserted into guides to eliminate metal-to-metal contact and to provide dust-seal around curtain.
- .4 Brackets: Metal plates with permanently sealed ball bearings designed to enclose ends of coil and provide support for counterbalance pipe at each end. Plated fabricated of stainless steel 3/16" thick minimum.
- .5 Counterbalance: Curtain is coiled on a pipe of sufficient size to carry door load with a deflection not to exceed 0.033 inch per foot of door span and to be correctly balanced by helical springs, oil tempered torsion type. Cast iron barrel plugs are used to anchor springs to tension shaft and pipe.
- .6 Hood: Hood will enclose curtain coil and counterbalance mechanism and is fabricated of sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal stiffness.
  - .1 Stainless steel minimum 24-gauge.
- .7 Locking
  - .1 Curtain to be locked at each end of bottom bar by concealed slide bolts which engage in a developed slot in each guide.
  - .2 Provide cylinder lock at jambs or in center of bottom bar.
- .8 Mounting: Overhead Structure with: Steel jambs.

### 2.2 COILING OVERHEAD DOORS

- .1 Basis of Design Material: Cornell Cookson, or accepted equivalent, as approved by the Consultant.

### **2.3 OPERATION - MANUAL**

- .1 Equip doors for manual operation with crank operator and removable hand crank.

### **3 Execution**

### **3.1 EXAMINATION**

- .1 Verify opening sizes, tolerances and conditions are acceptable.
- .2 Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- .3 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.2 PREPARATION**

- .1 Clean surfaces thoroughly prior to installation.
- .2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.3 INSTALLATION**

- .1 Install work in accordance with manufacturers' printed instructions.
- .2 Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- .3 Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- .4 Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- .5 Coordinate installation of sealants and backing materials at frame perimeter.
- .6 Install perimeter trim and closures.
- .7 Replace damage work with new work in matching finish and colour.

### **3.4 ADJUSTING**

- .1 Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- .2 Adjust hardware and operating assemblies for smooth and noiseless operation.

### **3.5 CLEANING**

- .1 Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- .2 Remove labels and visible markings.

### **3.6 PROTECTION**

- .1 Protect installed products until completion of project.
- .2 Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**

1 General

**1.1 RELATED WORK**

- .1 Section 07 92 00: Joint Sealants

**1.2 REFERENCES**

- .1 Review and comply with NBC:

- .1 Section 9.7: Windows
- .2 Subsection 9.7.2: Window Standards
- .3 Subsection 9.7.3: Glass

These minimum material and performance standards shall apply as if written here.

- .2 CAN/CGSB-12.8-M: Insulating Glass Units.
- .3 CAN/CGSB-12.10-M: Glass, Light and Heat Reflecting.
- .4 Hardware and glazing shall meet requirements of jurisdictional authorities.
- .5 Test Reports: Submit CMHC Evaluation Report, certifying compliance with specifications for:
  - .1 Windows: Classifications CAN/CSA-A440
  - .2 Material: Aluminum
  - .3 Screens: Insect to CGSB 79-GP-1M
  - .4 Air Leakage: A3 to ASTM E-283-91
  - .5 Water Leakage: B5
  - .6 Wind Load Resistance: C3
  - .7 Temperature Index: I56.7/63.3 with Low E glass

**1.3 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit extended guarantee for insulating glass units installed in windows.
- .3 Provide operation and maintenance data for windows into manual specified in Section 01 78 00 – Closeout Submittals.

2 Products

**2.1 MATERIALS**

- .1 Materials to conform to CAN A440-M supplemented as follows:
  - .1 All windows by same manufacturer.
  - .2 Sash: aluminum profiles thermally broken.
  - .3 Aluminum Alloy: to CAN/CSA-A440, including Appendix B, finish to be prefinished colour from manufacturer's standard range to be selected by Architect at later date.
  - .4 Main frame: aluminum, thermally broken.
  - .5 Fasteners: stainless steel, type 303 to ASTM E-149.
  - .6 Thermal break; cork-neoprene composition or extruded rigid polyvinyl chloride.
  - .7 Sill: modest aluminum sill made of same material as window to be provided by window manufacturer. See details.

- .2 Window Classification: CAN3 A440-M90.  
Air infiltration of exterior windows must not exceed  $7.75 \times 10^{-4}$ /s for each metre of sash crack when tested at a different pressure of 75pa.
  - .1 Air leakage: A3 to ASTM E-283-91
  - .2 Water leakage: B5
  - .3 Wind load resistance: C3
  - .4 Condensation resistance: minimum of  $47.8lg = 70$ ,  $lf = 69$
- .3 Glazing:
  - .1 Insulating glass units: to CAN2-12.8-M with rear pane clear float glass, and front pane tempered. 6mm thick for each lite.
  - .2 Refer to 2.1.2.4 above for translucent requirements.
- .4 Insect Screens: to CGSB 79-GP-1M-76
  - .1 Type: 2
  - .2 Class: A
  - .3 Style: 1
  - .4 Insect screening mesh: count 18 x 16 fibreglass
  - .5 Fasteners: spline
  - .6 Screen frames: Aluminum enameled frame to match window frame.
  - .7 Secure to interior of frame with manufacturer's standard latches coloured to match frames.
- .5 Fabricate windows generally to dimensions indicated on drawings to meet specified requirements, and all requirements of CMHC and in accordance with CAN/CSA A440-M supplemented as follows:
  - .1 Fabricate units square and true with maximum tolerance of plus or minus
  - .2 1.5mm for units with a diagonal measurement of 1800mm or less and plus or minus 3mm for units with a diagonal measurement over 1800mm.
- .6 Brace frames to maintain square and rigidity during shipment and installation.
- .7 Finish exposed surfaces of aluminum components with enamel coating in accordance with CAN/CSA A440, including Appendix C. Colour to be selected from manufacturer's standard finishes.
- .8 Hardware:
  - .1 Generally: manufacturer's standard operating and locking hardware. Enamelled finish on exposed hardware.
- .9 Weatherstrip:
  - .1 To meet requirements of Evaluation Report for:
    - .1 Air Leakage: A3
    - .2 Water Leakage: B5
- .10 Approved manufacturer: Kawneer or approved equal.

3 Execution

**3.1 ERECTION**

- .1 Install in accordance with CAN/CSA A440 Appendix A and to details.
- .2 Install windows plumb, level, anchored to structure and with no structural load imposed at heads.
- .3 Adjust operating members and hardware to work smoothly without binding and to fit tightly when closed and locked. Lubricate where operation requires it.
- .4 Caulk at all jambs, sills and heads, interior and exterior, to provide an airtight joint as specified in Section 07 92 00. Use non-expanding EPS and polyethylene rope filler between rough openings and frames. Caulk around both outside and inside of all window/door end wall joints.
- .5 Anchor window/skylights to adjacent construction on all sides using manufacturer specified approved anchors.
- .6 Provide for levelling and continuous support of sills.
- .7 Examine construction at site and take critical dimensions to ensure that window sizes, anchorage and means of adjustment provide for required support and clearances.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 08 11 00: Metal Doors and Frames.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
  - .1 ANSI/BHMA A156.1-2000, American National Standard for Butts and Hinges.
  - .2 ANSI/BHMA A156.2-2003, Bored and Preassembled Locks and Latches.
  - .3 ANSI/BHMA A156.3-2001, Exit Devices.
  - .4 ANSI/BHMA A156.4-2000, Door Controls - Closers.
  - .5 ANSI/BHMA A156.5-2001, Auxiliary Locks and Associated Products.
  - .6 ANSI/BHMA A156.6-2005, Architectural Door Trim.
  - .7 ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.
  - .8 ANSI/BHMA A156.10-1999, Power Operated Pedestrian Doors.
  - .9 ANSI/BHMA A156.12-2005, Interconnected Locks and Latches.
  - .10 ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
  - .11 ANSI/BHMA A156.16-2002, Auxiliary Hardware.
  - .12 ANSI/BHMA A156.17-2004, Self-closing Hinges and Pivots.
  - .13 ANSI/BHMA A156.18-2006, Materials and Finishes.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
  - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

**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 door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
  - .3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
  - .4 After approval samples will be returned for incorporation in Work.
- .4 Hardware List:
  - .1 Submit contract hardware list.
  - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

- .5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: submit manufacturer's installation instructions.

#### 1.4 CLOSEOUT SUBMITTALS

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

#### 1.5 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra Stock Materials:
  - .1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Tools:
    - .1 Supply 2 sets of wrenches for door closers, locksets, and fire exit hardware.

#### 1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements:
  - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

#### 1.7 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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
  - .1 Store materials off ground, and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect door hardware from nicks, scratches, and blemishes.
  - .3 Protect prefinished surfaces with wrapping.
  - .4 Replace defective or damaged materials with new.
  - .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 2 Products

### 2.1 HARDWARE ITEMS

- .1 Use one manufacturer's products only for similar items.

### 2.2 DOOR HARDWARE

- .1 Locks and latches:

- .1 Bored and preassembled locks and latches: to ANSI/BHMA A156.2, series 2000 preassembled lock, grade 1, designed for function and keyed as stated in Hardware Schedule.
- .2 Interconnected locks and latches: to ANSI/BHMA A156.12, series 5000 interconnected lock, grade 2, designed for function and keyed as stated in Hardware Schedule.
- .3 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 2, designed for function and keyed as stated in Hardware Schedule.
- .4 Lever handles: plain design.
- .5 Normal strikes: box type, lip projection not beyond jamb.
- .6 Cylinders: key into keying system as directed.
- .7 All hardware shall be stainless steel.
- .2 Butts and hinges:
  - .1 Butts and hinges: to ANSI/BHMA A156.1, designated by letter A and numeral identifiers, followed by size and finish, listed in Hardware Schedule.
  - .2 Self-closing hinges and pivots: to ANSI/BHMA A156.17, designated by letter K and numeral identifiers listed in Hardware Schedule, with suffix letter F indicating listed for used on fire doors, finish as selected by Departmental Representative.
  - .3 All hardware shall be stainless steel.
- .3 Exit devices: to ANSI/BHMA A156.3, modern-narrow stile.
- .4 Door Closers and Accessories:
  - .1 Door controls (closers): to ANSI/BHMA A156.4, designated by letter C and numeral identifiers listed in Hardware Schedule, size in accordance with ANSI/BHMA A156.4, table A1, finished to clear anodized aluminum.
  - .2 Door controls - overhead holders: to ANSI/BHMA A156.8, designated by letter C and numeral identifiers listed in Hardware Schedule.
  - .3 Closer/holder release devices: to ANSI/BHMA A156.15, designated by letter C and numeral identifiers listed in hardware schedule.
  - .4 Door co-ordinator: surface for pairs of doors with overlapping astragal.
- .5 Auxiliary hardware: to ANSI/BHMA A156.16, designated by letter L and numeral identifiers as listed below.
  - .1 Stop, wall mounted.
  - .2 Door silencer.
- .6 Thresholds: 150 mm wide x full width of door opening, extruded aluminum, plain surface, with thermal break of rigid PVC, with vinyl door seal insert.
- .7 Weather Stripping:
  - .1 Head and jamb seal:
    - .1 Extruded aluminum frame and nylon brush insert, clear anodized finish.
    - .2 Adhesive backed neoprene material.
  - .2 Door bottom seal:
    - .1 Extruded aluminum frame and vinyl sweep, clear anodized finish.
- .8 Astragal: adjustable, extruded aluminum frame with vinyl insert, finished to match doors.
- .9 Barrier Free Pneumatic Door Operator:

- .1 Heavy duty pneumatically assisted door closer, capable of multi-door operation, complete with actuators, control boxes, pneumatic tubing and compressed air source.
- .2 Self-contained control box/compressor combination for independent operation of two door leaves.
- .3 Control boxes: complete with electric strike relay.
- .4 Mount operators on either push or pull sides of doors as required to place them inside rooms.
- .5 Electrical box and actuator: Hardwired low voltage actuator with stainless steel 114 mm round plate, engraved blue filled with handicap symbol. Box 51 mm wide x 102 mm high x 50 mm deep single gang electrical box, flush mounted in wall, locations indicated.
- .6 Supply switched line voltage to control box. Locate switch adjacent to box.
- .7 Supply low voltage wiring to each actuator and 6 mm diameter air tubing to each operator.
- .8 Mount control box in location as directed by Departmental Representative.
- .10 Mechanically Operated Key Access Pads to ANSI/BHMA 156.2 have 1 certification and weather resistant with key override model. Keys Simplex L1000 lever handle or approved equal.

### 2.3 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

### 2.4 KEYING

- .1 Doors, padlocks and cabinet locks to be master keyed, as directed. Prepare detailed keying schedule in conjunction with Departmental Representative.
- .2 Supply keys in duplicate for every lock in this Contract.
- .3 Supply 3 master keys for each master key group.
- .4 Stamp keying code numbers on keys and cylinders.
- .5 Supply construction cores.
- .6 Hand over permanent cores and keys to Departmental Representative.

## 3 Execution

### 3.1 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.

- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet.
- .7 Use only manufacturer's supplied fasteners.
  - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .8 Remove construction cores when directed by Departmental Representative.
  - .1 Install permanent cores and ensure locks operate correctly.

### 3.2 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to ensure tight fit at contact points with frames.

### 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 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
  - .3 Remove protective material from hardware items where present.
  - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .2 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.

### 3.4 DEMONSTRATION

- .1 Keying System Setup and Cabinet:
  - .1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.
  - .2 Place file keys and duplicate keys in key cabinet on their respective hooks.
  - .3 Lock key cabinet and turn over key to Departmental Representative.
- .2 Maintenance Staff Briefing:
  - .1 Brief maintenance staff regarding:
    - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
    - .2 Description, use, handling, and storage of keys.
    - .3 Use, application and storage of wrenches for door closers, locksets and fire exit hardware.
- .3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

**3.5 PROTECTION**

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

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

**1.2 SUMMARY**

.1 Furnish glazing materials and accessories to complete the fabrication and installation of:

.1 Curtain Wall Glazing

**1.3 RELATED REQUIREMENTS**

.1 Section 06 10 00: Rough Carpentry

.2 Section 07 92 00: Sealants

.3 Section 08 11 13: Metal Doors and Frames

**1.4 REFERENCES**

.1 American Society for Testing and Materials (ASTM):

.1 ASTM C542-05(2011), Standard Specification for Lock-Strip Gaskets

.2 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants

.3 ASTM C1172-09e1, Standard Specification for Laminated Architectural Flat Glass

.4 ASTM C1503-08, Standard Specification for Silvered Flat Glass Mirror

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass

.2 CAN/CGSB-12.3-M91, Flat, Clear Float Glass

.3 CAN/CGSB-12.8-97, Insulating Glass Units

.4 CAN/CGSB-12.9-M91, Spandrel Glass

.5 CAN/CGSB-12.11-M90, Wired Safety Glass

.6 CGSB-12.20-M89, Structural Design of Glass for Buildings

.3 National Fire Protection Association (NFPA):

.1 NFPA 80-2013, Standard For Fire Doors and Other Opening Protectives

**1.5 SUBMITTALS**

.1 Submit submittals in accordance with the requirements of Section 01 33 00 Submittals

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product data for each type of product specified. Data shall indicate compliance with specification and installation recommendations of manufacturer of products being used.

.2 Samples: Submit samples of materials if required by Consultant before commencing work of this section. Samples shall be clearly labeled with manufacturer's name and type.

.3 Shop Drawings: Submit shop drawings, to the Consultant for review prior to fabrication.

.4 Samples for Initial Selection: Submit samples for initial selection by Consultant:

.1 Submit samples of spandrel glass coatings, tinted glazing for review and acceptance by Consultant prior to ordering.

.5 Samples for Verification: Submit samples for verification including sample sets showing the full range of variations expected where products involve normal colour variations.

- .6 Maintenance Data: Upon completion of installation, supply instructions covering re-glazing, adjustments and other relevant maintenance data.

## 1.6 QUALITY ASSURANCE

- .1 Conform to the requirements of the Flat Glass Marketing Association Glazing Manual, latest Edition.

## 1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver packaged materials in their original containers with manufacturer's labels and seals intact.
- .2 Storage and Handling Requirements: Store vertically, blocked off the floor in a weatherproof enclosure in original containers with manufacturers labels and seals intact until read for installation, and as follows:
  - .1 Install glass as soon as possible after delivery to site.
  - .2 Handle glass carefully to its place of installation.
  - .3 Prevent damage to glass, adjacent materials and surfaces.

## 1.8 SITE CONDITIONS

- .1 Ambient Conditions: Maintain temperature, humidity and solar exposure conditions of Glass Glazing materials during shipping, storage and site installation as required by manufacturer to maintain warranty and performance of installed products.

## 1.9 WARRANTY

- .1 Provide manufacturer's warranty for the following types of glass listed, against defects in materials and workmanship for the period indicated, commencing from the date of Substantial Performance of Work:
  - .1 Seal Failure: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions.
  - .2 Evidence of Failure: Obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - .3 Allowable Specific Exclusions: Breakage resulting from thermal stress will be accepted as a limitation to the warranty in accordance with CAN/CGSB 12.20.
  - .4 Warranty Period: Ten (10) Years.

## 2 Products

### 2.1 MATERIALS

- .1 Float Glass: In accordance with CAN/CGSB-12.3, glazing quality and as follows:
- .2 Tempered Glass:
  - .1 Minimum 1/4" thick, clear, conforming to CAN/CGSB-12.1, Type 2, Class 'B'. Tempering shall be performed using horizontal tong free method. Provide 1/2" where indicated on drawings.
    - .1 Provide Category "I" Heat Strengthened tempered glass for spandrel panel applications.
- .3 Laminated Safety Glass: In accordance with CAN/CGSB-12.1 and ASTM C1172 as follows:
  - .1 Glass: Clear, tempered glass.
  - .2 Type: 1 - Laminated.
  - .3 Class: B - Float Glass.

- .4 Category: II - Fully Tempered.
- .4 Mirrors, Silvered: to ASTM C1503 and as follows:
  - .1 Type: 1B - Float glass for high humidity use.
  - .2 Tint: Clear
  - .3 Edges: Pencil polished edge. Seal edges to prevent chemical or atmospheric penetration of backing.
  - .4 Mirror Clips: – C26 (polished chrome) finished steel, or stainless steel edge clips, with fastening concealed behind mirror.
- .5 Gaskets:
  - .1 Neoprene/EPDM thermoplastic rubber type gaskets of sufficient thickness to be compressed 25% when installed, having 2,000 psi tensile strength, with 50 durometer shore A hardness plus/minus 5, maximum 30% resistance to permanent set, resistance to ozone without cracking, minimum elongation at break of 300% and conforming to ASTM C542.
  - .2 Colour - "Black".
- .6 Sealant:
  - .1 One component, silicone base, solvent curing sealant conforming to ASTM C920. Colour as selected Later by Consultant.
- .7 Glazing Compound:
  - .1 Non-hardening modified oil type glazing compound.
- .8 Setting Blocks:
  - .1 Neoprene/EPDM rubber type, 4" long, with 40 to 50 durometer shore A hardness plus/minus 5; resistant to sunlight, weathering, oxidation and permanent deformation under load and wide enough to extend from fixed stop to opposite face of glass of thickness suitable to glazing condition to provide adequate glazing "bite".
- .9 Spacer Shims:
  - .1 Neoprene/EPDM rubber type, with 40 to 50 durometer shore A hardness plus/minus 5; resistant to sunlight, weathering, oxidation and permanent deformation under load and of adequate thickness to provide correct glass to face clearance at least 1/8".
- .10 Glazing Tape:
  - .1 Macro-polyisobutylene preformed glazing tape, 'Polyshim' or 'Vision Strip' by Tremco Ltd., division of RPM Company, or approved equal.

## 2.2 INSULATING GLASS

- .1 Insulating Glass Units: Provide sealed insulating glass units in accordance with CAN/CGSB-12.8 in configurations indicated, and as specified herein.
- .2 Manufacture sealed insulating glass units without edge channels or tape, that is, with bare glass edges.
- .3 Use two stage seal method of manufacture, as follows:
  - .1 Primary Seal: polyisobutylene sealing compound between glass and metal spacer/separator.
  - .2 Secondary Seal: polyurethane, silicone or polysulphide base sealant, filling gap between the two lites of glass at the edge up to the spacer/separator and primary seal.
- .4 Install stainless steel capillary breather tubes to equalize pressure differentials between insulating glass fabricating location and insulating glass installation location; crimp tube immediately prior to installation in accordance with glass fabricators written instructions.

- .5 Sealants for Insulating Glass Units:
  - .1 Primary Seal: Polyisobutylene; colour black.
  - .2 Secondary Seal: Structural silicone based; colour black.
- .6 Insulating Glass Units:
  - .1 Unit Composition:
    - .1 Exterior Lite: Clear tempered glass.
    - .2 Air Space: 1/2" Air Filled
    - .3 Interior Lite: Tinted tempered glass having standard performance Low E coating on #3 surface. Tinted as requested by PC.

### 2.3 FABRICATION AND MANUFACTURE

- .1 Label each light of glass with the registered name of the product and the weight and quality of the glass.
- .2 Check dimensions on site before cutting materials.
- .3 Minimum bite or lap of glass on stops and rabbets as recommended by glass manufacturer. Finish surfaces shall be free of tong marks.
- .4 Cut glass true to dimensions, square, plumb and level. Verify all dimensions prior to fabrication.
- .5 Distortion, pock marking or defects detrimental to appearance and/or performance, as determined by the Consultant, will be rejected.
- .6 Fabricate mirrors to fit measurements of finished spaces, made at the site. Use one piece for mirrors 4' or less in width. Make no horizontal joints except where indicated.

### 3 Execution

#### 3.1 EXAMINATION

- .1 Examine areas of work affecting the work of this section. Report in writing all defects, errors and discrepancies immediately to the Consultant.
- .2 Commencement of work implies acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- .1 Openings shall be free from moisture, frost, rust, dirt and foreign matter.
- .2 Clean surface to receive sealant with a clean cloth dampened with xylol or a 50-50 mixture of acetone and xylol. Wipe dry with a clean, dry cloth.

#### 3.3 INSTALLATION

- .1 Conform to the recommendation of the glazing manual, Flat Glass Marketing Association, latest edition and as specified herein.
- .2 Unless otherwise indicated on drawings otherwise, provide tempered glass at all doors, transoms, sidelights and vision lites within 2'-6" of grade and/or finished floor.
- .3 Glaze doors scheduled to be glazed.
- .4 Set sheet glass with draw lines horizontal.
- .5 Glaze interior openings using compound or glazing tapes or gaskets.
- .6 Install removable stops. Insert spacer shims between glass and stops at 24" O.C. and not less than 1/4" below "sight lines". Fill remaining voids with sealant or glazing compound to "sight lines" and trim sealant/glazing compound to produce clean, sharp, straight lines without voids or depressions.

- .7 Replace loose stops in their original positions, tighten all screws.
- .8 Refer to drawings and door and frame schedule for locations of each type of glass.

### 3.4 CLEANING

- .1 Repair all defects caused by the work of this section. Remove as work progresses, all excess or foreign materials or droppings which would set or become difficult to remove from surfaces at time of final cleaning.
- .2 Immediately prior to acceptance of work of this section by Consultant, remove temporary protection, clean and polish exposed surfaces of all work of this section. Use proper cleaning materials and methods to prevent damage to surfaces, finishes, sealer or work of other trades. Make good such damage to Consultant's satisfaction.
- .3 Do not use steel wool, wire brushes or steel scrapers on any finished surfaces.
- .4 Replace or make good to Consultant's satisfaction, upon completion of work of this section, all defective, scratched or damaged work, at no extra cost to the Owner.

### 3.5 GLAZING SCHEDULE

- .1 Aluminum curtain wall:
  - .1 Vision areas/spandrel areas; insulating glass units, 1/4" tinted float exterior, 1/4" clear float interior.
- .2 Other glass types as indicated on drawings.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 09 91 00: Painting

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM C475-02(2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  - .2 ASTM C514-04(2009e1), Standard Specification for Nails for the Application of Gypsum Board.
  - .3 ASTM C557-03(2009)e1, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
  - .4 ASTM C840-08, Standard Specification for Application and Finishing of Gypsum Board.
  - .5 ASTM C954-07, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
  - .6 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .7 ASTM C1047-09, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
  - .8 ASTM C1280-99, Standard Specification for Application of Gypsum Sheathing.
  - .9 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .10 ASTM C1178/C1178M-08, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
  - .11 ASTM C1396/C1396M-09a, Standard Specification for Gypsum Wallboard.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-07, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

**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 gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.

- .3 Submit duplicate 300 mm long samples of corner and casing beads, and mouldings.

#### 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 gypsum board assemblies materials level off ground, and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
  - .3 Protect from weather, elements and damage from construction operations.
  - .4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
  - .5 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
  - .6 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### 1.5 AMBIENT CONDITIONS

- .1 Maintain temperature 10 degrees C minimum, 21 degrees C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost free surfaces.
- .3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

## 2 Products

### 2.1 MATERIALS

- .1 Glass mat water-resistant gypsum backing board: to ASTM C1178/C1178M, 13 or 16 mm thick (refer to drawings), 1200 mm wide x maximum practical length. DensArmor Plus® Interior Panel or approved equal.
- .2 Moisture and Impact Resistant Gypsum Board: 13 mm.
- .3 Standard board: to ASTM C1396/C1396M regular, 16 mm thick Type X, 16 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges squared.
- .4 Metal furring runners, hangers, tie wires, inserts, anchors: to ASTM C645.
- .5 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .6 Resilient clips and drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .7 Nails: to ASTM C514.
- .8 Steel drill screws: to ASTM C1002.
- .9 Laminating compound: as recommended by manufacturer, asbestos-free.

- .10 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.
- .11 Shadow mould: 35 mm high, snap-on trim, of extruded PVC plastic 0.6 mm base steel thickness galvanized sheet pre-finished in satin enamel, white colour.
- .12 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
  - .1 VOC limit 250 g/L maximum.
  - .2 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .13 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .14 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.
- .15 Joint compound: to ASTM C475, asbestos-free.

### 3 Execution

#### 3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant 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 Consultant.

#### 3.2 ERECTION

- .1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.
- .2 Do application of gypsum sheathing to ASTM C1280.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.
- .4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .5 Install work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, and grilles.
- .7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .10 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.
- .11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

- .13 Erect drywall resilient furring transversely across studs, joists and between the layers of gypsum board, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 38 mm common nail and/or 25 mm drywall screw.
- .14 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

### 3.3 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work has been approved.
- .2 Apply single layer gypsum board to wood furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.
  - .1 Single-Layer Application:
    - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.
    - .2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.
- .3 Apply water-resistant gypsum board where wall tiles to be applied and adjacent to sinks. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.
- .4 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.
- .5 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .6 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
- .7 Install gypsum board with face side out.
- .8 Do not install damaged or damp boards.
- .9 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

### 3.4 INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Install shadow mould at gypsum board/ceiling juncture as indicated. Minimize joints; use corner pieces and splicers.
- .6 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.
- .7 Provide continuous polyethylene dust barrier behind and across control joints.
- .8 Locate control joints where indicated, at changes in substrate construction, at approximate 10 m spacing on long corridor runs, and at approximate 15 m spacing on ceilings.

- .9 Install control joints straight and true.
- .10 Construct expansion joints as detailed, at building expansion and construction joints. Provide continuous dust barrier.
- .11 Install expansion joint straight and true.
- .12 Install cornice cap where gypsum board partitions do not extend to ceiling.
- .13 Splice corners and intersections together and secure to each member with 3 screws.
- .14 Install access doors to electrical and mechanical fixtures specified in respective sections.
  - .1 Rigidly secure frames to furring or framing systems.
- .15 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .16 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
  - .1 Levels of finish:
    - .1 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.
- .17 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .18 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .19 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .20 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .21 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.
- .22 Mix joint compound slightly thinner than for joint taping.
- .23 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.
- .24 Allow skim coat to dry completely.
- .25 Remove ridges by light sanding or wiping with damp cloth.

### **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.
- .2 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.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.

- .2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

**END OF SECTION**

1 General

**1.1 SUMMARY**

- .1 All conditions of the Contract apply to the work of this Section.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Trades which affect the quality or dimensions of this Contractor's work. Commencement of this Contractor's work shall imply complete acceptance of all work by other Trades.

**1.2 INTENT**

- .1 The Contractor shall supply labour, materials and equipment for the complete installation of epoxy flooring on all interior concrete floors as listed on the drawings. General floor coating shall form a covered 150mm curb along all walls and cover all maintenance pads in all rooms. Protective coating in the chemical containment areas shall be finished from finished floor to top of all containment walls and curbs height as shown on drawings.

**1.3 RELATED REQUIREMENTS**

- .1 Section 01330: Submittal Procedures
- .2 Section 03300: Cast-in-Place Concrete

**1.4 REFERENCES**

- .1 ASTM D16-07 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
- .2 ASTM D4259-88 (2006) – Standard Practice for Abrading Concrete.
- .3 ASTM D4263-83 (2005) - Indicating Moisture in Concrete by the Plastic Sheet Method.
- .4 ASTM F1869-04 - Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- .5 International Concrete Repair Institute (ICRI)
- .6 Guideline No. 03732: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
- .7 Society for Protective Coatings (SSPC)
  - .1 SSPC-TR 5 - Design, Installation, and Maintenance of Protective Polymer Flooring Systems for Concrete
  - .2 SSPC-TU 10 - Procedures for Applying Thick Film Coatings and Surfacing Over Concrete Floors
  - .3 SSPC-TU 2 INACE 6G197 - Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment
  - .4 SSPC SP13 - Surface Preparation of Concrete
  - .5 References herein are as detailed in Systems and Specifications SSPC Painting
  - .6 Manual, Volume 2, published by the Society for Protective Coatings (formerly the Steel Structures Painting Council), 40 24th Street 6th Floor, Pittsburgh, PA, 15222-4656 ([www.sspc.org](http://www.sspc.org)).

**1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- .2 Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.

- .3 Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.
- .4 Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- .5 Maintenance Data: For resinous flooring to include in maintenance manuals.

## 1.6 QUALITY ASSURANCE

- .1 Single Source Responsibility: Obtain primary protective resins including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with experience in manufacturing the principle materials described in this section. Contractor must have completed at least five projects of similar size and complexity. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- .2 Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.
- .3 All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.

## 1.8 DEFINITIONS

- .1 Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils.

## 1.9 PROJECT CONDITIONS

- .1 Report in writing to the General Contractor any defects of surfaces or work prepared by other trades which affect the quality or dimensions of this Contractor's work. Commencement of this Contractor's work shall imply complete acceptance of site and environmental conditions and of all work by other trades.

## 2 Products

### 2.1 MANUFACTURER

- .1 Stonhard or approved equal.

### 2.2 MATERIALS

- .1 Stonhard, Inc.; Stonshield HRI®. Complete with seamless 150mm coved base.
  - .1 Coordinate moisture and concrete additive requirements with supplier.

### 2.3 COLOUR

- .1 Epoxy floor coating, and base colour shall be selected by the Consultant at a later date from the entire colour range from the approved manufacturer.

## 3 Execution

### 3.1 FLOOR COATING APPLICATION

- .1 As per suppliers best practice recommendations.

### 3.2 CURING, PROTECTION AND CLEANING

- .1 Allow epoxy coating to cure at least the minimum required time as noted by the manufacturer to establish tack-free surface. Cure flooring and lining materials in compliance with manufacturer's

directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

- .2 Protect resinous systems from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surface after final coats.

### **3.3 WARRANTY**

- .1 Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full years from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

**END OF SECTION**

1 General

**1.1 SUMMARY**

.1 Section Includes:

- .1 Material and installation of site applied paint finishes to new exterior and interior surfaces, including site painting of shop primed surfaces.

**1.2 RELATED REQUIREMENTS**

- .1 Section 08 11 00: Metal Doors and Frames
- .2 Section 09 21 16: Gypsum Board Assemblies

**1.3 REFERENCES**

- .1 Environmental Protection Agency (EPA)
  - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).
- .2 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 Master Painters Institute (MPI)
  - .1 MPI Architectural Painting Specifications Manual.

**1.4 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Contractor: proven satisfactory experience.
  - .2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.
  - .3 Apprentices: working under direct supervision of qualified trades person in accordance with trade regulations.
- .2 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section on-site installations in accordance with Section 01 31 19 Project Meetings.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Coordination with other building sub-trades.
    - .4 Review manufacturer's installation instructions and warranty requirements.

**1.5 SCHEDULING**

- .1 Submit work schedule for various stages of painting to Consultant for review. Submit schedule minimum of 48 hours in advance of proposed operations.
- .2 Obtain written authorization from Consultant for changes in work schedule.
- .3 Schedule painting operations to prevent disruption of occupants.

**1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit product data and instructions for each paint and coating product to be used.

- .2 Submit product data for the use and application of paint thinner.
- .3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.
- .3 Samples:
  - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
  - .2 Submit duplicate 200 x 300 mm sample panels of each paint, stain, and clear coating with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
    - .1 3 mm plate steel for finishes over metal surfaces.
    - .2 13 mm birch plywood for finishes over wood surfaces.
    - .3 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
  - .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
  - .4 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
    - .1 Lead, cadmium and chromium: presence of and amounts.
    - .2 Mercury: presence of and amounts.
    - .3 Organochlorines and PCBs: presence of and amounts.
  - .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .6 Manufacturer's Instructions:
    - .1 Submit manufacturer's installation application instructions.
  - .7 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:
    - .1 Product name, type and use.
    - .2 Manufacturer's product number.
    - .3 Colour numbers.
    - .4 MPI Environmentally Friendly classification system rating.

## 1.7 MAINTENANCE

- .1 Extra Materials:
  - .1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.
  - .2 Quantity: provide one - one four litre can of each type and colour of primer, stain, and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.
  - .3 Delivery, storage and protection: comply with Departmental Representative requirements for delivery and storage of extra materials.

## 1.8 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:

- .1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Acceptance at Site:
  - .1 Identify products and materials with labels indicating:
    - .1 Manufacturer's name and address.
    - .2 Type of paint or coating.
    - .3 Compliance with applicable standard.
    - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection:
  - .1 Provide and maintain dry, temperature controlled, secure storage.
  - .2 Store materials and supplies away from heat generating devices.
  - .3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Fire Safety Requirements:
  - .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
  - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
  - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.
- .9 Waste Management and Disposal:
  - .1 Separate waste materials for reuse recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling.
  - .4 Place materials defined as hazardous or toxic in designated containers.
  - .5 Handle and dispose of hazardous materials in accordance with Regional and Municipal, regulations.
  - .6 Ensure emptied containers are sealed and stored safely.
  - .7 Unused paint and coating materials must be disposed of at official hazardous material collections site as approved by Departmental Representative.
  - .8 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.
  - .9 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

- .10 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
- .11 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
  - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
  - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
  - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
  - .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
  - .5 Empty paint cans are to be dry prior to disposal or recycling (where available).
- .12 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

## 1.9 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
  - .1 Ventilate enclosed spaces.
  - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
  - .3 Provide continuous ventilation for seven days after completion of application of paint.
  - .4 Coordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
  - .5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
  - .6 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
  - .1 Unless pre-approved written approval by and product manufacturer, perform no painting when:
    - .1 Ambient air and substrate temperatures are below 10 degrees C.
    - .2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.
    - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
    - .4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.
    - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
    - .6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.

- .2 Perform painting work when maximum moisture content of the substrate is below:
  - .1 15% for wood.
  - .2 12% for plaster and gypsum board.
- .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
- .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
  - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
  - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
  - .3 Apply paint when previous coat of paint is dry or adequately cured.
- .4 Additional interior application requirements:
  - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
  - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative DCC Representative Consultant such that painted surfaces will have dried and cured sufficiently before occupants are affected.

## 2 Products

### 2.1 MATERIALS

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Conform to latest MPI requirements for interior painting work including preparation and priming.
- .4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.
- .5 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- .6 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:
  - .1 Water-based.
  - .2 non-flammable.
  - .3 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
  - .4 Manufactured without compounds which contribute to smog in the lower atmosphere.
  - .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.
- .7 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .8 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.
- .9 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:

- .1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.
- .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.
- .10 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes.
- .11 Recycled water-borne surface coatings to contain 50 % post-consumer material by volume.
- .12 Recycled water-borne surface coatings must not contain:
  - .1 Lead in excess of 600.0 ppm weight/weight total solids.
  - .2 Mercury in excess of 50.0ppm weight/weight total product.
  - .3 Cadmium in excess of 1.0ppm weight/weight total product.
  - .4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.
  - .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

**2.2 COLOURS**

- .1 After Contract award, submit proposed Colour Schedule to Departmental Representative for review.
- .2 Colour schedule will be based upon selection of five base colours and three accent colours. No more than eight colours will be selected for entire project and no more than three colours will be selected in each area.
- .3 Selection of colours from manufacturers full range of colours.
- .4 Where specific products are available in restricted range of colours, selection based on limited range.
- .5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

**2.3 MIXING AND TINTING**

- .1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from Departmental Representative DCC Representative Consultant for tinting of painting materials.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

**2.4 GLOSS/SHEEN RATINGS**

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated.

## 2.5 EXTERIOR PAINTINGS SYSTEMS

- .1 Galvanized Metal: not chromate passivated including structural fastenings, plates etc.
  - .1 EXT 5.3B – Alkyd, gloss level 1 finish.
- .2 Dressed Lumber: structural timbers, doors, door and window frames, casings, battens, smooth facias, etc.
  - .1 EXT 6.3J - Waterborne light industrial, gloss level 5coating.

## 2.6 INTERIOR PAINTING SYSTEMS

- .1 Structural steel and metal fabrications: columns, beams, joists:
  - .1 INT 5.1A - Quick dry enamel, gloss level 1 finish.
- .2 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts.
  - .1 INT 5.3A – Latex, gloss level 2 finish.
- .3 Dimension lumber: columns, beams, exposed joists, underside of decking:
  - .1 INT 6.2A - Latex, gloss level 5 finish (over alkyd primer).
- .4 Dressed lumber: including structural columns, beams, exterior wood accents:
  - .1 INT 6.3D: Semi transparent stain / alkyd varnish, gloss level 1 finish.
- .5 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:
  - .1 INT 9.2A – Latex, gloss level 3 finish (over latex sealer).

## 3 Execution

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

### 3.3 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .3 Maximum moisture content as follows:
  - .1 Plaster and gypsum board: 12%.
  - .2 Wood: 15%.

### 3.4 PREPARATION

- .1 Protection:

- .1 Protect existing building surfaces and adjacent structures from paint splatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Consultant.
- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished products and equipment.
- .4 Protect building occupants and general public in and about the building.
- .2 Exterior Surface Preparation:
  - .1 Clean and prepare exterior surfaces to be repainted in accordance with MPI Maintenance Repainting Manual requirements. Refer to the MPI Manual in regard to specific requirements and as follows:
    - .1 Remove dust, dirt, and surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
    - .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
    - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
    - .4 Allow surfaces to drain completely and allow drying thoroughly. Allow sufficient drying time and test surfaces using electronic moisture meter before commencing work.
    - .5 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water based paints.
    - .6 Many water-based paints cannot be removed with water once dried. Minimize use of kerosene or such organic solvents to clean up water-based paints.
  - .2 Clean metal surfaces to be repainted by removing rust, dirt, oil, grease and foreign substances in accordance with MPI requirements. Remove such contaminants from surfaces, pockets and corners to be repainted by brushing with clean brushes, blowing with clean dry compressed air, or brushing/vacuum cleaning as required.
  - .3 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before priming and between applications of remaining coats. Touch-up, spot prime, and apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
  - .4 Do not apply paint until prepared surfaces have been accepted by Consultant.
  - .5 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .3 Interior Surface Preparation:
  - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
  - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
  - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
- .4 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:

- .1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
- .2 Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
- .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
- .4 Allow surfaces to drain completely and allow to dry thoroughly.
- .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
- .6 Use trigger operated spray nozzles for water hoses.
- .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
  - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
  - .2 Apply wood filler to nail holes and cracks.
  - .3 Tint filler to match stains for stained woodwork.
- .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by blowing with clean dry compressed air and/or vacuum cleaning.
- .9 Touch up of shop primers with primer as specified.
- .10 Do not apply paint until prepared surfaces have been accepted by Consultant

### 3.5 APPLICATION

- .1 Method of application to be as approved Consultant. Apply paint by brush, roller, air sprayer and/or airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
  - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
  - .2 Work paint into cracks, crevices and corners.
  - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
  - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
  - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray application:
  - .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

- .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
- .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
- .4 Brush out immediately all runs and sags.
- .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .9 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .10 Finish closets and alcoves as specified for adjoining rooms.
- .11 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

### 3.6 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.
- .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .8 Paint fire protection piping red.
- .9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .10 Paint natural gas piping yellow.
- .11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .12 Do not paint interior transformers and substation equipment.

### 3.7 SITE TOLERANCES

- .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
- .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.

- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 09 21 16: Gypsum Board Assemblies

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .2 ASTM B456-03, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
  - .3 ASTM A653/A653M-09, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A924/A924M-09, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
  - .2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
  - .3 CGSB 31-GP-107MA-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
- .3 CSA International
  - .1 CAN/CSA-B651-04, Accessible Design for the Built Environment.
  - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

**1.3 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 data sheets 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 Ontario, Canada.
  - .2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Tools:
  - .1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 - Closeout Submittals.

- .2 Deliver special tools to Departmental Representative.

## 1.6 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 off ground, and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect toilet and bathroom accessories from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 2 Products

### 2.1 MATERIALS

- .1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A167, Type 304, with No.4 satin finish.
- .3 Stainless steel tubing: In accordance with ASTM A1008/A1008M, cold rolled, commercial quality; minimum nominal thickness as established by product type; surface preparation and metal pre-treatment as required for applied finish.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

### 2.2 COMPONENTS

- .1 All accessories to be supplied by Bobrick or approved equal.
- .2 **Toilet tissue dispenser:** double roll type, surface mounted, capacity of 500 double ply roll, roll under spring tension for controlled delivery.
  - .1 Model: Bobrick marble roll toilet tissue holder, Code **B-2746**, aluminum satin finish.
- .3 **Combination towel dispenser/waste receptacle:** recessed wall unit.
  - .1 Model: Bobrick surface mounted mask receptacle, Code **B-369**, stainless steel with satin finish.
- .4 **Soap dispenser:** liquid push-in valve, self-contained translucent polyethylene, stainless steel piston and valve assembly, tamper proof filler lock, recessed wall mounted, exposed metal components stainless steel.
  - .1 Model Bobrick Surface Mounted Soap Dispenser Code **B-4112**
- .5 **Sanitary Napkin Disposal:** stainless steel surface mounted unit.
  - .1 Model: Bobrick sanitary napkin dispenser, Contura Services, Code **B-270**, stainless steel with satin finish.
- .6 **Grab Bar:** Horizontal 1.214mm (0.048") thickness; 615mm (24") long x 38mm (1-1/2") Ø, straight, stainless steel, slip resistant grip, concealed mounting, cap secured with vandal resistant set screws. Ensure grab bars have matching finish.
  - .1 Model Bobrick: Code **B-6806.99**

- .7 **Grab Bar:** Side "L"-shape grab bar, 760mm (30") long x 760mm (30") high 38mm (1-1/2") dia., stainless steel, slip resistant grip, concealed mounting, cap secured with vandal resistant set screws. Ensure grab bars have matching finish.
  - .1 Model Bobrick: Code **B-6898.99**
- .8 **Coat hook:** 2 located in each universal washroom and one in each stall of the regular washrooms.
  - .1 Model: Bobrick surface mounted vandal resistant clothes hook, Code **B-983**, stainless steel with satin finish.
- .9 **Diaper changing station:** Recessed horizontal design, prefabricated baby changing station with built-in sanitary liner dispenser and safety belt, complete with initial stocking supplies and stocking list for replacement stock. Safety instructions in both official languages, graphic illustration, labeled with universally accepted symbol for "changing station".
  - .1 Model: Bobrick / Koala Code **KB110-SSRE**
- .10 **Mirror:** wall mounted unit, fixed framed mirror 6 mm frost glass mirror with security film to prevent shattering. Extending length of sink (120mm), stainless steel frame with integral shelf.
  - .1 Model: Bobrick Code **B-165 1830**
- .11 **Shelf for Universal Washroom:** mounted not more than 1200mm above the floor:
  - .1 Model: Bobrick Code B-295 x 18 stainless steel shelf.

## 2.3 FABRICATION

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5 mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CAN/CSA-G164.
- .7 Shop assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

## 2.4 FINISHES

- .1 Chrome and nickel plating: to ASTM B456, satin finish.
- .2 Baked enamel: condition metal by applying one coat of metal conditioner to CGSB 31-GP-107Ma, apply one coat Type 2 primer to CAN/CGSB-1.81 and bake, apply two coats Type 2 enamel to CAN/CGSB-1.88 and bake to hard, durable finish. Sand between final coats. Colour selected from standard range by Departmental Representative.
- .3 Manufacturer's or brand names on face of units not acceptable.

## 3 Execution

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.

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

### **3.2 INSTALLATION**

- .1 Install and secure accessories rigidly in place as follows:
  - .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
  - .2 Hollow masonry units, existing plaster or drywall: use toggle bolts drilled into cell or wall cavity.
- .2 Install grab bars on built-in anchors provided by bar manufacturer.
- .3 Use tamper proof screws/bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.
- .5 Install mirrors in accordance with Section 08 80 50 - Glazing.

### **3.3 ADJUSTING**

- .1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

### **3.4 CLEANING**

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

### **3.5 PROTECTION**

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

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

**1.2 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 33 00: Submittal Procedures

**1.3 DELIVERY, STORAGE, AND HANDLING**

.1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

**1.4 SUBMITTALS**

- .1 Submit submittals in accordance with the General Conditions and Section 01 33 00.
- .2 Shop drawings:
  - .1 Indicate the following: methods of anchoring, thickness and finishes of materials, relationship of work of other sections, including all required cutouts, and all other pertinent data and information.
- .3 Samples: When requested submit full size samples of all Products.
- .4 Maintenance data: Three copies of instructions covering cleaning, replacement and other relevant maintenance data.
- .5 Extended Warranty: Submit a written warranty in accordance with Section 01 33 00.
  - .1 Warranty period of 5 years
  - .2 Commencement: Substantial Performance of the Work

**1.5 ELECTRICAL CO-ORDINATION**

- .1 Electrical Requirements: Coordinate wiring requirements and power characteristics of work with building electrical system. Do wiring in strict conformity with requirements of the Electrical Code and Electrical Sections.
  - .1 Work by Electrical Sections: Supply and installation of disconnect switch/junction box and power to the disconnect switch/junction box.
  - .2 Work by This Section: Wiring and connection at and from disconnect switch/junction box to motors, starters, switches, controls, safety devices and other items requiring power.
- .2 Employ licensed electrician to wire and interconnect all operational and safety components for the Work. Terminate wiring required for connection to control circuitry and power at NEMA enclosures. Ground all control wiring.
- .3 Electrical Components, Devices, and Accessories: CSA certified and labelled.

2 Products

**2.1 MATERIALS**

- .1 Provide reinforcing, fastenings, and anchorage required for building in.
- .2 Insulate between dissimilar metals, and metal and incompatible materials to prevent electrolysis with bituminous paint or other approved means.
- .3 Do not attach manufacturer's name or trademark, plates, imprints or labels to products unless approved by Consultant.

## 2.2 FABRICATION

- .1 Verify site dimensions prior to fabrication. Fabricate work true to dimensions and square. Finished work shall be free from distortion and defects detrimental to appearance and performance.

## 2.3 MISCELLANEOUS SPECIALTIES

- .1 Refer to drawings and schedules for items required but not specified herein.

## 2.4 INTERIOR WALL PANELS FOR BATHROOMS

**Note:** Final interior panel system to be selected by PC & AECOM.

- .1 Option One: FRP Panels complete with cement board backing.
  - .1 Manufacturers: Laird Plastics (Or approved Equal)
  - .2 Accessories: Aluminum Trims & Corners as required
  - .3 Finish: Selected by Architect and Parks Canada
  - .4 Fasteners: Flush plastic or composite rivets
- .2 Option Two: Acrovyn High-Impact Wall Panels
  - .1 Manufacturers: CS Acrovyn (Or approved Equal)
  - .2 Accessories: Aluminum Trims & Corners as required
  - .3 Finish: Selected by Architect and Parks Canada
  - .4 Fasteners: Filly adhered

## 3 Execution

### 3.1 EXAMINATION

- .1 Examine substrate surfaces to receive the Work of this Section and ensure that work done as part of the Work of other Sections is complete and that there are no conditions which will adversely affect the performance of this Work.
- .2 Do not proceed with work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of surfaces and conditions.

### 3.2 INSTALLATION

- .1 Securely fasten work level and plumb in the locations shown on the drawings and as specified herein.
- .2 Co-ordinate installation with the work of sections providing adjacent construction as required.
- .3 Execute electrical work by qualified electricians and in compliance with the Canadian Electrical Code and other requirements of authorities having jurisdiction.

### 3.3 ADJUSTMENT

- .1 Upon completion of the work or when directed, remove all traces of protective coatings or paper.
- .2 Test operation, adjust, lubricate and ensure that accessories are in perfect working order.

### 3.4 PROTECTION

- .1 Promptly upon completion of work and following preliminary review by the Consultant, cover finished products and protect exposed corners and areas vulnerable to damage by persons or by the movement of materials, tools or equipment.
- .2 Maintain protective coverings in good order until the Consultant instructs that they be removed.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES**

- .1 Portable Fire Extinguishers
- .2 Fire Extinguisher Brackets.

**1.3 REFERENCES**

- .1 FM - Factory Mutual System - Approval Guide.
- .2 NFPA 10 - Portable Fire Extinguishers.
- .3 ULC - Fire Protection Equipment Directory.

**1.4 SUBMITTALS**

- .1 Submit shop drawings and product data for each of the following:
  - .1 Portable fire extinguishers.

**1.5 QUALITY ASSURANCE**

- .1 Perform Work to NFPA 10.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.

**1.6 REGULATORY REQUIREMENTS**

- .1 ULC listed and labelled.
- .2 Rated and identified in conformance with CAN/ULC S508, "Rating and Fire Testing of Fire Extinguishers".

2 Products

**2.1 GENERAL**

- .1 Manufacturers
  - .1 National Fire Equipment
  - .2 Badger
  - .3 Kidde
- .2 Stored pressure, rechargeable type with hose and shut-off nozzle.
- .3 ULC labelled.

**2.2 MULTI-PURPOSE DRY CHEMICAL**

- .1 5lb (2.27kg)
  - .1 Type: multi-purpose (ABC) type, dry chemical
  - .2 Rating: minimum 3A:10Bc.
- .2 10lb (4.54kg)
  - .1 Type: multi-purpose (ABC) type, dry chemical
  - .2 Rating: minimum 4A:60Bc

### 2.3 IDENTIFICATION

- .1 Identify extinguishers in accordance with the recommendations of NFPA No. 10 and CAN/ULC-S508.
- .2 Attach a tag or label to the extinguisher indicating the month and year of installation. Provide space for service dates.

### 3 Execution

#### 3.1 INSTALLATION

- .1 Install to manufacturer's instructions.
- .2 Conform to NFPA 10
- .3 Install with wall mounting bracket where not installed in cabinets.
- .4 Refer to Architectural drawings for quantity and installation locations.

#### 3.2 APPLICATIONS

- .1 Provide fire extinguishers where indicated and in conformance with the Ontario Fire Code and NFPA 10.
- .2 Provide 5lb. (2.27kg) multi-purpose extinguishers in mechanical room.
- .3 Provide 10lb. (4.54kg) multi-purpose extinguishers in storage room and tuck shop.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES**

- .1 Pipe, pipe fittings, valves, and connections for piping systems.
  - .1 Sanitary Sewer
  - .2 Sanitary Vent
  - .3 Domestic Water

**1.3 REFERENCES**

- .1 CAN/CSA B137.1 - Polyethylene Pipe, Tubing, and Fittings for Cold Water Pressure Services
- .2 CAN/CSA B137.5 - Cross-Linked Polyethylene (PEX) Tubing Systems for Pressure Applications
- .3 CAN/CSA B181.2 - Poly(Vinyl Chloride) (PVC) Drain, Waste, and Vent Pipe and Pipe Fittings
- .4 ASTM D2447 - Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
- .5 ASTM D2466 - Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- .6 ASTM D2564 - Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- .7 ASTM D2665 - Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- .8 ASTM D2729 - Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .9 ASTM D2855 - Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- .10 ASTM D3034 - Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .11 ASTM E814 - Fire Tests of Through-Penetration Fire Stops.
- .12 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .13 AWWA C651 - Disinfecting Water Mains.
- .14 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- .15 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- .16 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

**1.4 SUBMITTALS**

- .1 Submit a 'Letter of Conformance', indicating specified items selected for use in the project with the following supporting product data and reports.
- .2 Provide data on valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- .3 Provide manufacturers catalogue data of all piping and fittings.
- .4 Record actual locations of valves.

**1.5 QUALITY ASSURANCE**

- .1 Perform Work to Province of Ontario standards. Maintain one copy on site.

- .2 Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

## 1.6 REGULATORY REQUIREMENTS

- .1 Perform Work to National Plumbing Code of Canada.
- .2 Conform to applicable code for installation of backflow prevention devices.
- .3 Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

## 1.7 DELIVERY, STORAGE AND PROTECTION

- .1 Accept valves on site in shipping containers with labelling in place. Inspect for damage.
- .2 Provide temporary protective coating on cast iron and steel valves.
- .3 Cover the stockpile or the crated pipes with an opaque material such as canvas. If the pipe is covered, always allow for circulation of air through the pipe to avoid heat buildup in hot summer weather.
- .4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## 1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install underground piping when bedding is wet or frozen.

## 2 Products

### 2.1 SANITARY PIPING, BURIED

- .1 PVC Pipe: CAN/CSA-B181.2, "Polyvinylchloride (PVC) Drain, Waste, and Vent Pipe and Pipe Fittings".

### 2.2 SANITARY PIPING, ABOVEGROUND

- .1 PVC Pipe: CAN/CSA-B181.2, "Polyvinylchloride (PVC) Drain, Waste, and Vent Pipe and Pipe Fittings".
- .2 Flame Spread Rating of not greater than 25 as per ULC S102.2 test methods.
- .3 Acceptable Manufacturer:
  - .1 IPEX "System 15" Pipe and Fittings to CSA B181.2. Provide IPEX One-Step Solvent Cement without Primer for solvent weld joints.

### 2.3 WATER PIPING, BURIED

- .1 HDPE Pipe: CAN/CSA-B137.1, "Polyethylene Pipe, Tubing, and Fittings for Cold Water Pressure Services".
- .2 Acceptable Manufacturer:
  - .1 IPEX "Gold 901", 1380 kPa (200 psi) Copper Tube Size (CTS) High-Density Polyethylene (HDPE) to CSA B137.1 and AWWA C901, complete with brass or plastic compression fittings and stainless steel insert or a specially designed (copper tube size) plastic insert to reinforce Gold Stripe at the joint.

### 2.4 WATER PIPING, ABOVEGROUND

- .1 PEX Pipe: CAN/CSA-B137.5, "Cross-Linked Polyethylene (PEX) Tubing Systems for Pressure Applications".
- .2 Flame Spread Rating of not greater than 25 as per ULC S102.2 test methods.

- .3 Acceptable Manufacturer:
  - .1 Uponor "PEX-a", 1105 kPa (160 psi) Cross-Linked Polyethylene (PEX) to CSA B137.5 and AWWA C904, complete with Uponor ProPEX fittings. Provide Copper Tube Size (CTS) hangers and supports.

## 2.5 VALVES – GENERAL

- .1 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
- .2 Provide valves of the same manufacturer where possible.
- .3 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.
- .4 Valid CRN (Canadian Registration Number) issued by Province of Ontario required for each valve.
- .5 Materials:
  - .1 Bronze: ASTM B62 or B61 as applicable
  - .2 Brass: ASTM B283 C3770
  - .3 Cast Iron: ASTM A126 Class B
- .6 End Connections:
  - .1 Flanged ends: ANSI B16.1 (Class 125), ANSI B16.5
  - .2 Face-to-face dimensions: ANSI B16.10
- .7 Design and Testing:
  - .1 Bronze Gate & Check valves: MSS-SP-80
  - .2 Ball Valves: MSS-SP-110
  - .3 Cast Iron Gate Valves: MSS-SP-70
  - .4 First named product as indicated in paragraphs below; other acceptable manufacturers, subject to shop drawing review.

## 2.6 ISOLATION VALVES

- .1 Sizes up to 50mm (2"):
  - .1 Construction: MSS SP-110, 2 piece full port forged brass ball valve, cold working pressure 600psig (4,140kPa), threaded or soldered ends, PTFE seats, brass stem, chrome plated ball. Valves in insulated piping, provide a 2" (50mm) stem extension and extended operating handle of non-thermal conductive material, and protective sleeve that allows operation of valve without breaking the vapour seal or disturbing insulation.
  - .2 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - .1 Jenkins.
    - .2 Kitz Corporation.
    - .3 Watts Regulator.

## 3 Execution

### 3.1 EXAMINATION

- .1 Verify that excavations are to required grade, dry, and not over-excavated.

### 3.2 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

- .2 Remove scale and dirt, on inside and outside, before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.

### 3.3 INSTALLATION

- .1 Install to manufacturer's instructions.
- .2 Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- .3 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- .4 Install piping to maintain headroom, conserve space, and not interfere with use of space.
- .5 Group piping whenever practical at common elevations.
- .6 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- .7 Install vent piping penetrating roofed areas to maintain integrity of roof assembly; refer to Division 07.
- .8 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer (maximum VOC content of 80g/L) to welding.
- .9 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting where required. Coordinate with general trades.
- .10 Excavate and backfill as required for work of this Section.
- .11 Install valves with stems upright or horizontal, not inverted.
- .12 Sleeve pipes passing through partitions, walls and floors.
- .13 Protect outdoor "System 15" pipes and fittings from ultraviolet oxidation by painting with a heavily pigmented, exterior water-based latex paint. White or a similar light colour is preferred to minimize heat absorption on the pipe surface. Apply latex paint thickly as an opaque coating on well cleaned and lightly sanded pipe and fittings.
- .14 Pipe Hangers and Supports:
  - .1 Install to OBC.
  - .2 Support horizontal piping as scheduled.
  - .3 Install hangers to provide minimum 1/2" (13mm) space between finished covering and adjacent work.
  - .4 Place hangers within 12" (300mm) of each horizontal elbow.
  - .5 Use hangers with 1-1/2" (38mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - .6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - .7 Prime coat exposed steel hangers and supports.

### 3.4 APPLICATION

- .1 Install unions downstream of valves and at equipment or apparatus connections.
- .2 Install ball valves for shut-off and to isolate equipment or part of systems.

### 3.5 ERECTION TOLERANCES

- .1 Establish invert elevations, slopes for drainage 1% to 2% as shown on drawings. Maintain gradients.
- .2 Slope all water piping and arrange to drain at low points, as shown on drawings. Provide hose bibs as shown on drawings. Provide additional hose bibs as required.

### 3.6 DISINFECTION OF POTABLE WATER PIPING

- .1 Disinfect water distribution system.
- .2 Prior to starting work, verify system is complete, flushed and clean.
- .3 Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- .4 Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80mg/L residual.
- .5 Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15% of outlets.
- .6 Maintain disinfectant in system for 24 hours.
- .7 If final disinfectant residual tests less than 25mg/L, repeat treatment.
- .8 Flush disinfectant from system until residual equal to that of incoming water or 1.0mg/L.
- .9 Take samples no sooner than 24 hours after flushing, from 10% of outlets and from water entry, and analyze to AWWA C651.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES**

- .1 Floor drains
- .2 Trench drains
- .3 Cleanouts
- .4 Hose bibs
- .5 Hydrants
- .6 Backwater valves
- .7 Air Trap Seal Guards

**1.3 REFERENCES**

- .1 ASME A112.21.1 - Floor Drains.
- .2 ASSE 1011 - Hose Connection Vacuum Breakers.
- .3 ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

**1.4 SUBMITTALS**

- .1 Submit shop drawings for each plumbing specialty.

**1.5 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with documented experience.
- .2 Provide listing/approval stamp, label or other marking on plumbing specialties are made to the specified standard(s).

**1.6 DELIVERY, STORAGE AND PROTECTION**

- .1 Accept specialties on site in original factory packaging. Inspect for damage.

2 Products

**2.1 GENERAL**

- .1 Manufacturer: Watts Drainage models and ACO models indicated or equivalent by;
  - .1 Zurn
  - .2 Jay R. Smith

**2.2 FLOOR DRAINS**

- .1 Floor Drain (FD):
  - .1 Manufacturer: Watts Drainage model FD-100-C-5
  - .2 Epoxy coated cast iron floor drain with anchor flange, reversible membrane clamp with primary and secondary weep hole, 1/2" (13mm) thick 5" (125mm) adjustable nickel bronze strainer grate and no shank hub outlet.
  - .3 Accessories:

- .1 Sediment bucket.

### 2.3 TRENCH DRAINS [TD]

- .1 Manufacturer: ACO Quartz Premium Line pre-sloped trench drain system with standard or custom dimension of:
  - .1 [TD-1]: 84mm wide x 1795mm long (3.3" x 70.7")
  - .2 [TD-2]: 84mm wide x 800mm long (3.3" x 31.5")
- .2 304 Stainless steel 19 gage flange edge channel, Wave 304 Stainless steel 17 gage grating with integral 51mm (2") center vertical outlet.
- .3 Accessories:
  - .1 Stainless steel debris strainer
  - .2 Stainless steel clad flexible coupling.

### 2.4 CLEANOUTS [CO]

- .1 Interior Finished Floor Areas:
  - .1 Watts Drainage Model CO-200-R
    - .1 Epoxy coated cast iron floor cleanout with 5-1/8" (130mm) round adjustable nickel bronze top and no hub connection.
- .2 Interior Unfinished Accessible Areas
  - .1 Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.
- .3 Caulking for cleanouts
  - .1 VOC content not to exceed 250g/L.

### 2.5 HYDRANTS

- .1 Exterior Wall Hydrant – Single Temperature [WH-1]
  - .1 Watts Drainage Model HY-330
  - .2 Concealed moderate climate key operated wall hydrant with nickel bronze box and door, chrome plated hydrant face, integral vacuum breaker, 3/4" (19mm) hose connection, all bronze head, seat casting and internal working parts, galvanized wall casing and hydrant key.

### 2.6 HOSE BIB [HB]

- .1 Watts Drainage Series [HB-1]
  - .1 Brass body construction with 1/2" (13mm) copper x 3/4" (19mm) hose thread connection, hose coupling, integral vacuum breaker, built-in backflow protection, and cast iron hand wheel.

### 2.7 BACKWATER VALVES [BWV]

- .1 Recessed
  - .1 Watts Drainage Model BV-230-R
  - .2 Epoxy coated cast iron backwater valve with gasket cover and removable bronze seat, flapper and adjustable cast iron body and collar with nickel bronze access cover. Soil pipe extension shall be supplied by the Contractor.

### 2.8 AIR TRAP SEAL GUARDS

- .1 Manufacturer: Rectorseal, SureSeal Model.
  - .1 Other manufacturers subject to shop drawing review.

3 Execution

**3.1 GENERAL**

- .1 Install all products in accordance with the plumbing code and with manufacturer's instructions.

**3.2 FLOOR DRAINS AND TRENCH DRAINS**

- .1 Provide floor drains and trench drains where indicated on architectural and plumbing floor plans.
- .2 Inspect locations where floor drains and trench drains are shown to determine that floor is sloped appropriately. Report concerns to Consultant prior to installation of drains.
- .3 Coordinate installation with general trades.
- .4 Trap and vent all floor drains and trench drains in accordance with Plumbing Code.
- .5 Floor drains and trench drains in floors with surface membranes shall be installed with a membrane clamp and anchoring flange.
- .6 Floor drains, traps and drain pipes installed in slabs on grade shall be embedded in concrete and made water-tight to prevent water seepage
- .7 Provide air trap seal guards for drain outlets of all floor drains and trench drains, with the same size of drain connection as specified on drawings.

**3.3 CLEANOUTS**

- .1 Cleanouts shall be the same size as the pipe.
- .2 Provide cleanouts at the end of mains and branches and at changes in direction.
- .3 Extend cleanouts to finished floor or wall surface.
- .4 Install floor cleanouts at elevation to accommodate finished floor.
- .5 Cleanouts in floors with surface membranes shall be installed with a membrane clamp and anchoring flange.
- .6 Lubricate threaded cleanout plugs with mixture of graphite and linseed oil.
- .7 Ensure clearance at cleanout for rodding of drainage system.

**3.4 BACKWATER VALVES**

- .1 Install backwater valves, full line size in locations indicated as being susceptible to backflow conditions. In locations where backwater valve is buried up to 450 mm (18") below finished floor, install complete with cast iron soil pipe extension piece terminated with approximately 225mm (9") accessible cleanout access cover.

**3.5 HYDRANTS**

- .1 Locate wall hydrants where indicated.
- .2 Coordinate installation with general trades.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES**

- .1 Water closets, seats, tanks, supplies, carriers
- .2 Lavatories, faucets, spouts, waste, carriers
- .3 Service sinks, traps, faucets, spouts, accessories
- .4 Bottle filling stations

**1.3 REFERENCES**

- .1 ASME A112.6.1 - (Floor Affixed) Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- .2 ASME A112.18.1 - Plumbing Fixture Fittings.
- .3 ASME A112.19.2 - Vitreous China Plumbing Fixtures.
- .4 ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.
- .5 CAN/CSA-B45.0 General Requirements for Plumbing Fixtures
- .6 CAN/CSA-B45.1 Ceramic Plumbing Fixtures
- .7 CAN/CSA-B125.1 Plumbing Supply Fittings
- .8 CAN/CSA-B125.2 Plumbing Waste Fittings
- .9 CAN/CSA-B125.3 Plumbing Fittings
- .10 CAN/CSA-B125.6 Flexible Water Connectors

**1.4 SUBMITTALS**

- .1 Submit shop drawings and product data for each plumbing fixture.
- .2 Maintenance data for each plumbing fixture and components.

**1.5 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with documented experience.
- .2 Installer Qualifications: trades licence with documented experience.

**1.6 DELIVERY, STORAGE AND PROTECTION**

- .1 Transport, handle, store, and protect products.
- .2 Accept fixtures on site in factory packaging. Inspect for damage.
- .3 Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
- .4 Store plumbing fixtures on elevated platforms in dry locations.

**1.7 WARRANTY EFFICIENCY**

- .1 The flow rates of fittings that supply water to a fixture shall not exceed the maximum flow rates at the test pressures listed in the table as follows:

Fittings	Maximum Flow		Test Pressure	
	GPM	LPM	PSI	kPa
Lavatory Faucet	2.2	8.35	60	413

- .2 The flush cycle for each fixture that is a water closet or urinal, shall not exceed the maximum flush cycle listed in the table as follows:

Fixtures	Maximum Flush	
	Gal.	L
Water Closet (Tank)	1.6	6.0

2 Products

**2.1 GENERAL**

- .1 Manufacturer as indicated or equivalent by;
- .1 Fixtures: Crane, Eljer, Kohler, Vitra
  - .2 Faucet/Flush Valve: American Standard, Chicago Faucets, Delta
  - .3 Seat: Beneke, Olsonite
  - .4 Carrier: Watts Drainage, Zurn

**2.2 WATERCLOSETS**

- .1 Designation: W-1 (Barrier-Free)
- .1 Fixture: Kohler Model No. Veil K-6299 elongated wall hung vitreous china closet with 76mm (3") trapway, 114mm x 140mm (4-1/2" x 5-1/2") water surface, 38mm (1-1/2") rear spud.
  - .2 Flush Tank and Carrier System: Kohler Model No. K-18829 concealed diaphragm type, low consumption dual flush technology 6LPF (1.6GPF) or 3LPF (0.8GPF), insulated tank, 50mm x 100mm (2" x 4") behind-the-wall steel framing system with adjustable height.
  - .3 Flush Actuator Plate: Kohler Model No. Bevel K-8857.
  - .4 Seat: Centoco 820STSS, elongated heavy duty solid plastic open front with cover, reinforced stainless steel self sustaining check hinge, posts, washers and nuts.
- .2 Designation: W-2 (General Use)
- .1 Fixture: Kohler Model No. Veil K-6299 elongated wall hung vitreous china closet with 76mm (3") trapway, 114mm x 140mm (4-1/2" x 5-1/2") water surface, 38mm (1-1/2") rear spud.
  - .2 Flush Tank and Carrier System: Kohler Model No. K-18829 concealed diaphragm type, low consumption dual flush technology 6LPF (1.6GPF) or 3LPF (0.8GPF), insulated tank, 50mm x 100mm (2" x 4") behind-the-wall steel framing system with adjustable height.
  - .3 Flush Actuator Plate: Kohler Model No. Bevel K-8857.
  - .4 Seat: Centoco 500STSCSS, elongated heavy duty solid plastic open front less cover, reinforced stainless steel self sustaining check hinge, posts, washers and nuts.

**2.3 LAVATORIES**

- .1 Designation: L-1 (Barrier Free)
- .1 Fixture: Barclay Bella Model 4-901 vitreous china bathroom Sink. 610mm wide x 510mm deep (24" x 20-1/8") wall hung unit, ADA compliant single faucet hole and complete with:

- .1 One (1) American Standard Model No. 1340.105 metering Piller tap faucet cast spout 5.7 LPM (1.5GPM) vandal resistant aerator. Factory set to 1 Lit (0.25 Gal) per activation.
- .2 Two Barclay steel hangers.
- .2 Supply: McGuire LFH165LK, chrome plated polished brass sink supply, rigid horizontal nipples 10mm x 25mm (3/8" x 1") long, IPS heavy all brass angle stop with vandal proof loose key, escutcheon and flex riser.
- .3 Waste Fitting: McGuire 155AC, chrome plated, cast brass one (1) piece top, open grid with 1.5mm (17ga.), 32mm (1-1/4") tailpiece.
- .4 Trap: McGuire 8872C P-trap, chrome plated, 1.5mm (17ga.), brass adjustable body, 32mm (1-1/4") and escutcheon.
- .2 Designation: L-2 (General Use)
  - .1 Fixture: Barclay Compact Slim Line Basin vitreous china bathroom Sink. 450mm wide x 216mm deep (17-3/4" x 8.5") wall hung unit, single faucet hole on right side, overflow hole and complete with:
    - .1 One (1) American Standard Model No. 1340.105 metering Piller tap faucet cast spout 5.7 LPM (1.5GPM) vandal resistant aerator. Factory set to 1 Lit (0.25 Gal) per activation.
    - .2 Two Barclay steel hangers.
  - .2 Supply: McGuire LFH165LK, chrome plated polished brass sink supply, rigid horizontal nipples 10mm x 25mm (3/8" x 1") long, IPS heavy all brass angle stop with vandal proof loose key, escutcheon and flex riser.
  - .3 Waste Fitting: McGuire 155AC, chrome plated, cast brass one (1) piece top, open grid with 1.5mm (17ga.), 32mm (1-1/4") tailpiece.
  - .4 Trap: McGuire 8872C P-trap, chrome plated, 1.5mm (17ga.), brass adjustable body, 32mm (1-1/4") and escutcheon.

## 2.4 MOP SINKS

- .1 Designation: S-1
  - .1 Fixture: Fiat Products MSB3624, floor mounted, 914mm x 610mm x 254mm (36" x 24" x 10") square, molded stone with plain curbs, stainless steel drain and strainer.
  - .2 Faucet: Fiat model 830-AA, chrome plated faucet with vacuum breaker, integral stops, adjustable wall brace, pail hook and 19mm (3/4") house thread and spout.
  - .3 Accessories:
    - .1 Bumper Guard: Fiat E88A24000, 610 mm stainless steel
    - .2 Back Splash Panel: Fiat MSG3624000
    - .3 Hose and Wall Hook: Fiat 832AA000, 30" (762 mm) long flexible heavy duty 5/8" rubber hose, cloth reinforced with 3/4" chrome coupling. Bracket is 5"(127 mm) long by 3" (76.2 mm) stainless steel rubber grip.
    - .4 Mop Hanger: Fiat 889CC000, 22 GA. (0.8 mm) type 304 stainless steel.
    - .5 Quick Drain Connector: Fiat QDC32000

## 2.5 BOTTLE FILLING STATIONS

- .1 Designation: BF-1 (Barrier Free)
  - .1 Fixture: Elkay model LK4405BF, wall mount, non-filtered non-refrigerated bottle filling station. Unit shall be of 316 stainless steel, laminar flow, heavy duty vandal-resistant

construction. Furnished with vandal-resistant mechanical bottle filler button. Product shall be wall mount (on-wall), for outdoor applications.

- .2 Unit shall be lead-free design which is certified to NSF/ANSI 61 & 372.
- .3 Finished colour shall be selected by owner at shop drawing review.
- .4 Supply Fitting and Trap: Field fabricated.
- .5 Waste Fitting: Integral.

### 3 Execution

#### 3.1 EXAMINATION

- .1 Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- .2 Do not proceed until unsatisfactory condition(s) have been corrected.

#### 3.2 PREPARATION

- .1 Rough-in fixture piping connections to minimum sizes indicated in fixture rough-in schedule for particular fixtures.

#### 3.3 INSTALLATION

- .1 Install each fixture with trap, easily removable for servicing and cleaning.
- .2 Provide chrome plated rigid supplies to fixtures with screwdriver stops, reducers, and escutcheons.
- .3 Install components level and plumb.
- .4 Install and secure floor mounted fixtures in place with bolts.
- .5 Install and secure wall hung fixtures in place with wall carriers and bolts.
- .6 Seal fixtures to wall and floor surfaces with sealant having VOC content not exceeding 250g/L, colour to match fixture.
- .7 Install water supply stop valves in accessible locations

#### 3.4 BOTTLE FILLING STATION

- .1 Provide wall mounting structure capable of supporting 136kg (300lb) load minimum on fountain.
- .2 Provide trap inside the wall. Provide stop valve at the fountain inlet line.

#### 3.5 LAVATORIES

- .1 Reinforce wall before installation. 50mm x 300mm (2"x12") securely fastened to wall studs are recommended at the desired height for the installation
- .2 Install Barclay hangers for added support.

#### 3.6 ADJUSTING

- .1 Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

#### 3.7 CLEANING

- .1 Clean plumbing fixtures and equipment.

#### 3.8 PROTECTION OF FINISHED WORK

- .1 Do not permit use of fixtures.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Read and conform to:
  - .1 Division 01 requirements and documents referred to therein.
- .2 Section 23 01 00 applies to and governs the work of all Sections of Divisions 21 Fire Protection, 22 Plumbing and 23 Mechanical.
- .3 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among subcontractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish sub-contract limits between any Sections of the work.
- .4 The specifications are integral with the drawings which accompany them. Neither shall be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.
- .5 Wherever differences occur in the tender documents, the most onerous condition governs. Base the bid on the most costly arrangement.

**1.2 WORK INCLUDED**

- .1 Products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.
- .2 Cutting and patching of new or existing work.
- .3 Identification of equipment, piping, ductwork, and valves and controllers.
- .4 Motors required for equipment supplied under this Division.
- .5 Internal wiring, relays, contactors, switches, transformers, motor starters, and all controls necessary for the intended operation, furnished with terminals and external controls suitable for connection to power source at a single easily accessed location for equipment items that are supplied with motors and/or electrical or electronic components under this Division.
- .6 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval prior to starting and/or returning to operation.
- .7 Coordinate with all disciplines.

**1.3 RELATED WORK**

- .1 Power wiring, conduit and connections for motors under this Division will be by Division 26.
- .2 Flashings for mechanical equipment and services located on or passing through roofs will be provided under Division 7. Supply counter flashings, and integral flashing collars on equipment and piping under this Division.
- .3 Painting of exposed piping and ductwork other than for identification will be supplied under Division 09.

**1.4 SUBMITTALS**

- .1 Submit names of the Commissioning Agent and Balancing Agent to Consultant within one week of award of Contract.
- .2 Approval Drawings: Prepare and submit drawings necessary for approval to any authority having jurisdiction, and obtain two (2) copies of approved drawings for retention by the Consultant prior to commencement of work under this Division.
- .3 Shop Drawings: Prepare and submit electronic (PDF format) copies of shop drawings of major equipment items, to the Consultant for review. The Consultant will return one copy, marked with comments and review stamp as deemed appropriate. Prepare the necessary number of copies

of the returned set and distribute to the Owner, the Prime Consultant, the General Contractor, the site, and to sub-contractors and suppliers.

- .1 Clearly indicate the manufacturer's and supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities and performance. Prior to submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by Consultant, has been returned to Contractor.
- .2 Clearly indicate the weight, location, method of support and anchor point forces and locations for each piece of equipment on shop drawings.
- .3 The Consultant will not review shop drawings that fail to bear the Contractor's stamp of approval or certification.
- .4 Read the following in conjunction with the wording on the shop drawing review stamp applied to each and every drawing submitted;  
  
*" The consultant's review will be for conformity to the design concept and for general arrangement only and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the Contract Documents unless a deviation on the shop drawings has been approved in writing by the Consultant."*
- .4 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they conform to the requirements of those documents (eg. NFPA-standards). Include a copy of each certificate in the Operation and Maintenance manual. Certificates shall include the following:
  - .1 description of the system (description and type),
  - .2 description of the tests conducted and results observed, including re-testing, where necessary,
  - .3 description of any corrective measures undertaken,
  - .4 description of materials used (pipe and fittings),
  - .5 list of witnesses for each test conducted,
  - .6 date system left ready for service,
  - .7 signature of installing Contractor.
- .5 Maintenance Data and Operating Instructions
  - .1 Submit three (3) hard copies and one (1) electronic (PDF format) copy of Operation and Maintenance Manual individually bound in hard backed three-ring binders.
  - .2 Ensure the binder spines have typewritten lettering as follows:  
  
OPERATION & MAINTENANCE MANUAL  
  
for  
  
[Insert name of project]  
  
[Insert date of submission]  
  
[Insert Division Title]
  - .3 Provide a list of names, addresses and telephone numbers of equipment suppliers, installing contractors, general contractors, architect and Consultant. Include special telephone numbers for service departments on normal and emergency call basis.
  - .4 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item.

- .5 Include copies of start-up reports and checklists and all certificates issued with respect to this contract.
- .6 Ensure operating instructions include the following:
  - .1 General description of each mechanical system.
  - .2 Step by step procedure to follow in putting each piece of equipment into service.
  - .3 Drawings of each control panel including temperature control and electrical panels, completely identifying all components on the panels and their function.
- .7 Ensure maintenance instructions include the following:
  - .1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts numbers and lists, name of supplier and maintenance and lubrication instructions.
  - .2 Summary list of each item of mechanical equipment requiring lubrication, indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.
  - .3 Equipment directory indicating name, model, serial number and nameplate data of each item of equipment supplied, and system with which it is associated.
  - .4 Balancing and testing reports.

#### 1.5 QUALITY ASSURANCE

- .1 Conform to the minimum requirements or better of provincial and local codes, where existing, and to the requirements of local inspection authorities for execution of work under this Division.
- .2 Ensure materials supplied under this Division conform to minimum requirements and recommendations or better of applicable standards of the following:
  - .1 AABC Associated Air Balance Council
  - .2 AMCA Air Moving and Conditioning Association
  - .3 ANSI American National Standards Institute
  - .4 ASA American Standards Association
  - .5 ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
  - .6 ASME American Society of Mechanical Engineers
  - .7 ASSE American Society of Sanitary Engineers
  - .8 ASPE American Society of Plumbing Engineers
  - .9 ASTM American Society of Testing and Materials
  - .10 AWWA American Water Works Association
  - .11 CAN2 National Standard of Canada (Published by CGSB)
  - .12 CAN3 National Standard of Canada (Published by CSA)
  - .13 CGSB Canadian General Standards Board
  - .14 CSA Canadian Standards Association
  - .15 EEMAC Electrical & Electronic Manufacturer's Association of Canada
  - .16 NBC National Building Code of Canada
  - .17 NEBB National Environmental Balancing Bureau
  - .18 NFPA National Fire Protection Association

- .19 NEMA National Electrical Manufacturers Association
  - .20 OBC Ontario Building Code
  - .21 OFC Ontario Fire Code
  - .22 OFM Ontario Fire Marshall
  - .23 SMACNA Sheet Metal & Air Conditioning Contractors National Association
  - .24 TIAC Thermal Insulation Association of Canada
  - .25 ULC Underwriter's Laboratories of Canada Ltd
  - .26 UL Underwriter's Laboratories (including cUL)
- .3 Use latest editions and amendments in effect on date of Bid call subject to requirements of NBC.
  - .4 Arrange and pay for permits and inspections by authorities having jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.
  - .5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or Owner when requested.

#### **1.6 PRODUCT DELIVERY, HANDLING AND STORAGE**

- .1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- .2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

#### **1.7 JOB CONDITIONS**

- .1 Visit site and examine existing conditions which may affect work of this Division.
- .2 Examine all Contract Documents to ensure that work of this Division may be satisfactorily completed.
- .3 Notify Consultant upon discovery of conditions which adversely affect work of this division. No allowance will be made after letting of contract for any expenses incurred through failure to do so.
- .4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications, unless exceptions are specifically noted in the Bid.

#### **1.8 WARRANTY**

- .1 Refer to General Conditions. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.
- .2 Make submissions necessary to register product warranties to the benefit of the Owner.
- .3 Submit to Consultant, prior to Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one year or offering greater benefits than required in specifications and in the Owner's name.

#### **1.9 DEFINITIONS**

- .1 The following are definitions of words found in this specification and on associated drawings under this Division:
  - .1 "Concealed" - hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.
  - .2 "Exposed" - mechanical work normally visible to building occupants.
  - .3 "Provide" - (and all tenses of "provide") - supply, install and connect complete.
  - .4 "Install" - (and all tenses of "install") - install and connect complete, products and services specified.

- .5 "Supply" - supply to site in location determined by Owner.
- .6 "Wet" - wet areas requiring special materials.

## 2 Products

### 2.1 MATERIALS AND EQUIPMENT

- .1 Ensure materials and equipment provided under this Division are new and free from defects and bear labels of approval as required by codes referred to in this Division and/or by inspection authorities.
- .2 Ensure apparatus and equipment provided under this Division bears manufacturer's nameplate indicating name of manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.
- .3 Ensure manufacturers and suppliers of equipment or materials under this Division determine if their products are composed of any hazardous materials. If they are, the products are suitably labelled and supplied with Material Safety Data sheets. Obtain the Owner's approval in writing to bring hazardous materials onto the site prior to doing so.
- .4 When utilizing any products that are hazardous, keep Material Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

### 2.2 ACCEPTABLE PRODUCTS

- .1 First item named or specified by catalogue number meets specifications regarding performance, quality of material and workmanship, and is acceptable to the Consultant.
- .2 Items, other than first named, meeting specifications regarding quality of materials and workmanship are acceptable to the Consultant, only, if they also meet performance and/or capacities specified and can be accommodated within the space allotted.
- .3 General approval indicated by inclusion of other manufacturers named is subject to final review of shop drawings, performance data and test reports.

### 2.3 EQUIVALENTS AND ALTERNATIVES

- .1 Suppliers wishing approval for additional equipment items as equivalent to those specified must submit a complete description, technical and performance data to Consultant at least ten (10) working days prior to Bid closing date. Such equivalent equipment, if accepted, to conform to specifications with regard to all details, accessories, modifications, features and performance. Deviations from specifications must be stated in writing at time of submission for approval.
- .2 Bid Prices shall include only products specified or approved equivalents. Contractors may propose unsolicited alternatives to the products specified. Alternative proposals shall be submitted in sealed envelope at time of general contract Bid submission and shall include full description and technical data, and a statement of the related increase or decrease in Bid Price should alternatives be accepted. All additional costs associated with unsolicited alternative proposals such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. Shall be included in the alternative price. Prior approval by Consultant is not required for unsolicited alternative proposals.
- .3 Where the Contractor uses equipment other than that first named, on which the design is based, they shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in Bid Price.

## 2.4 SUBSTITUTIONS DURING PROGRESS OF WORK

- .1 If during the progress of work, specified products are not obtainable, equivalent or similar products by other manufacturers may be permitted by the Consultant.
- .2 Apply, in writing, to Consultant for substitution of any products, indicating the following:
  - .1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities and performance of proposed products.
  - .2 Reason for substitution.
  - .3 Any revisions to the contract price made necessary by substitution and shall include an itemized break down.
  - .4 Any revisions to the contract time made necessary by substitution.
  - .5 Any revisions to layout, arrangement or services made necessary by substitution.
- .3 No substitutions will be permitted without written authorization from the Consultant.

## 2.5 CONSULTANT'S REVIEW

- .1 The consultant will review and evaluate unsolicited alternatives and substitutions proposed by the Contractor. Such review and evaluation work will be undertaken by the Consultant on an additional fee basis. The Contractor shall reimburse the Owner for all costs associated with such reviews and evaluations.
- .2 The Contractor shall also reimburse the Owner for any and all costs incurred in updating Contract Documents to reflect such changes.

## 3 Execution

### 3.1 RELATIONSHIP WITH OTHER TRADES

- .1 Cooperate with other trades whose work affects or is affected by work of this Division to ensure satisfactory installation and to avoid delays.
- .2 Provide materials to be built-in, such as sleeves, anchors, and inserts, together with templates and/or measurements, promptly when required by other trades.
- .3 Provide structural supports for equipment to be mounted on or in walls, supported above floors and/or suspended from the structure.

### 3.2 INSTALLATION REQUIREMENTS

- .1 The Consultant's drawings and instructions govern the location of all items. Prepare fully coordinated installation drawings prior to installation.
- .2 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.
- .3 Confirm the exact location of outlets, fixtures and connections. Confirm location of outlets for equipment supplied under other Divisions.
- .4 Install equipment and apparatus to allow free access for maintenance, adjustment and eventual replacement.
- .5 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.
- .6 Provide suitable shielding and physical protection for devices.
- .7 Install products and services in accordance with the manufacturer's requirements and/or recommendations.

- .8 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.
- .9 Do not use power activated tools without written permission of the Consultant. Use them in accordance with the Owner's health and safety policies.
- .10 Ensure that the load onto structures does not exceed the maximum loading indicated on the structural drawings or as directed by the Consultant.

### 3.3 CONTRACT DRAWINGS

- .1 The drawings of this Division are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given.
- .2 Obtain accurate dimensions from the architectural and structural drawings, or by field measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.
- .3 Make changes, where required to accommodate structural conditions. Obtain Consultant's approval before proceeding.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Outlets and/or equipment may be relocated up to 10 feet (3 m) in any direction without a change to the contract price.
- .5 Note that the layout and orientation of the ceiling outlets on the architectural reflected ceiling plan drawings may differ from that shown on the mechanical drawings. Make the installation in accordance with the latest architectural reflected ceiling plans. Provide the equipment as specified and/or shown on the documents of this Division.
- .6 The drawings of this Division are intended for tender pricing. The quantities and quality to be included in the bid price shall be based on the layout and specifications as indicated in the mechanical documents. If there is a difference in quantity between the architectural and drawings of this Division, base the contract price on the greater quantity.
- .7 Prepare installation drawings to reflect the latest architectural ceiling layout.

### 3.4 RECORD DRAWINGS

- .1 Maintain project "as-built" record drawings. Obtain white prints from the Consultant for this purpose and pay printing costs. Identify each set as "Project Record Copy".
- .2 Record deviations from contract documents caused by site conditions or by addendums, site instructions and/or changes orders. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of Consultants documents.
- .3 Record deviations as work progresses throughout the execution of this contract. Maintain record drawings on site in clean, dry, legible condition, making them available for periodic review by the Consultant.
- .4 Record the location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.
- .5 Transfer records from the "Project Record Copy" to a DVD in Autocad format matching the Consultant's documents. Arrange computer file in layers to exactly match the layering system of the Consultant.
- .6 Submit the "Project Record Copy" on one (1) or more DVD's with white prints of each drawing to the Consultant at the time of Substantial Performance.

### 3.5 USE OF EQUIPMENT

- .1 For the duration of this contract, do not use any piece of equipment provided under this contract for the purposes of heating, ventilation or air conditioning without the specific authorization of the

Owner and Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to commence.

- .2 specific written authorization is given for the use of equipment while work is still in progress, seal off ductwork, grilles, diffusers, and registers or other openings to the air distribution system(s) or air handling equipment that is not in use. Provide filters over openings in ductwork, over grilles, diffusers and registers and in or at any air handling equipment that is in use. Ensure that the edges are sealed so that the filters are not bypassed. Change the filters frequently, to the satisfaction of the Consultant, until the building is turned over the Owner.

### 3.6 SPECIAL TOOLS & SPARE PARTS

- .1 Within 30 days of award of contract, prepare a complete itemized list of special tools and spare parts and submit to Consultant for review. List will be used as a checklist and should include provision for sign off by the Owner on receipt.
- .2 Identify spare parts containers as to contents and replacement parts number.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one grease gun and adaptors to suit different types of grease and fittings.

### 3.7 PAYMENT BREAKDOWN

- .1 After award of Contract, submit an itemized payment and breakdown showing the installed cost with material and labour component breakdown indicated separately for each of the major work items listed below. The payment breakdown shall be subject to the approval of the Consultant. No progress payment approvals will be processed until an approved payment schedules in place.
- .2 Payment breakdown shall be as follows:
  - .1 General
    - .1 Mobilization and Insurance
    - .2 Project supervision
    - .3 Shop drawings
    - .4 Balancing and commissioning
    - .5 Project record drawings and manuals
    - .6 Instructions to Owner's personnel
  - .2 Plumbing and Drainage
    - .1 Underground and under floor piping
    - .2 Above ground piping
    - .3 Valves, specialties, roof and floor drains
    - .4 Plumbing fixtures
  - .3 Heating, Ventilating and Air Conditioning
    - .1 Fans
    - .2 Grilles, diffusers, registers
    - .3 Controls
  - .4 Fire Protection
    - .1 Portable fire extinguishers

### 3.8 EXTRAS AND CREDITS

- .1 Accompany all price submissions requested by Consultant for extra work, or work to be deleted, with a complete cost breakdown as follows:
  - .1 Materials, quantities and unit costs including any applicable contractor's trade discount clearly identified.
  - .2 Labour hours and unit costs.
  - .3 Total materials and labour costs.
  - .4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

### 3.9 INSTRUCTIONS

- .1 Instruct and familiarize the Owner's operating personnel with the various mechanical systems. Arrange instruction for each system separately.
- .2 Provide instruction for each system on two separate occasions, coordinated with the Owner's staff operating schedule, in order that interested personnel may arrange to attend.
- .3 Ensure each instruction period includes, but is not limited to the following;
  - .1 Classroom seminar with operating manuals, product and system drawings and such other audio/visual aids as may be appropriate,
  - .2 Instruction during the classroom seminar by the manufacturer's representative regarding the proper operating and maintenance procedures for each item of equipment,
  - .3 Demonstration of the proper operating procedures for each item of equipment,
  - .4 Explanation of the purpose and function of all safety devices provided, and
  - .5 Demonstration of all measures required for safe and proper access for operation and maintenance.
- .4 Provide a period of follow-up instruction approximately one month after completing the Owner's instruction to clarify and reinforce earlier instructions.
- .5 Submit a letter from the Owner's management staff indicating the instruction has been given satisfactorily to the Consultant prior to substantial completion of the project.

### 3.10 COMMISSIONING

- .1 The Contractor shall start-up and completely commission all equipment and systems installed and/or modified under this contract. Commissioning work shall be completed to the satisfaction of the Consultant prior to acceptance of the Work or any part thereof.
- .2 The Commissioning Team shall be comprised of:
  - .1 Commissioning Agent
  - .2 The individual, company or agency undertaking the work of each Section,
  - .3 Representatives of the Contractor and his sub-contractors as required,
  - .4 Representatives of equipment manufacturers,
  - .5 Representatives of the Consultants,
- .3 The Contractor and his sub-contractors shall each assign an individual representing each of the relevant trades to the commissioning team and shall ensure that representatives of the equipment manufacturers are present during the relevant commissioning tasks.
- .4 The Contractor shall provide all necessary labour, materials, equipment, testing apparatus and incidentals necessary to completely start-up, verify, test and commission each system provided as part of the Work.

END OF SECTION

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES**

- .1 Testing, adjustment, and balancing of air systems.

**1.3 SEQUENCING**

- .1 Convene a minimum of one (1) week prior to commencing the scope of work of this Section.
- .2 Sequence work to commence after completion of the systems. Schedule completion of work before Substantial Completion of Project.

**1.4 SCHEDULING**

- .1 Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.

**1.5 COORDINATION**

- .1 Cooperate with the installing Contractor(s) in advising them of specific scheduling requirements for systems verification.
- .2 Provide advice to the installing Contractor(s) regarding the location and installation of devices required to permit system balancing and measurements, prior to start of the installation work.

**1.6 SUBMITTALS**

- .1 Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- .2 Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- .3 Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
- .4 Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Consultant and for inclusion in operating and maintenance manuals.
- .5 Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side.
- .6 Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- .7 Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data in S.I. Metric units.
- .8 All reports shall be prepared in electronic (computer) format using MS Word software and all tabulations shall be prepared in electronic (computer) format using MS Excel spreadsheet software. Submittals shall include three (3) copies each of hard copy printout and electronic copy (CD/DVD/USB Drive).

**1.7 QUALITY ASSURANCE**

- .1 Perform total system balance to AABC National Standards for Field Measurement and Instrumentation, Total System Balance.
- .2 Maintain one copy of each document on site.

## 1.8 REFERENCES

- .1 National Building Code.
- .2 National Fire Code.
- .3 AABC - National Standards for Total System Balance.
- .4 ACG - AABC Commissioning Guideline.
- .5 ADC - Test Code for Grilles, Registers, and Diffusers.
- .6 ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- .7 ASHRAE Guideline 0 The Commissioning Process,
- .8 ASHRAE Guideline 1 The HVAC Commissioning Process,
- .9 ASHRAE Guideline 1.1 HVAC&R Technical Requirements for the Commissioning Process,
- .10 ASTM E779 Determining Air Leakage Rate by Fan Pressurization.
- .11 NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- .12 SMACNA - HVAC Systems Testing, Adjusting, and Balancing.
- .13 SMACNA HVAC Systems Commissioning Manual,

## 1.9 QUALIFICATIONS

- .1 Agency: Company specializing in the testing, adjusting, and balancing of systems under this Section with documented experience certified by AABC.
- .2 Work shall be performed under the supervision of an AABC certified Test and Balance Engineer, an NEBB Certified Testing, Adjusting and Balancing Supervisor or a registered Professional Engineer experienced in the performance of this work and licensed at the place where the Project is located.

## 2 Products

### 2.1 REFERENCE STANDARDS

- .1 All equipment required for the verification of equipment and systems shall be furnished by the agency employed to conduct the Mechanical Systems Verification.
- .2 Testing and measuring equipment used in the verification of the mechanical systems shall be calibrated to give true readings within the accuracy specifications of the equipment used. A certificate of calibration from an independent testing laboratory may be required by the Consultant if there is any reason to suspect that the equipment used is giving erroneous readings. In such an event the verification agency shall re-conduct its verifications.
- .3 All equipment used by the agency in its verification of mechanical systems remains the property/responsibility of the agency and is not included in the supply to the project.

## 3 Execution

### 3.1 EXAMINATION

- .1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  - .1 Systems are started and operating in a safe and normal condition.
  - .2 Temperature control systems are installed complete and operable.
  - .3 Proper thermal overload protection is in place for electrical equipment.
  - .4 Duct systems are clean of debris.

- .5 Fans are rotating correctly.
- .6 Volume dampers are in place and open.
- .7 Access doors are closed and duct end caps are in place.
- .8 Air outlets are installed and connected.
- .9 Duct system leakage is minimized.
- .2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- .3 Beginning of work means acceptance of existing conditions.

### **3.2 PREPARATION**

- .1 Prepare a TAB Plan that includes strategies and step by step procedures.
- .2 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.
- .3 Provide additional balancing devices as required.

### **3.3 INSTALLATION TOLERANCES**

- .1 Prepare test reports for both fans and outlets.
- .2 Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- .3 Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

### **3.4 ADJUSTING**

- .1 Ensure recorded data represents actual measured or observed conditions.
- .2 Permanently mark settings of dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- .3 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- .4 Leave systems in proper working order, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- .5 At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- .6 Check and adjust systems approximately six months after final acceptance and submit report.

### **3.5 AIR SYSTEM PROCEDURE**

- .1 Adjust exhaust air systems to provide required or design exhaust air quantities at site altitude.
- .2 Make air quantity measurements in ducts by pitot tube traverse of entire cross sectional area of duct.
- .3 Measure air quantities at air inlets and outlets.
- .4 Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- .5 Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- .6 Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- .7 Measure static air pressure conditions on units, and total pressure across the fan.

### 3.6 SCHEDULES

- .1 Equipment requiring testing, adjusting and balancing:
  - .1 Fans
  - .2 Air Inlets and Outlets
- .2 Report Forms
  - .1 Title Page:
    - .1 Name of Testing, Adjusting, and Balancing Agency
    - .2 Address of Testing, Adjusting, and Balancing Agency
    - .3 Telephone number of Testing, Adjusting, and Balancing Agency
    - .4 Project name
    - .5 Project location
    - .6 Project Architect
    - .7 Project Engineer
    - .8 Project Contractor
    - .9 Project altitude
    - .10 Report date
  - .2 Summary Comments:
    - .1 Design versus final performance
    - .2 Notable characteristics of system
    - .3 Description of systems operation sequence
    - .4 Summary of outdoor and exhaust flows to indicate amount of building pressurization
    - .5 Nomenclature used throughout report
    - .6 Test conditions
  - .3 Instrument List:
    - .1 Instrument
    - .2 Manufacturer
    - .3 Model number
    - .4 Serial number
    - .5 Range
    - .6 Calibration date
  - .4 Electric Motors:
    - .1 Manufacturer
    - .2 Model/Frame
    - .3 HP/BHP
    - .4 Phase, voltage, amperage; nameplate, actual, no load
    - .5 RPM
    - .6 Service factor

- .7 Starter size, rating, heater elements
- .5 Exhaust Fan Data:
  - .1 Location
  - .2 Manufacturer
  - .3 Model number
  - .4 Serial number
  - .5 Air flow, specified and actual
  - .6 Total static pressure (total external), specified and actual
  - .7 Inlet pressure
  - .8 Discharge pressure
  - .9 Fan RPM
- .6 Duct Leak Test:
  - .1 Description of ductwork under test
  - .2 Duct design operating pressure
  - .3 Duct design test static pressure
  - .4 Duct capacity, air flow
  - .5 Maximum allowable leakage duct capacity times leak factor
  - .6 Test apparatus
    - .1 Blower
    - .2 Orifice, tube size
    - .3 Orifice size
    - .4 Calibrated
  - .7 Test static pressure
  - .8 Test orifice differential pressure
  - .9 Leakage
- .7 Air Distribution Test Sheet:
  - .1 Air terminal number
  - .2 Room number/location
  - .3 Terminal type
  - .4 Terminal size
  - .5 Area factor
  - .6 Design velocity
  - .7 Design air flow
  - .8 Test (final) velocity
  - .9 Test (final) air flow
  - .10 Percent of design air flow

### 3.7 VERIFICATION CHECKLIST

- .1 Prepare a series of checklists to record the verification of each item of equipment and each system. Submit a draft of each checklist to the Consultant and the Owner for review and approval. Discuss comments offered the Consultant and Owner and include improvements as directed.
- .2 Checklists shall include the following as a minimum;
  - .1 a record of the nameplate data for each equipment item and each associated motor,
  - .2 a list of observations appropriate to the equipment item or system with space adjacent to indicate whether the item was satisfactory or unsatisfactory,
  - .3 a list of observations appropriate to the equipment item or system with space adjacent to indicate whether the item was satisfactory or unsatisfactory,
  - .4 appropriate space for recording comments and/or instructions given during observations.

### 3.8 EQUIPMENT VERIFICATION

- .1 Test the operation of all equipment installed under Divisions 22 and 23 according to instructions in appropriate articles of this Division. Advise installing contractor of any required adjustments or replacements to ensure that equipment is operating as intended. Retest equipment after adjustment or replacement.
- .2 Ensure that the Contractor has given proper advance notification to all persons required to be present as tests are conducted. Refer to 23 10 00.
- .3 Instrumentation: verify installation of gauges, pitot traverse stations, and flow-measuring devices ensuring that:
  - .1 Location of points for readings is appropriate to measure what it is intended to measure;
  - .2 The scale range is appropriate to place the normal reading near mid-range of the scale;
  - .3 Proper positioning of instrumentation to allow reading from a convenient location, and for easy access.
- .4 Pre-start-up Inspection:
  - .1 Verify proper equipment mounting and setting.
  - .2 Verify that control, interlock, and power wiring are complete.
  - .3 Verify proper alignment of motors and drives.
  - .4 Verify proper piping connections and accessories.
  - .5 Verify that lubrication is complete.
- .5 First Run Observation:
  - .1 Verify direction of rotation.
  - .2 Verify setting of safety controls.
  - .3 Monitor heat build-up in bearings.
  - .4 Check motor loads against nameplate ratings.
- .6 Equipment Checkout:
  - .1 Verify the proper overload heater sizes.
  - .2 Verify function of safety and operating controls.
  - .3 Verify proper operation of equipment.
  - .4 Report on inspection, observation, and checkout procedures.

- .7 Motor Rotation: visually inspect and verify the direction of motor rotation. It is possible for motor rotation to have been checked by the electrician when power connections were made on temporary electric power, then when final connections were made to the permanent transformer bank, crossed phasing may reverse the rotation of all three-phase motors on the system.
- .8 Safety and Operating Control Setpoints: systematically verify the safety and operating controls of equipment, including an operational check of associated control sequences.
- .9 Verify that manufacturer's start-up procedures have been performed and that equipment is installed in accordance with the manufacturer's written installation recommendations.

### **3.9 AIR SYSTEM VERIFICATION**

- .1 Review drawings, specifications and installed work to ensure that systems may be properly balanced in accordance with drawings. Advise installing Contractor of any additional requirements for effective balancing.
- .2 Test and record fan rpm for each fan.
- .3 Test and record motor full load amperes.
- .4 Make Pitot tube traverse of main supply and obtain operating air quantities at fans.
- .5 Test and record system static pressures, suction and discharge.
- .6 Test and record airflow at each diffuser, grille, and register.
- .7 Witness and verify results of duct leakage tests conducted under section 23 81 00.
- .8 Tabulate and certify test results on suitable forms and submit Consultant for approval and record. Identify each diffuser, grille, and register as to location and area. Identify and list size, type, and manufacturer of diffusers, grilles, registers, and all testing equipment. Use manufacturer's rating on all equipment to make required calculations.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 COMMON WORK RESULTS**

- .1 Section 23 10 00 applies to and governs all work of Divisions 21 Fire Protection, 22 Plumbing and 23 Mechanical.

**1.3 REFERENCES**

- .1 Provide all work in accordance with requirements of Regulatory Agencies and conform to:
  - .1 Local and district by-laws, regulations and published engineering standards.
  - .2 Regulations for Construction Projects under The Occupational Health and Safety Act.
  - .3 Fire Code made under the Fire Marshal's Act.
- .2 Conform to following National Research Council Canada publications:
  - .1 National Building Code of Canada and Supplements to National Building Code of Canada
  - .2 National Fire Code of Canada.
  - .3 Canadian Plumbing Code.
- .3 The above documents or portions thereof are referenced within the work of Divisions 21 - Fire Protection, 22 – Plumbing and Drainage and 23 – Mechanical and shall be considered part of the requirements of this document as though fully repeated herein.

**1.4 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 23 01 00, for the following items:
  - .1 Piping specialties

2 Products

**2.1 PIPING SPECIALTIES**

- .1 Piping specialties including valves etc. shall be line size unless indicated otherwise on drawings.

**2.2 ADHESIVES, SEALANTS, PAINTS AND COATINGS**

- .1 Adhesives, Sealants, Paints and Coatings: Use only low VOC emitting materials meeting following criteria;
  - .1 Paint for Mechanical Identification: maximum VOC emission of 250g/L
  - .2 Touch-Up Paint: maximum VOC emission of 250g/L
  - .3 Zinc-Rich Primer: maximum VOC emission of 250g/L
  - .4 Adhesives for Mechanical Identification: maximum VOC emission of 70g/L
  - .5 Sealants for service penetrations: maximum VOC emission of 650g/L clear and 350g/L pigmented
  - .6 Sealants for Firestopping: max. VOC emission of 650g/L clear and 350g/L pigmented.
  - .7 Acrylic Sealant for supports and anchors: maximum VOC emission of 250g/L
  - .8 Insulation Vapour Barrier Lap Adhesive: maximum VOC emission of 80g/L
  - .9 Insulation Joint Sealer: maximum VOC emission of 250g/L

- .10 Insulation Vapour Barrier Mastic: maximum VOC emission of 400g/L
- .11 Flame Retardent Adhesive: maximum VOC emission of 650g/L clear and 350g/L pigmented

3 Execution

**3.1 INSPECTION**

- .1 Inspect installed work of other trades and verify that such work is complete to point where work under this Division may properly commence.
- .2 Verify that work of this Division may be executed in accordance with pertinent codes and regulations, specifications, drawings, and referenced standards.
- .3 Review drawings and verify dimensions at the site. Report discrepancies immediately to Consultant before proceeding with any construction work or shop drawings.

**3.2 ABOVE GROUND PIPING INSTALLATION**

- .1 Cooperate with other trades whose work affects or is affected by work of this Section, to ensure satisfactory installation and to avoid delays. Provide all materials to be built-in such as sleeves, anchors, etc., together with accurate dimensions or templates, promptly.
- .2 Layout all work accurately, installing piping parallel to lines of building.
- .3 Install piping, wherever possible, in partitions and above ceiling. Do not install piping in outside walls unless so shown on drawings. Wrap un-insulated piping in masonry walls with building paper.
- .4 Install concealed piping close to building structure to minimize furring dimensions.
- .5 Provide adequate space around piping to facilitate application of insulation.
- .6 Use dielectric couplings where piping of dissimilar metals connect.
- .7 Where piping passes through concrete floors, or walls, sleeves shall be sized to permit the pipe to expand freely without binding or crushing pipe insulation.
- .8 Where branch pipes are welded into main without the use of "T" connections, torch cut openings must be cut true, bevelled and filed smooth. Branch pipes must not be allowed to project inside of main pipe. Openings must not be cut large enough to permit entry of welding metal and slag within the pipe.

**3.3 PIPING JOINTS**

- .1 Make joints in piping installed under this Division using persons familiar with the particular materials being used and in accordance with Canadian Plumbing Code, manufacturer's instructions, and as specified herein.
- .2 Carefully ream joints in threaded pipe and paint with approved graphite type joint sealer on male connections only. Make connections with proper wrench to suit pipe size. Where leaks occur, the joint shall be disassembled and corrected if possible, or replaced. Over-tightening, caulking or peening will not be acceptable.
- .3 Install unions or welding flanges at connections to valves, etc. to facilitate removal.

**3.4 FLUSHING AND CLEANING**

- .1 Flush and sterilize domestic water mains in accordance with procedures established by AWWA Specification C601.
- .2 Flush new domestic water piping in accordance with Local and Provincial Codes.
- .3 Thoroughly flush all other piping installed by this Division.
- .4 Remove, clean and replace all strainers in systems after flushing.

- .5 Thoroughly clean all equipment and fixtures, lubricate mechanical equipment, and leave all items in perfect order ready for operation.

### **3.5 PIPING SYSTEMS TESTING AND INSPECTION**

- .1 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures.
- .2 Test all piping at the completion of roughing-in, before connecting to existing systems, and prior to concealment, insulation or covering of piping.
- .3 Make tests, which are required by any authority having jurisdiction, in the presence of the authority's authorized inspector and shall be certified by them.
- .4 Conduct tests in the presence of:
  - .1 Authorized inspector(s) for authorities having jurisdiction.
  - .2 The Owner's Representative
  - .3 The Consultant
- .5 Notification must be given at least 48 hours in advance of tests being conducted, to all persons required to be present.
- .6 Repair all leaks exposed during testing and retest. If defects in pipe or fittings are discovered in the system, they shall be removed and replaced.
- .7 Certify tests: not required by authorities having jurisdiction.

### **3.6 EQUIPMENT TESTING AND INSPECTION**

- .1 Test operation of equipment installed under this Division according to instructions in appropriate articles of this Division. Make any required adjustments or replacements to ensure equipment is operating as intended. Retest equipment requiring adjustment or replacement.
- .2 Conduct tests before application of external insulation and before concealment of piping or ductwork.
- .3 Arrange and pay for inspections by authorities as required by code and complete any changes or alterations required by such inspections.
- .4 Conduct tests in the presence of:
  - .1 Authorized inspector(s) for authorities having jurisdiction.
  - .2 The Systems Verification Agency.
  - .3 The Consultant.
  - .4 The Owner's Representative.
- .5 Notification must be given at least 48hours in advance of tests being conducted, to all persons required to be present.

### **3.7 TESTING AND BALANCING**

- .1 Allow sufficient time for testing and verification prior to substantial completion. Notify Testing and Balancing Agency on completion of adjusting and balancing of systems.
- .2 Maintain systems in full operation during testing and verification.

### **3.8 ELECTRICAL COMPONENTS AND WIRING**

- .1 Conform to requirements of Division 26 for all wiring included in Divisions 21, 22 and 23. Includes pre-wired equipment provided by Sections under Divisions 21, 22 and 23.
- .2 Ensure that all pre-wired electrical equipment is CSA approved. Arrange and pay for special approval where this is not possible.

- .3 Coordinate all wiring requirements with other Divisions. Line voltage wiring from power distribution panels to starters and from starters to motors will be provided under Division 26. All the field wiring for equipment shall be included under Division 26, unless specifically called for.

### 3.9 PROTECTION

- .1 Protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under this Division.
- .2 Repair to satisfaction of Consultant, damage to building resulting from failure to provide such protection.

### 3.10 EXCAVATING AND BACKFILLING

- .1 Be responsible for excavation and backfilling necessary for installation of underground work under this Division.
- .2 Excavate to the depth and dimensions shown on drawings.
  - .1 Excavate to the depth and dimensions shown on drawings.
  - .2 Keep excavation free of water by bailing, pumping or a system of drainage as required.
  - .3 Cut and trim banks of excavation evenly, as nearly vertical as possible, and shore if required to prevent caving-in.
  - .4 Keep bottom of excavation clean and clear of loose material. Slope or grade as required.
  - .5 Provide shoring in accordance with The Occupational Health and Safety Act, and Regulations for Construction Projects.
  - .6 Notify the Consultant immediately in case of encountering any unstable ground, unsuitable for bearing of pipes. Consultant will decide the method of installation of pipes in unstable ground.
  - .7 Inform the Consultant immediately if the excavation reveals seepage zones, springs or other unexpected sub-surface conditions which may necessitate revisions to drainage or water supply systems.
- .3 Obtain Consultant's approval prior to commencement of backfilling of pipe trenches. Backfill the trenches carefully to prevent injury to the work and subsequent settlement and execute backfilling generally as follows:
  - .1 provide minimum 6" (150mm) fine gravel or coarse sand bedding (Class B) or as indicated for the bottom of trenches.
  - .2 backfill above pipe bedding with granular material specified, hand tamp in layers of 6" (150mm) thickness. Extend backfill 12" (300mm) above pipe.
  - .3 backfill and consolidate remainder of trench depth below paved or gravelled areas with granular Class "B" aggregate in 6" (150mm) layers to an elevation to allow for thickness of Class "A" aggregate and asphalt pavement.
  - .4 backfill and consolidate remainder of trench depth below sodded or seeded areas with specified granular material or material obtained from site excavation where approved by Consultant, in 9" (225mm) layers to an elevation 6" (150mm) below of proposed grades in sodded/seeded areas.
  - .5 compact each layer thoroughly at optimum moisture content with approved hand or mechanical tampers to a density equal to;
    - .1 Behind foundation and retaining walls on grades
    - .2 Below sodded or seeded areas
  - .6 Do not puddle or flood with water for consolidating backfill. Add Water during the compaction to optimum moisture content of backfilling material.

**3.11 SUPPORT AND ATTACHMENT**

- .1 Support and attach piping, ductwork fixtures and equipment from load bearing structures such as beams, joists, reinforced concrete slabs and concrete block walls, and do not support from or attach to steel roof deck and/or wall or ceiling finishes.

**3.12 PAINTING**

- .1 Repair minor damage to finish of equipment with standard factory applied baked enamel finish under the appropriate Sections of this division. Replace entirely, items suffering major damage to finish if too extensive to be repaired in the opinion of the Consultant.
- .2 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.

**3.13 DISSIMILAR METALS**

- .1 Separate dissimilar metals in order to prevent galvanic corrosion.
- .2 Provide gaskets or shims of approved materials to avoid electrolytic action.
- .3 Use dielectric unions and/or flanges where piping of dissimilar metals are connected.

**3.14 FIELD QUALITY CONTROL**

- .1 Temporary and Trial Usage
  - .1 Allow the Owner the privilege of temporary and trial usage of installed equipment, as soon as work is complete, for a period of time required to conduct a thorough test.
  - .2 Do not construe such usage as evidence of acceptance of work by Owner
  - .3 Repair damage to work tested, resulting from such trial usage, by this Contractor at no cost to Owner.
- .2 Systems Verification:
  - .1 Verify the correct installation and proper operation of equipment and systems installed. Adjust and balance each system as necessary to achieve optimum operation of each system.
  - .2 Co-operate with the Systems Verification agency as follows:
    - .1 provide assistance when and as requested
    - .2 co-ordinate completion of work systematically to permit orderly verification and adherence to schedules,
    - .3 provide additional necessary flow balancing devices as directed by agency,
    - .4 notify Systems Verification Agency of tests being conducted.

**3.15 ADJUST AND CLEAN**

- .1 Clean equipment and fixtures, lubricate mechanical equipment installed under this Division and leave items in perfect order ready for operation.
- .2 Remove from the premises upon completion of work of this division, debris, surplus, and waste materials resulting from operations.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 REFERENCES**

- .1 ASME A13.1 - Scheme for the Identification of Piping Systems.

**1.3 SUBMITTALS**

- .1 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
- .2 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- .3 Product Data: Provide manufacturers catalogue literature for each product required.
- .4 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

2 Products

**2.1 NAMEPLATES**

- .1 Fasten nameplates securely in a conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.

**2.2 TAGS**

- .1 Metal Tags: Brass with stamped letters; tag size minimum 1-1/2" (40mm) diameter with smooth edges.
- .2 Chart: Typewritten letter size list in anodized aluminum frame.

**2.3 STENCILS**

- .1 Stencils: With clean cut symbols and letters of following size:
  - .1 3/4"-1-1/4" (20-30mm) Outside Diameter of Insulation or Pipe: 8" (200mm) long colour field, 1/2" (15mm) high letters.
  - .2 1-1/2"-2" (40-50mm) Outside Diameter of Insulation or Pipe: 8" (200mm) long colour field, 3/4" (20mm) high letters.
  - .3 2-1/2"-6" (65-150mm) Outside Diameter of Insulation or Pipe: 12" (300mm) long colour field, 1-1/4" (30 mm) high letters.

**2.4 SELF ADHESIVE PIPE MARKERS**

- .1 Vinyl: Factory fabricated vinyl, 0.13 mm (5 mil) thick, preformed to fit around pipe or pipe covering.
- .2 Polyester: Factory fabricated polyester, 0.05 mm (2 mil) thick, coated with acrylic adhesive.
- .3 Plastic: Factory fabricated plastic film, roll formed, clear laminated to protect lettering.

3 Execution

**3.1 PREPARATION**

- .1 Degrease and clean surfaces to receive adhesive for identification materials.
- .2 Prepare surfaces for stencil painting.

### 3.2 INSTALLATION

- .1 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer (VOC content not to exceed 680g/L).
- .2 Install tags with corrosion resistant chain.
- .3 Comply with standard detail drawing plate, "Detail of Piping Identification".
- .4 Apply stencil markings on all covered piping.
- .5 Install plastic tape pipe markers complete around bare pipe to manufacturer's instructions.
- .6 Install underground plastic pipe markers 6"-8" (150-200mm) below finished grade, directly above buried pipe.
- .7 Identify valves in main and branch piping with tags. Consecutively number valves in each system.
- .8 Identify piping, concealed or exposed, with stencilled painting and plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 6m on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

### 3.3 SCHEDULES

- .1 Consult the Owner and identify piping, ductwork and equipment as directed;
  - .1 conforming to the Owner's existing identification practices, or
  - .2 conforming to the following Pipe and Valve Identification Table:

	Valve	Primary	Secondary
Pipe Marker Legend	Tag Legend	Colour	Colour
Cold Water	CW	Green	None
Sanitary Sewer	SAN	Green	None
Vent		Green	None

- .2 The above lists are to be used as a guideline for colour coding only, and is not intended to supersede lists of other authorities or agencies. (i.e. Ministry of Environment; Ministry of Government Services, Canadian Government Standards Board).

### 3.4 MANUFACTURE'S NAMEPLATE

- .1 Provide metal nameplates on each piece of equipment, mechanically fastened with raised or recessed letters.
- .2 Include registration plates, Underwriters' Laboratories and CSA approval, as required by respective agency and as specified. Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors, all factory supplied.
- .3 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENT**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES:**

- .1 Sealants
- .2 Sleeves
- .3 Flashings and counter-flashings
- .4 Escutcheons and plates

**1.3 SUBMITTALS**

- .1 Product Data: physical properties, application limits.
- .2 Manufacturer's Installation Instructions.
- .3 Submit manufacturer's performance data, certification agency file numbers and catalogue information.
- .4 Prepare and submit a schedule of service penetration systems to be employed indicating the ULC listing designation, services involved.

**1.4 QUALITY ASSURANCE**

- .1 Manufacturer: Company specializing in manufacture of sealants with documented product development, testing, and manufacturing experience.

**1.5 REGULATORY REQUIREMENTS**

- .1 Conform to Ontario and National Building Code.

2 PRODUCTS

**2.1 ADHESIVES, SEALANTS, PAINTS AND COATINGS**

- .1 Adhesives, Sealants, Paints and Coatings: Use only low VOC emitting materials meeting following criteria;
  - .1 Sealants for Service Penetrations: maximum VOC emission of 650g/L clear and 350g/L pigmented.

**2.2 SEALANTS AND CAULKING**

- .1 Refer to Division 07.

**2.3 SLEEVES**

- .1 Materials: minimum schedule 20 galvanized steel or cast iron.

**2.4 ESCUTCHEONS**

- .1 Finish; Polished chrome

**2.5 FLASHINGS AND COUNTER FLASHINGS**

- .1 Thaler or equivalent mechanical/electrical flashings as recommended for specific purpose.
- .2 Stainless steel flashing sleeve, integral deck flange and EPDM seal.

3 EXECUTION

3.1 SEALANTS AND CAULKING

- .1 Fill voids around pipes:
  - .1 Seal between sleeve and pipe in foundation walls and below grade floors with penetration seals (link-seal)). Install as per manufacturer's installation instructions.
  - .2 Where sleeves pass through non-fire rated walls or floors, caulk space between pipe and sleeve with fibreglass. Seal space at each end with waterproof, fire retardant, non-hardening mastic.
  - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
  - .4 Fill future-use sleeves with easily removable filler.
  - .5 Coat exposed exterior surfaces or ferrous sleeves with heavy application of zinc rich paint (VOC content not to exceed 250 g/L).
- .2 Temporarily plug all openings during construction.

3.2 SLEEVES AND CURBS

- .1 Provide pipe sleeves at points where pipes pass through masonry or concrete.
- .2 Provide sleeves of minimum schedule 20 galvanized steel or cast iron.
- .3 Use cast iron or steel pipe sleeves with annular fin continuously welded at midpoint:
  - .1 through foundation walls, with penetration seals.
  - .2 through floors of mechanical rooms and equipment rooms.
- .4 Provide 1/4" (6mm) clearance all around, between sleeve and pipes.
- .5 Where piping passes below footings, provide minimum clearance of 2" (50mm) between sleeve and pipe. Backfill up to underside of footing with concrete of same strength as footing with concrete of same strength as footing.
- .6 Terminate sleeves flush with surface of concrete and masonry and 2" (50mm) above floors. Not applicable to concrete floors on grade.
- .7 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction, caulk between sleeve recess and pipe, fasten roof flashing to clamp device, make water-tight durable joint. Co-ordinate with roofing Section.

3.3 FLASHINGS

- .1 Provide all flashing at each point where piping passes through the roof.
- .2 Coordinate this work with the roofing Trades to ensure a satisfactory installation and to avoid delays.

3.4 ESCUTCHEON PLATES

- .1 Provide on pipes passing through finished walls, partitions, floors and ceilings.
- .2 Use chrome or nickel plated brass, solid type with set screws for ceiling or wall mounting.
- .3 Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve.
- .4 Where sleeve extends above finished floor, escutcheon or plates shall clear sleeve extension.
- .5 Secure to pipe or finished surface.

**END OF SECTION**

**1** General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES**

- .1 Pipe and equipment hangers and supports
- .2 Sleeves and seals.
- .3 Flashing and sealing equipment and pipe stacks.

**1.3 REFERENCES**

- .1 ASME B31.9 - Building Services Piping.
- .2 ASTM A 125, Standard Specification for Steel Springs, Helical, Heat-Treated.
- .3 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .4 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .5 ASTM A 563, Standard Specification for Carbon and Alloy Steel Nuts.
- .6 MSS SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture
- .7 MSS SP 69, Pipe Hangers and Supports - Selection and Application
- .8 MSS SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.

**2** Products

**2.1 PIPE HANGERS AND SUPPORTS**

- .1 Manufacturers:
  - .1 Anvil
  - .2 Myatt
  - .3 Hunt
- .2 Plumbing Piping - Drain, Waste, and Vent:
  - .1 Conform to ASME B31.9.
  - .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 38mm): Malleable iron, adjustable swivel, split ring.
  - .3 Hangers for Pipe Sizes 2" (50mm) and Over: Carbon steel, adjustable, clevis.
  - .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - .5 Wall Support for Pipe Sizes to 3-1/4" (80mm): Cast iron hook.
  - .6 Wall Support for Pipe Sizes 4" (100mm) and Over: Welded steel bracket and wrought steel clamp.
  - .7 Vertical Support: Steel riser clamp.
  - .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

- .3 Plumbing Piping - Water:
  - .1 Conform to ASME B31.9.
  - .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 38mm): Malleable iron, adjustable swivel, split ring.
  - .3 Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
  - .4 Wall Support for Pipe Sizes to 3-1/4" (80mm): Cast iron hook.
  - .5 Vertical Support: Steel riser clamp.
  - .6 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .7 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

## 2.2 ACCESSORIES

- .1 Hanger Rods: galvanized, carbon steel continuous threaded.
- .2 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 3 Execution

### 3.1 INSTALLATION

- .1 Install hangers, supplies and attachments as required to properly support from the building structure and to manufacturer's instructions and best trade practises.

### 3.2 INSERTS

- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4" (100mm).
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

### 3.3 PIPE HANGERS AND SUPPORTS

- .1 Support horizontal piping as scheduled.
- .2 Install hangers to provide minimum 1/2" (13mm) space between finished covering and adjacent work.
- .3 Place hangers within 12" (300mm) of each horizontal elbow.
- .4 Use hangers with 1-1/2" (38mm) minimum vertical adjustment.
- .5 Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5m) maximum spacing between hangers.
- .6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .7 Support riser piping independently of connected horizontal piping.
- .8 Provide copper plated hangers and supports for copper piping.
- .9 Design hangers for pipe movement without disengagement of supported pipe.

**3.4 FLASHING**

- .1 Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- .2 Flash vent and soil pipes projecting 3" (75mm) minimum above finished roof surface with lead worked 1" (25mm) minimum into hub, 8" (200mm) minimum clear on sides with 24" x 24" (600 x 600mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter flash, and seal.
- .3 Flash floor drains in floors with topping over finished areas with lead, 10" (250mm) clear on sides with minimum 36" x 36" (900 x 900mm) sheet size. Fasten flashing to drain clamp device.
- .4 Seal roof, floor, shower and mop sink drains watertight to adjacent materials.

**3.5 SLEEVES**

- .1 Set sleeves in position in formwork. Provide reinforcing around sleeves.
- .2 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- .3 Extend sleeves through floors 1" (25mm) above finished floor level. Caulk sleeves.
- .4 Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and caulk. air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- .5 Install chrome plated steel escutcheons at finished surfaces.

**3.6 SCHEDULES**

- .1 For PEX Piping, Copper Tubing

Pipe Diameter mm (ins)	Horizontal Spacing of Supports mm (ins)	Threaded Rod Diameter mm (ins)
13 (1/2)	1500 (60)	10 (3/8)
19 (3/4)	1500 (60)	10 (3/8)
25 (1)	1800 (72)	10 (3/8)
32 (1-1/4)	2100 (84)	10 (3/8)
38 (1-1/2)	2400 (96)	10 (3/8)
50 (2)	2400 (96)	10 (3/8)

- .2 For PVC or ABS Pipes

Pipe Diameter mm (ins)	Horizontal Spacing of Supports mm (ins)	Threaded Rod Diameter mm (ins)
< 75 (3)	1200 (48)	10 (3/8)
>100 (4)	1200 (48)	13 (1/2)

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 REFERENCES**

- .1 ASHRAE HANDBOOK, HVAC SYSTEMS & EQUIPMENT, Duct Construction Recommendations
- .2 Sheet Metal And Air Conditioning Contractors' National Association (SMACNA)
  - .1 HVAC Duct Construction Standards - Metal and Flexible
  - .2 HVAC Duct Systems Design
  - .3 Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
  - .4 HVAC Systems - Testing, Adjusting and Balancing
  - .5 HVAC Air Duct Leakage Test Manual.
- .3 National Fire Protection Association (NFPA)
  - .1 90A Standard for Installation of AC and Ventilation Systems
  - .2 90B Standard for Installation of Warm Air Heating and AC Systems
  - .3 255 Building Materials, Test of Burning Characteristics (same as ASTM E84)
- .4 American Society for Testing and Materials (ASTM)
  - .1 A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
  - .2 A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .3 A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .4 A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .5 A1011/A1011M - Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.
  - .6 B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
  - .7 A240 Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
  - .8 A480 Standard Specification for General Requirements for Flat Rolled Stainless Heat-Resisting Steel Plate, Sheet and Strip
  - .9 A653 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot Dip Process.
  - .10 E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .11 E814 Standard Test Method for Fire Tests of Through Penetration Fire Stops
- .5 American Welding Society (AWS)
  - .1 B2.2 Brazing Procedures and Performance Qualifications
  - .2 D9.1 Sheet Metal Welding Code
- .6 Underwriter's Laboratories (UL)

- .1 181 Factory Made Air Ducts and Air Connectors
- .2 555 Standard for Safety Fire Dampers
- .3 723 Test for Surface Burning Characteristics of Burning Materials (ASTM E84)

### 1.3 PERFORMANCE REQUIREMENTS

- .1 No variation of duct configuration or sizes permitted except by written permission.
- .2 Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.
- .3 Sizes indicated on drawings are clear inside dimensions and do not include for duct linings.

### 1.4 SUBMITTALS

- .1 Shop drawings and product Data: data for duct materials.
- .2 Shop Drawings:
  - .1 Factory fabricated ducts, fittings and joining systems.
- .3 Submit changes or alterations in ductwork layout, with supporting calculations showing that the modified design will not increase total pressure, before work commences. Submittals for proposed changes shall be stamped for acceptance prior to commencement of work.
- .4 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Material Safety Data Sheets (MSDS) for sealants, adhesives and coatings.
- .6 Submit two samples of typical shop fabricated duct fittings.

### 1.5 PROJECT RECORD DOCUMENTS

- .1 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

### 1.6 QUALITY ASSURANCE

- .1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible. .
- .2 Perform Duct Leakage Testing to SMACNA "HVAC Air Duct Leakage Testing Manual"
- .3 Maintain one copy of document on site.
- .4 Asbestos Free: Insulating and sealing materials must be certified to be free of asbestos.
- .5 Brazing: Certify brazing procedures, brazers, and operators in accordance with AWS B2.2 Brazing Procedures and Performance Qualifications
- .6 Welding: Certify welding procedures, welding equipment and welders in accordance with AWS D9.1 Sheet Metal Welding Code.

### 1.7 REGULATORY REQUIREMENTS

- .1 National Building Code
- .2 National Fire Code
- .3 Construct ductwork to NFPA 90A standards.

### 1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- .2 Maintain temperatures during and after installation of duct sealants.

2 Products

**2.1 MATERIALS**

.1 Table of materials:

Application	Materials
Rigid HVAC ducts, casings and fittings	ASTM A653 galvanized steel sheet, lock form quality, G90 zinc coating (0.90 oz/ft <sup>2</sup> ) to ASTM A90. Sheets free of pits, blisters, slivers, and ungalvanized spots.

- .2 Hanger Rod: continuously threaded, ASTM A36 galvanized steel in general.
- .3 Sealant: Non-hardening, water resistant, fire resistive, low VOC (VOC content not to exceed 250g/L), compatible with mating materials; liquid used alone or with tape, or heavy mastic.
- .4 Supports: Angle iron, channels, rods and related supporting materials shall be galvanized or red oxide coated.
- .5 Fasteners: Use galvanized rivets, screws and bolts throughout.
- .6 Reinforcements: Provide galvanized steel or stainless steel reinforcement shapes and plates to match ductwork.
- .7 Tie Rods: Use galvanized steel, 1/4" minimum diameter fasteners for ductwork 36" (900mm) or less in length; use 3/8" minimum diameter for lengths longer than 36" (900mm).
- .8 Thickness, fabrication and reinforcement to SMACNA.

**2.2 DUCT CONSTRUCTION**

.1 Duct construction schedule:

Duct Application	Duct Pressure	Pressure Class (ins. wg.)	Seal Class	Leakage Class
Rectangular sanitary exhaust ductwork	Negative	2	A	6
Round sanitary exhaust ductwork	Negative	2	A	3
Exhaust fan discharge ductwork	Positive	2	A	0

.2 Note:

- .1 Pressure class shall be the lower of the exhaust fan shut-off pressure or value shown.

**2.3 DUCT SEALING**

.1 Duct sealing schedule:

Seal Class	Sealing Requirements
A	All transverse joints, longitudinal seams and duct wall penetrations.

**2.4 DUCT LEAKAGE**

.1 Leakage Class is defined as

$$CL = F / (P)^{0.65}$$

where: CL = Leakage Class

F = Leakage Factor (cfm/100sq.ft. of duct surface)

P = Static pressure in the duct (in.wg.)

.2 Table

Leakage Factor (F) CFM/100sq.ft. of duct surface					
Leakage Class	Pressure Class (ins.wg.) Positive or Negative				
	C <sub>L</sub>	1	2	4	6
48	48	75	118	154	214
24	24	38	59	77	107
12	12	19	30	38	54
6	6	9	15	19	27
3	3	5	7	10	13
0	0	0	0	0	0

**2.5 DUCTWORK FABRICATION**

- .1 All Ductwork shall be constructed to withstand 1-1/2 times fan pressure at shut-off and 2" (500Pa) minimum.
- .2 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated in accordance with recommendations of ASHRAE and SMACNA.
- .3 Joints and reinforcements:
  - .1 to SMACNA and ASHRAE
  - .2 may be made with the Ductmate System or Nexus System. System components shall be made of standard catalogue manufacture as supplied by Ductmate Industries, Inc. Or Nexus Inc.
- .4 Construct Tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.
- .5 Increase duct sizes gradually, not exceeding 15deg. divergence wherever possible; maximum 30deg. divergence upstream of equipment and 45deg. convergence downstream.
- .6 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 4" (100mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.
- .7 Provide standard 45-degree lateral wye takeoffs. Alternative 90deg. conical tee connections may be used only where specifically indicated.

**2.6 ROUND SPIRAL LOCK SEAM DUCTWORK**

- .1 Spiral ducts and elbows shall not be used for watertight exhaust systems.
- .2 Ducts and fittings shall be manufactured from minimum G90 galvanized steel meeting ASTM A527/A527M-85.
- .3 Ductwork shall be "Uni-Seal" single wall, round spiral lock-seam type duct with wall thicknesses listed below.
- .4 Fittings shall be "Uni-Form" single wall, round fittings suitable for use with "Uni-Seal" ductwork in wall thicknesses as follows:

Diameter ins. (mm)	Duct Metal Thickness ins. (Ga.) (mm)	Fitting Metal Thickness ins. (Ga.) (mm)
3-14 (75-350)	0.022 (26) (0.56)	0.028 (24) (0.70)

- .5 Acceptable Manufacturer: "Uni-Seal" spiral lock-seam duct and "Uni-Form" fittings as manufactured by United Sheet Metal. Other manufacturers subject to shop drawing review.

3 Execution

**3.1 INSTALLATION**

- .1 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .2 Install ductwork parallel to building lines.
- .3 Support all ductwork from structural members. Where structural bearings do not exist, suspend strapping or hangers from steel channels or angles. Provide supplementary structural members. Do not suspend from metal deck.
- .4 Do not break continuity of insulation vapour barrier by hangers or rods.
- .5 Hangers shall be steel angles with supporting rods, locking nuts and washers to following table:

Duct Size ins. (mm)	Angle Size ins. (mm)	Rod Size ins. (mm)	Spacing ft. (m)
<30 (750)	1x1x1/8 (25x25x3)	1/4 (6)	10.0 (3000)

- .6 Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- .7 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- .8 Use crimp joints with or without bead for joining round duct sizes 8" (200mm) and smaller with crimp in direction of air flow.
- .9 Use double nuts and lock washers on threaded rod supports.
- .10 Connect flexible ducts to metal ducts with adhesive and metal or nylon straps.
- .11 Ground across flexible connector with No. 2/0 braided copper strap.
- .12 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.
- .13 Balancing dampers shall be installed on branches as per locations shown on the drawings and as per the requirements of NEBB and AABC listing/measuring standards.
- .14 Perform duct leakage testing for all ductwork installed under this contract.

**3.2 DUCT CLEANLINESS**

- .1 All ductwork shall be handled and installed in accordance with the advanced level described in SMACNA Duct Cleanliness for New Construction Guidelines.
- .2 After completing system installation including outlet fittings and devices, inspect the system.
- .3 Ductwork leaving the premises of the manufacturer may include some or all of the following:
  - .1 self-adhesive labels or marking for part(s) identification shall be applied to external surfaces only;
  - .2 exposed mastic sealant;
  - .3 light zinc oxide coating on the metal surface;
  - .4 a light coating of oil on machine formed ductwork;
  - .5 minor protrusions into the airway of rivets, screws, bolts and other jointing devices;
  - .6 internal insulation and associated fasteners;

- .7      discoloration marks from plasma cutting process.
- .8      to maintain cleanliness during transportation, all ductwork shall be sealed either by blanking or capping duct ends, bagging small fittings, surface wrapping or shrink wrapping. Care must be taken to prevent damage during transportation and off loading.
- .4      A clean and dry environment where the ductwork is protected from dust, must be provided for the storage of ductwork prior to installation. All sealed ends shall be visually examined and if damaged resealed with an appropriate material.
- .5      During installation, the working area shall be clean, dry and the ductwork protected from dust.
- .6      The internal surfaces of the un-insulated ductwork shall be wiped to remove excess dust immediately prior to installation.
- .7      Open ends on completed ductwork and overnight work-in-progress shall be sealed.
- .8      Access covers shall be firmly fitted in position on completion of each section of the work.
- .9      Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

### **3.3 DUCT LEAKAGE TESTING**

- .1      Ductwork shall be leak tested in accordance with the SMACNA "HVAC Air Duct Leakage Test Manual". The maximum permitted duct leakage shall be determined by multiplying the leakage factor by the surface area of the ductwork in the test zone.
- .2      Ductwork that exceeds the maximum permitted leakage shall be re-sealed and re-tested.
- .3      Duct leakage test shall be witnessed and certified by the Systems Verification Agency.
- .4      Record and submit three (3) copies of test results to the Consultant for review prior to application of duct insulation or concealment of ductwork.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES**

- .1 Duct access doors.
- .2 Duct test holes.
- .3 Flexible duct connections.
- .4 Volume control dampers.

**1.3 REFERENCES**

- .1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- .2 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

**1.4 SUBMITTALS**

- .1 Submit a 'Letter of Conformance', indicating the specified items selected for use in this Project with the following supporting product data reports.
- .2 Shop Drawings for shop fabricated assemblies including balancing dampers, volume control dampers, duct access doors and duct test holes.
- .3 Product Data for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

**1.5 DELIVERY, STORAGE AND PROTECTION**

- .1 Transport, handle, store, and protect products.
- .2 Protect dampers from damage to operating linkages and blades.

2 Products

**2.1 VOLUME CONTROL DAMPERS**

- .1 Factory fabricated with recognized hardware and accessories and to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Single Leaf Dampers: fabricated from minimum 20 gauge (1.0mm) galvanized steel, suitably reinforced to prevent vibration and fitted with indicating regulator. Duro-Dyne, Lawson & Taylor, Dyn-Air.
- .3 Multi-Blade Opposed Action Dampers: fabricated from 16 gauge (1.6mm) galvanized steel, mounted in separate channel frames, reinforced to prevent vibration, and fitted with opposed action linkage hardware. Duro-Dyne "Opax" blade kit, Lawson & Taylor, Dyn-Air.
- .4 End Bearings: Except in round ductwork 12" (300mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- .5 Quadrants:
  - .1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.
  - .2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

## 2.2 DUCT ACCESS DOORS

- .1 Fabricate doors airtight and suitable for duct pressure and to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated duct work, install minimum 1" (25mm) thick insulation with sheet metal cover.
  - .1 Less Than 12" (300mm ) Square: Secure with sash locks.
- .3 Access doors with sheet metal screw fasteners are not acceptable.

## 2.3 DUCT TEST HOLES

- .1 Provide test ports to suit intended application, (ie. Insulated / un-insulated duct, round/rectangular duct).
- .2 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- .3 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
- .4 Acceptable Products: Air Power Co. Dial 1000, Dial 2000 or Duro-Dyne IP-1, IP-2, IPG-3, IP-4, Dyne-Air

## 2.4 FLEXIBLE DUCT CONNECTORS

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Connector: Fabric crimped into metal edging strip.
  - .1 Fabric: UL listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0kg/sq m.
  - .2 Net Fabric Width: Approximately 2" (50mm) wide.
  - .3 Metal: 3" (75mm) wide, 1/32" (0.6mm) thick.

## 2.5 HANGERS AND SUPPORTS

- .1 Fabricate strap hangers to same material as duct. Hanger configuration to SMACNA details. 20" (500mm) is maximum duct size to be supported by strap hanger.
- .2 Rod and angle hangers: galvanized steel to SMACNA details.
- .3 Hanger attachments: manufactured concrete inserts, expansion shields and bolted steel clamps. Do not weld rods to steel decks or use powder actuated fasteners.

## 2.6 DUCT SEALANT

- .1 General: Low VOC, water based sealant, non-toxic, non-combustible, non-flammable, and tested in accordance with CAN4-S102-M83. Flame spread shall not exceed 25 and smoke developed shall not exceed 50.
- .2 Acceptable Products: Multi-Purpose Duct Sealant as manufactured by Trans Continental Equipment, Duro Dyne SWB Duct Sealer, Iron Grip 601 as supplied by Alpha Sheet Metal Co., or Uni-Grip Duct Sealer from United McGill Corporation.

## 3 Execution

### 3.1 INSTALLATION

- .1 Install accessories to manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 15810 for duct construction and pressure class.

- .2 Provide back draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- .3 Provide duct access doors for inspection and cleaning before and after fans, and elsewhere as indicated. Provide minimum 8" x 8" (200 x 200mm) size for hand access. Provide 4" x 4" (100 x 100mm) for balancing dampers only. Review locations prior to fabrication.
- .4 Provide duct test holes where indicated and required for testing and balancing purposes.
- .5 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators. For fans developing static pressures of 1250Pa and over, cover connections with loaded vinyl sheet, held in place with metal straps.
- .6 Use splitter dampers only where indicated.
- .7 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- .8 Provide turning vanes where space restrictions prohibit the use of elbows having a minimum inside radius equal to the duct width for horizontal elbows or the duct depth for vertical elbows.
- .9 Provide test ports as required by Balancing Agency and at inlet and outlet of fans, to completely test and balance the system. No temporary holes will be permitted in ductwork or flexible connections.

### **3.2 DUCT ACCESS DOORS**

- .1 Provide duct access doors of suitable size in ductwork in the following locations:
  - .1 Suction inlet of all fans
  - .2 At not more than 12m intervals
  - .3 At all locations having an internally mounted piece of equipment or device.
  - .4 Where required for duct cleaning.
- .2 Wherever possible, doors shall be mounted to close in direction of air flow.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES**

- .1 In-Line centrifugal fans.
- .2 Fan timer panels.

**1.3 REFERENCES**

- .1 AMCA 99 - Standards Handbook.
- .2 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
- .4 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- .5 AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

**1.4 SUBMITTALS**

- .1 Provide shop drawings and product data on fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- .2 Manufacturer's Installation Instructions.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation
- .2 Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual
- .3 Handling: Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer

2 Products

**2.1 IN-LINE CENTRIFUGAL FANS.**

- .1 Manufacturers: Greenheck models indicated or equivalent products by;
  - .1 PennBarry
  - .2 Loren Cook
  - .3 Carnes
  - .4 BroanSubject to shop drawing review.
- .2 Product Requirements:
  - .1 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
  - .2 Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

- .3 Fabrication: Conform to AMCA 99.
- .3 Performance: as scheduled on drawings
- .4 General Description
  - .1 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number
- .5 Wheel:
  - .1 Non-overloading, backward inclined centrifugal wheel
  - .2 Constructed of aluminum
  - .3 Statically and dynamically balanced in accordance to AMCA Standard 204-05
  - .4 The wheel cone and fan inlet shall be matched and shall have precise running tolerances for maximum performance and operating efficiency
  - .5 Single thickness blades shall be securely riveted or welded to a heavy gauge back plate and wheel cone.
- .6 Motors
  - .1 Motor enclosures: Open drip proof (ODP) opening in the frame body and or end brackets.
  - .2 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
- .7 Housing/Cabinet Construction
  - .1 Construction material: Galvanized
  - .2 Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars
  - .3 Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.
- .8 Housing Supports and Drive Frame
  - .1 Housing supports shall be constructed of structural steel with formed flanges
  - .2 Drive frame is welded steel which supports the motor
- .9 Disconnect Switches
  - .1 NEMA rated: 1
  - .2 Positive electrical shut-off
  - .3 Wired from fan motor to junction box
- .10 Duct Collars:
  - .1 Square design to provide a large discharge area
- .11 Finishes
  - .1 Coating type: Epoxy, one part polyamide activated epoxy resin coating with moisture and moderate chemical resistance
- .12 Isolation:
  - .1 Type: Free Standing Open Springs and Mounting Brackets
  - .2 Sized to match the weight of each fan
- .13 Electrical Characteristics and Components
  - .1 Electrical Characteristics: as scheduled

- .2 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.

## 2.2 FAN TIMER PANELS

- .1 Manufacturers:
  - .1 Tulsar Canada
  - .2 Alternates Subject to shop drawing review.
- .2 Provide two fan timer control panels with the following specifications:
  - .1 Cabinet: Painted steel
  - .2 Non-fusible disconnect switch
  - .3 Short circuit protection for fans and controls
  - .4 Hand/On/Auto switch, with a warning label "Hand operation for testing purposes only"
  - .5 Power and LED lights
  - .6 Timer
  - .7 Programmable time relay and solid-state overload relay
  - .8 Dry contacts and Terminals
- .3 Fan timer control panels shall run each fan for 5 minutes every 20 minutes, 12 hours a day.
- .4 Control power should be via 120-24VAC isolation control transformer, by panel supplier.
- .5 Timer operation intervals and daily operation hours shall be adjustable by Parks Canada

## 3 Execution

### 3.1 INSTALLATION

- .1 Install fans in accordance with manufacturer's instructions.
- .2 Startup and commissioning of the fan and timer system shall be included in the contractor scope.

**END OF SECTION**

1 General

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the General Requirements of Section 23 01 00 and the Common Work Elements of Section 23 10 00.
- .2 Division 01 requirements and documents referred to therein.

**1.2 SECTION INCLUDES**

- .1 Grilles
- .2 Louvres

**1.3 REFERENCES**

- .1 ADC 1062 - Air Distribution and Control Device Test Code.
- .2 AMCA 500 - Method of Testing Louvres for Ratings.
- .3 ARI 650 - Air Outlets and Inlets.
- .4 ASHRAE 70 - Method of Testing for Rating the Performance of Outlets and Inlets.
- .5 SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- .6 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

**1.4 SUBMITTALS**

- .1 Shop drawings and product data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- .2 Samples: Submit two of each required air outlet and inlet type, if requested by the Consultant.

**1.5 QUALITY ASSURANCE**

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with documented experience.

**1.6 REGULATORY REQUIREMENTS**

- .1 Test and rate air outlet and inlet performance to ADC Equipment Test Code 1062 and ASHRAE 70.
- .2 Test and rate louvre performance to AMCA 500.

2 Products

**2.1 MANUFACTURER'S**

- .1 Grilles
    - .1 Krueger models indicated or equivalent products by;
      - .1 E. H. Price
      - .2 Titus
      - .3 Metalaire

Substitutions are subject to shop drawing review.

  - .2 Refer to the schedule on the drawings for grille models, types, performance requirements and finishes.
- .2 Louvres

- .1 Greenheck models indicated or equivalent by;
  - .1 VentexSubstitutions are subject to shop drawing review.
- .2 Refer to the schedule on the drawings for louvre models, types, performance requirements and finishes

3 Execution

**3.1 INSTALLATION**

- .1 Install to manufacturer's instructions.
- .2 Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

**END OF SECTION**

1 General

**1.1 GENERAL**

- .1 All conditions of the Contract apply to the work of this Section.
- .2 The requirements of this Section shall apply to and govern the work of this Division and shall be read as an integral part of each Section.
- .3 The Electrical Drawings and these Specifications are complementary to each other and each forms a part of this contract. In the event of discrepancies between Drawings and Specifications, the more restrictive conditions shall apply unless a written clarification is obtained from the Consultant.
- .4 Misinterpretation of any requirement of the Drawings or Specifications will not relieve this Division of responsibility to complete the work. If in doubt, contact the Consultant for written clarification. If clarification is not sought the Consultant's decision shall be final and binding on the Contractor.
- .5 Do not scale drawings but use only dimensions, which are shown. Where exact building dimensions and details are required, use only figured dimensions on the Architectural or Structural Drawings or job site dimensions.
- .6 No deviations from the Drawings or Specifications will be permitted without written authorization from the Consultant.

**1.2 RELATED WORK**

- .1 Provide all labour, tools, services and installation (except as noted below) of all products.

**1.3 RELATIONSHIP TO OTHER DIVISIONS (REFER BELOW TO MECH/ELEC SCHEDULES OF RESPONSIBILITIES)**

- .1 Division 26 shall:
  - .1 Provide line voltage power wiring and terminations to equipment of all Divisions.
  - .2 Provide low voltage (31 to 750 volts) wiring to equipment of all other Divisions. Unless otherwise indicated on the electrical drawings Division 22/23/25 control and interlock wiring, extra-low (up to & including 30 volts) and/or low voltage not exceeding 120V shall be by Division 22/23/25.
  - .3 Provide starters and/or disconnects as noted on drawings.

**1.4 SCOPE**

- .1 Generally, the work includes, in the time frame set out or implied, the provision of a complete, interfaced, reliable, continuous operating electrical systems shown, implied, described or required, including but not limited to all labour, equipment, confirmations, co-ordination of equipment, interim set-up and operation, spare parts, fees, service layouts, permits, inspections, investigations, studies, acceptance tests, including 3rd party, demonstrations, reports, bonds, notices, declarations, administration, liaison, reviews, meetings, correspondence and travel. Provide training, warranties and insurance.
- .2 Refer to Division 1 for requirements regarding temporary power / construction power. Supply portable generator equipment as required to complete scope of work.
- .3 The electrical drawings are schematic and indicate major equipment and intended overall arrangement. Exact sizes, dimensions, locations, devices and arrangements shall suit equipment, site conditions and requirements. Review shop drawings for sizes and requirements under Division 26 and ensure compatibility of all systems specified and installed; report problems, concerns and variations. The Engineer shall review shop drawings of equipment prior to installation. Refer to Division 1.
- .4 The Contract Drawings and the Specifications are to be read in conjunction with all other design and engineering documents. Provide all equipment after co-ordinating and reviewing all Division

26 work required by other Sections, service companies and jurisdictional authorities. The omission of work and materials that are required to complete the project is not to be interpreted as relieving this Section of the necessity of providing such work and materials. Ensure all equipment is installed correctly and sequentially.

- .5 In case of conflict among authorities, trades, drawings, specifications and other documents, the most stringent requirements shall apply, as directed by the Consultant.
- .6 All work and material shall be installed to the manufacturer's and the Consultant's recommendations and satisfaction, as applicable. Construction shall be performed by relevant, competent, qualified and certified trade persons.
- .7 Protect materials and equipment after delivery to minimize the probability of condensation or other damage prior to the application of final heating systems.

### 1.5 PERMITS AND ALLOWANCES

- .1 Submit the Contract Drawings and specifications to the Electrical Safety Authority for approval. ESA comments will be incorporated in the project using normal contract procedures. Co-ordinate and provide additional information as required. Inform the Engineer of any concerns noted prior to ordering equipment.
- .2 Pay all Electrical Safety Authority permit and inspection costs.
- .3 Provide, in a timely manner, a copy of all applicable comments made by authorities having jurisdiction.

### 1.6 EXAMINATIONS

- .1 Prior to submission of tender, carefully examine the electrical drawings, drawings of other trades and all Specifications having a bearing on the work of this Division. Visit the site of the work and thoroughly ascertain that the work of this Division can be carried out satisfactorily without any changes to the Drawings or Specifications. No extras will be allowed for anything, which would have been revealed in the course of such an examination.
- .2 Examine the proposed locations of equipment and fixtures of other trades and report any defects or interference with the work of this Division in writing to the Consultant. Affected work shall not commence until any discrepancies adversely affecting the work of this Division are remedied.
- .3 Fully understand the function of the systems described in this Division. Have no doubt as to the extent of the systems and/or materials and labour required. Contact the Consultant for clarification. No extras will be allowed to complete systems inadequately installed or not fully operational.

### 1.7 EXTRAS AND CREDITS

- .1 Changes to the contract requiring additions to or deletions from the work of this Division shall be carried out upon written request of the Consultant. Extras to the contract or credits shall be submitted with a complete cost breakdown as follows:
  - .1 Materials, quantities and unit prices for all equipment required or deleted.
  - .2 Unit man hours.
  - .3 Total material cost.
  - .4 Total man hours.
  - .5 Hourly rate. (Refer to Supplementary Conditions and General Contract).
  - .6 Total overhead and profit. (Refer to Supplementary Conditions and General Contract).
- .2 Equipment and material costs shall be accepted at net costs only.
- .3 Invoices, time sheets, and other evidence of costs shall be provided upon request by the Consultant.
- .4 Prices not submitted in this format will not be accepted.

## 1.8 REGULATIONS

- .1 Comply with the latest Ontario Building Code and amendments and the requirements of the Municipal Building Department.
- .2 Comply with the latest regulations of the Electrical Safety Code and the requirements of the local Electric Safety Authority inspection department, the requirements of the local hydro commission, the recommended standards of the Canadian Standards Association, the Ontario Ministry of Labour, the Occupational Health and Safety Act, Provincial and Federal governments or any other authority having jurisdiction.
- .3 The Contract Drawings show the minimum standard acceptable regardless of any lesser standards set by any Codes, Regulations or Authorities Having Jurisdiction.

## 1.9 SUBMITTALS

- .1 Submit a list of delivery dates for each type of equipment, within 30 days of awarding of the contract or at the preconstruction meeting. The list shall include the manufacturer's name. Shop drawings shall indicate conformity with all items of the equipment specifications.
- .2 Submit to Consultant submittals listed for review. Submit with reasonable promptness and in an orderly sequence so as to not cause delay in the construction schedule. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default is allowed.
- .3 Work affected by the submittal not to proceed until the review is complete unless an approval is obtained from the Consultant.
- .4 Review submittals prior to submission to the Consultant. This review represents that necessary requirements have been determined and verified, and that each submittal has been checked and co-ordinated with the requirements of the Contract Documents.

## 1.10 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with the General Requirements of Division 1 and as required in various sections of these specifications and on the drawings.
- .2 Shop drawings to be submitted with a cover sheet(s) on the Contractor's letterhead listing the following information:
  - .1 Project:
  - .2 Owner/Client:
  - .3 Architect:
  - .4 Electrical Consultant:
  - .5 General Contractor:
  - .6 Electrical Contractor:
  - .7 Supplier
  - .8 Specification Section
  - .9 Materials or Equipment submitted

**Note: Include space for review stamps by Consultant, General Contractor and Electrical Contractor.**

- .3 Prepare and submit for review, where specified, shown or considered necessary by the Consultant, shop drawings showing details of work as follows:
  - .1 Descriptive names of equipment (as identified on drawings), manufacturer's model numbers and electrical characteristics.
  - .2 Physical dimensions of equipment.

- .3 Sections, arrangements and details which indicate complete construction as well as interconnections with other work.
- .4 Location and type of anchors and fastenings.
- .5 Materials including gauges, thickness, sizes and finishes.
- .4 Manufacturer's printed data sheets for standard items are acceptable providing pertinent characteristics are identified and relate to specified items. Submit eight (8) copies of data sheets except where specified otherwise.
- .5 Check shop drawings and data sheets, before submission as follows:
  - .1 Against contract documents and other applicable shop drawings, to ensure that work adjacent to and affecting other work is accurately detailed.
  - .2 To ensure that work shown on shop drawings conforms to requirements of Contract Documents.
  - .3 Enclose notice in writing of any variations from requirements of Contract Documents.
- .6 Indicate on shop drawings that they have been checked by applying stamp "checked and certified correct for construction", including date and Contractor's signature. Drawings and details submitted without such stamp or whenever it is evident that drawings have not been checked (despite approval stamp) will not be reviewed and will be returned to Contractor.
- .7 The Consultant's review of shop drawings and data sheets pertain to general design only. Errors in dimensions, quantities or interference will be marked if noticed, but this will not in any way relieve Contractor from his responsibility to complete work as shown and specified.
- .8 Shop drawings are to be returned with "Reviewed – No Comment", "Reviewed – As Noted", "Reviewed – Revise and Resubmit" or "Review by Consultant Not Required".
  - .1 "Reviewed – No Comment" - Drawings conform with the general design concept.
  - .2 "Reviewed – As Noted" - Drawings conform with the general design concept subject to the corrections noted. Drawings to be corrected and resubmitted for final review and incorporation into maintenance manuals. Such submission is not to hold up manufacture.
  - .3 "Reviewed – Revise and Resubmit" - Drawings are rejected and manufacture/supply of this equipment is not to proceed. Drawings are to be resubmitted with required corrections on equipment.
  - .4 "Review by Consultant Not Required".

#### 1.11 CERTIFICATES

- .1 Provide copies of all required certificates of approval, test results and verifications. Insert in Operating and Maintenance Manuals.

#### 1.12 RECORD DRAWINGS

- .1 As-built drawings are to be maintained in accordance with the general requirements of Division 1.
- .2 The Consultant shall provide the Contractor with an extra set of white prints on which to show clearly in red ink, as the job progresses, all changes and deviations from the plans, including all changes as part of change orders, site instructions or site condition.
- .3 Dimension all buried services/wiring from permanent structures.
- .4 Maintain as-built drawings on site for periodic review by Consultant.
- .5 On application for Certificate Of Substantial Performance, provide to the Consultant two complete sets of as-built drawings.

#### 1.13 WARRANTY

- .1 Provide warranty of material and workmanship in accordance with the requirements of Division 1.
- .2 Provide manufacturers' standard warranty if greater than one year.

- .3 The Contractor is to submit extended warranties for specific materials and/or work where specified. Extended warranties are to be issued on the Contractor's letterhead, under seal, and issued in the name of the Owner.
- .4 Insert warranties in Operating and Maintenance Manuals.

#### 1.14 OPERATING AND MAINTENANCE MANUALS

- .1 Submit three (3) copies of Operation and Maintenance Manual individually bound in suitable sized hard backed three ring binders.
- .2 Front cover of each binder to be suitably lettered as follows:

OPERATION AND MAINTENANCE MANUAL FOR  
(Project Name)  
(Owners Name)  
(Date)
- .3 Provide master index at the beginning of each binder indicating all items included in each section.
- .4 Provide plastic tab indices for all sections of the manual. Provide separate sections for each major piece of equipment and for groups of smaller products.
- .5 Provide list of names, addresses and telephone numbers of equipment suppliers, Electrical Contractor, General Contractor, Architect and Consulting Engineer.
- .6 Provide final review shop drawings of each manufactured item in addition to the operating and maintenance instructions.
- .7 Provide operating instructions. Operating instructions to include:
  - .1 General description of each electrical system.
  - .2 Step by step procedure to follow in commissioning each piece of equipment.
  - .3 Schematic control diagrams for each separate system.
  - .4 Drawings of each control panel identifying all components on the panels and their function.
  - .5 All electrical equipment wiring diagrams.
- .8 Provide maintenance instructions. Maintenance instructions are to include:
  - .1 Manufacturer's maintenance instructions for each item of electrical equipment installed under this Division. Instructions are to include installation instructions, parts numbers and lists, name of supplier and maintenance instructions.
  - .2 Summary list of each item of electrical equipment requiring maintenance, indicating the name of the equipment item, maintenance required and frequency of maintenance.
- .9 Provide written warranty (or warranties as applicable) on the Contractor's letterhead addressed to the Owner, copied to the General Contractor.
- .10 Include certificates issued by regulatory authorities (ESA, etc.), test and/or verification reports, programming parameters for devices with field adjustment capabilities and a list of ranges and setpoints at final commissioning.

#### 1.15 SPARE PARTS

- .1 Provide one (3) spare recessed LED light fixture of each type used.
- .2 Provide two (3) spare fusible links of rated ampacity for each fused disconnect type used (per campsite).

2 Products

**2.1 MATERIAL**

- .1 All material shall be specification grade, where applicable, new and carry CSA approval or special approval in accordance with ESA requirements.
- .2 Similar devices and items shall be from one manufacturer throughout the project.
- .3 Material or equipment specified by technical description shall be provided with the best commercial qualities obtainable for the purposes described.
- .4 Requests for extra money, time or equipment substitution due to late ordering of equipment will not receive any consideration.

**2.2 ALTERNATE MATERIALS**

- .1 Whenever a substitute or alternate product is proposed for use, the Contractor shall guarantee that such proposed substitutes or alternates will not adversely affect the requirements allocated on the drawings for the material or item or plant or equipment specified. He shall agree to bear any additional expense incurred due to the use of proposed substitutes or alternates, particularly in connection with any required changes in the work of any other division.
- .2 Requests for approval shall be accompanied by complete specifications for the equipment, showing dimensions, ratings, photometrics, cost reductions, etc.
- .3 Any equipment installed, without the Consultant's written approval, shall be removed and the correct equipment installed at no extra cost.
- .4 In the event the approved alternate equipment is not available for any reason, the specified equipment shall be installed.
- .5 When proposing an alternative product make all affected parties aware of any structural, architectural, mechanical, or electrical design changes necessary to accommodate the alternative product. The contractor is responsible for paying all costs incurred, which may result, from the acceptance of the alternative. Any cost savings anticipated must include all additional costs incurred for any changes to the original design.

**2.3 EXHAUST FANS AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring, conduit and connections: provided by Division 26 where voltage exceeds 120V, provided by Division 22/23/25 where voltage is 120V or less.

**2.4 EQUIPMENT IDENTIFICATION**

- .1 Identify all panels, starters, disconnect switches, etc. with approved, mechanically fastened lamicoïd nameplates. Indicate equipment being controlled, voltage and the supply panel/device and its location.
- .2 Labels on fused disconnect switches to include size and type of fusing. Also indicate "Equipment to be off before Isolation".
- .3 Terminal cabinets, junction boxes and pull boxes: indicate system and voltage and/or circuits.
- .4 Use 3mm (1/8") thick lamacoïd plates. White colour background with 6mm (1/4") high black letters. Use client equipment numbers as required.
- .5 Within panel boards, provide a typewritten directory of all circuits identifying the loads connected.
- .6 Provide warning signs, as specified or to meet requirements of Inspection Department and Consultant. Use porcelain enamel for outdoor and decal for indoor signs, minimum 175 x 250 mm size.

## 2.5 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, metal sheathed cables and junction boxes. Code with plastic tape or paint at points where conduit or cable enters wall, ceiling or floor and at 3050mm (120") intervals. Colours to be 25mm (1") wide.

## 2.6 WIRING IDENTIFICATION

- .1 All wiring shall be colour coded and shall be identified at each end with Brady self-sticking permacode wire markers. Update and or indicate numbers on "as-built drawings".
- .2 Maintain phase sequence and colour coding throughout. Colour coding to CSA C22.1.
- .3 Use colour coded wires in communication cables, matched throughout system.

## 3 Execution

### 3.1 EQUIPMENT INSTALLATION

- .1 Do complete installation in accordance with OESC.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 and CSA C22.3 No.7 respectively, except where specified otherwise.
- .3 The location of any panels, equipment, outlet, raceway and wiring may be changed by the Consultant if the new location is within a limit of 3000mm (120") radius of the original location. Provide changes without extra cost if requested before installation.
- .4 Do not install wall-mounted equipment at locations where built-in furniture or other equipment is to be installed. In cases of conflict, install equipment above the built-in furniture and clear the trim by approximately 150mm (6") unless otherwise instructed by the Consultant.
- .5 Arrange for openings in the walls and floors for transportation and installation equipment. Extra charges for cutting and making good of walls or floors for the work will not be accepted.
- .6 Prior to installation and start up, co-ordinate and confirm that all electrical equipment and systems are compatible, are sized correctly and shall work safely as intended.
- .7 Provide an acceptable documented procedure for the commissioning of all systems. Contact the Consultant to arrange for a viewing of the system demonstration. All systems shall be fully operational and verification documents available at least 24 hours before requesting a review by the Consultant. Provide hard copies of all programs for review before and after commissioning of equipment. At the discretion of the Owner, back charges for costs incurred may be levied if systems are not commissioned and operational at the time of the Consultants visit and return visit(s) are required.
- .8 Install, program, set-up and adjust all equipment as indicated and or required and complete all commissioning.
- .9 Electrical work is indicated generally on the Contract Drawings by standard symbols as per the legend. The letters in the symbol indicate the type of device as per the schedules. The letters and numbers outside and adjacent to the symbols indicate the panel and circuit number. If no circuit identification is indicated utilize available circuit(s) and load to acceptable practices.
- .10 All row mounted fixtures shall be accurately installed in line with all mounting hardware.
- .11 Support every outlet box, junction box, panel tub, etc. independent of conduits running to it.
- .12 Surface mounted distribution and control equipment shall be mounted square and level on flame retardant backboard.

### 3.2 NAMEPLATES AND LABELS

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

### 3.3 CONDUIT AND CABLE INSTALLATION

- .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 50mm (2"). All holes through concrete or steel structural members shall be approved by the Structural Consultant.
- .3 Install cables, conduits and fittings close to building structure so furring can be kept to minimum.

### 3.4 EQUIPMENT MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless indicated otherwise. Verify unspecified heights and dimensioned locations before installation.
- .2 Install switches, devices, etc. on one common centre line when shown on the drawings in a grouping.
- .3 The top of recessed boxes to be mounted even with the nearest top of block. Alternatively, the bottom of recessed boxes may be mounted even with the nearest bottom of block.
- .4 Generally install electrical equipment at following heights unless indicated otherwise on drawings:
  - .1 Light switches in public spaces: 1200mm (47").
  - .2 Panelboards and battery enclosures: as required by Code or as indicated (Maximum circuit breaker height 1700mm (67")).

### 3.5 CLEAN-UP

- .1 Continuously remove surplus and waste material generated by the electrical work.
- .2 Clean all supplied equipment and material of dirt, dust and stray paint, immediately prior to final acceptance of the work.
- .3 Remove tools, surplus material, scrap and debris (resulting from the work of this Division) on completion of the Contract.
- .4 Clean and touch-up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .5 Clean, prime and paint exposed non-galvanized hangers, racks and fastenings to prevent corrosion.

### 3.6 CO-ORDINATION OF PROTECTIVE DEVICES

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

### 3.7 TESTING

- .1 Furnish labour, materials, and instruments and bear other costs in connection with all tests, including third party and factory tests, obtain required certificates of approval, acceptance, and compliance with regulations of agencies having jurisdiction and as specified.
- .2 Confirm proper operation of each piece of equipment and system for correct function.
- .3 Measure amperage readings of each phase at service entrance switchboard and on each panel/equipment feeder. Ensure phase imbalance does not exceed 10% at operating load conditions. Adjust loads as required.
- .4 Megger test all DC and AC feeders prior to energizing; submit test results in Operating & Maintenance Manuals. Provide insulation resistance testing on service entrance cables, panel feeders and feeders to major equipment. Testing to be completed as follows:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

**Note: Check resistance to ground and conductor to conductor resistance for conductors in the same conduit before energizing.**

- .5 Measure DC and AC voltages at feeder supply connections and AC voltages at load connections. Measurements to be taken under normal operating conditions. Submit test results in Operating & Maintenance Manuals.
- .6 Confirm continuity of metal raceways where raceway is used in lieu of a bonding conductor.

### **3.8 INSPECTIONS**

- .1 Inform the Consultant in writing a minimum of 3 working days prior to any test of any system.
- .2 All work and materials covered by these Specifications shall be subject to inspection at any time by the Consultant.
- .3 If the Consultant finds that any material or workmanship does not conform to these specifications undertake to correct such workmanship within 5 days of notification by the Consultant.
- .4 Work shall not be deemed complete and Certificate of Substantial Performance will not be issued, until all indicated certificates of approval, test results and/or verifications have been delivered to the Consultant.
- .5 Notify the Consultant when the final inspection of the work shall be performed. Defects or deficiencies found during this inspection shall be corrected to the satisfaction of the Consultant before final payment is made.

**END OF SECTION**

1 General

**1.1 GENERAL**

.1 All conditions of the Contract apply to the work of this Section.

**1.2 RELATED WORK**

.1 General Electrical Requirements, Section 260500.

**1.3 REFERENCES**

- .1 CSA C22.2 No. 41 Grounding and Bonding Equipment
- .2 CSA C22.2 No. 38 Thermoset Insulated Wires and Cables.
- .3 CSA C22.2 No. 51 Armoured Cables.
- .4 CSA C22.2 No. 52 Underground Secondary and Service- Entrance Cables.
- .5 CSA C22.2 No. 75 Thermoplastic-Insulated Wires and Cables.
- .6 CSA C22.2 No. 83.1 Electrical Metallic Tubing - Steel.
- .7 CSA C22.2 No. 211.1 Rigid Types EB1 and DB2/ES2 PVC Conduit.
- .8 CSA C22.2 No. 211.2 Rigid PVC Conduit.
- .9 CSA C22.2 No. 45.1 Electrical Rigid Metal Conduit – Steel
- .10 CSA C22.2 No. 45.2 Electrical Rigid Metal Conduit – Aluminum, Red Brass & Stainless Steel
- .11 CSA C22.2 No. 56 Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
- .12 CSA C68.3 Power Cables with Thermoset Insulation.
- .13 CSA C22.2 No. 85 Rigid PVC Boxes and Fittings.
- .14 CSA C22.2 No. 18.1 Metallic Outlet Boxes
- .15 CSA C22.2 No. 18.2 Non-Metallic Outlet Boxes
- .16 CSA C22.2 No. 18.3 Conduit, Tubing and Cable Fittings
- .17 CSA C22.2 No. 18.4 Hardware for the Support of Conduit, Tubing and Cable
- .18 CSA C22.2 No. 40 Cutout, Junction and Pull Boxes.
- .19 CSA C22.2 No. 65 Wire Connectors.
- .20 CSA C22.2 No. 14 Industrial Control Equipment.
- .21 CSA C22.2 No. 177 Clock-Operated Switches
- .22 CSA C22.2 No. 42 General Use Receptacles, Attachment Plugs, and Similar Wiring Devices
- .23 CSA C22.2 No. 42.1 Cover Plates for Flush Mounted Wiring Devices
- .24 C22.2 NO. 182.1 Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type
- .25 C22.2 NO. 182.2 Industrial Locking Type, Special Use Attachment Plugs, Receptacles and Connectors
- .26 C22.2 NO. 182.3 Special Use Attachment Plugs, Receptacles and Connectors
- .27 CSA C22.2 No. 4 Enclosed and Dead-Front Switches
- .28 CSA C22.2 No. 111 General Use Snap Switches
- .29 CSA C22.2 No. 55 Special Use Switches
- .30 CSA C22.2 No. 106 HRC Miscellaneous Fuses
- .31 CSA C22.2 No. 248 Low-Voltage Fuses

## 1.4 SCOPE

- .1 Provide wiring and equipment as detailed on the Contract drawings and specified herein.

## 1.5 SHOP DRAWINGS

- .1 Submit shop drawings for the equipment detailed within this specification section. Shop drawings shall be submitted in accordance with Section 260500 General Electrical Requirements and the requirements of Division.

## 2 Products

### 2.1 MATERIAL

- .1 All material shall be specification grade, where applicable, new and carry C.S.A. approval or special approval in accordance with the requirements of the Electrical Safety Authority.
- .2 Similar devices and items shall be from one manufacturer throughout the project.

### 2.2 WIRING

- .1 All conductors, unless specifically noted otherwise, shall be copper with 600 volt, x-link insulation. Temperature rating to be 90°C or as required by Code.
- .2 All conductors shall be colour coded consistent with the Ontario Electrical Safety Code.
- .3 Photovoltaic system DC wiring to be as shown on the drawings. AC system wiring to be as indicated below.
- .4 Conductors up to and including # 10 may be solid copper. Larger conductors shall be stranded.
- .5 Branch circuit wiring shall be #12 AWG minimum. For circuit (15Amp, 120VAC) lengths exceeding 30m (100') minimum size shall be #10 AWG and for circuit lengths exceeding 45m (150') minimum size shall be #8AWG. Size wiring to maintain a maximum of 2% voltage drop.
- .6 Control wiring to be #16 AWG minimum. Size wiring to maintain a maximum of 2% voltage drop.
- .7 Wiring in dry locations shall be: R90 or RW90 installed in EMT conduit (unless noted otherwise).
- .8 Wiring in damp locations shall be: RW90 in conduit (conduit type as noted on drawings).
- .9 Underground solar service entrance wiring shall be RPVU90 in PVC duct or conduit.
- .10 Armoured cable (AC90) shall be permitted for exposed wiring in dry locations only.
- .11 All feeders shall be run in continuous length between power supply point and the load with no splices.
- .12 Do not share neutrals between lighting circuits.
- .13 Sleeve and seal wiring and conduit penetrations through walls and floors per Ontario Building Code requirements.

### 2.3 CONDUIT

- .1 EMT conduit shall be utilized for typical wiring where noted on the drawings. Conduit to be concealed wherever possible.
- .2 Where conduit is surface mounted and subject to mechanical damage, use rigid galvanized steel threaded conduit to a minimum of 2.4m (8') above finished floor level. Use electrical metallic tubing (EMT) above 2.4m (8').
- .3 Direct buried conduit shall be rigid PVC conduit with bond, as permitted by Code.
- .4 Seal tight (flexible, PVC jacketed, metallic) conduit shall be used when indicated on drawings; minimize length of runs where possible.
- .5 Concrete encased conduit shall be PVC type DB2 duct with bond wire, as permitted by Code. The minimum cover to concrete surface shall be 50 mm.

- .6 For damp/wet locations, minimum conduit size for lighting and power circuits shall be 21 mm (3/4") unless otherwise stated. All buried conduit or conduit embedded in concrete shall be minimum 27 mm diameter.
- .7 Provide all pull boxes, junction boxes, terminal boxes, fittings, drains, plugs, cover plates, bushings, clips, rods and accessories as required and appropriate.
- .8 EMT conduit connectors to be c/w steel set screw.
- .9 Where the potential for box submergence exists, the box is to have a submersible rating with all fittings designed and installed to prevent the entry of water.
- .10 Supports for conduit, cable or equipment shall be corrosion resistant (PVC coated hot dipped galvanized steel or equivalent).

## 2.4 WIRING DEVICES AND COVERPLATES

- .1 General
  - .1 Colour of devices and cover plates (other than stainless) to be confirmed by Consultant.
  - .2 Acceptable Manufacturers: Hubbell, Bryant, Pass & Seymour, Leviton.
  - .3 All devices to be of the same manufacturer throughout.
- .2 Switches
  - .1 Digital manually operated lighting switches, integral part of Hubbell Lighting Control System. Refer to 26 09 24 - Lighting Control Devices.
- .3 Coverplates
  - .1 Cover plates shall be from one manufacturer throughout project.
  - .2 Stainless steel (302/302), smooth cover plates, for wiring devices mounted in flush-mounted outlet box.
  - .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
  - .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

## 2.5 OUTLET & CONDUIT BOXES

- .1 General
  - .1 Gang boxes where wiring devices are grouped.
  - .2 Provide blank cover plates for boxes which are roughed in only. Cover plate style as detailed above.
  - .3 Provide combination boxes with barriers where outlets for more than one system are grouped.
- .2 Galvanized Steel Outlet Boxes
  - .1 One-piece electro-galvanized construction.
  - .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38mm (3" x 2" x 1½") or as indicated. 102mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
  - .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48mm (4" x 2" x 2").
  - .4 102mm (4") square or octagonal outlet boxes for lighting fixture outlets.
  - .5 Extension and plaster rings for flush mounting devices in finished tile walls.
- .3 Masonry Boxes

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.
- .4 Concrete Boxes
  - .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
- .5 Conduit Boxes
  - .1 Where subject to mechanical damage (or as noted on drawings) provide cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

## 2.6 GROUND & BONDING

- .1 Provide all grounding to the authorities' approval. Use approved connection methods (thermal weld or compression). Provide appropriate mechanical protection for all ground wire.
- .2 Provide appropriately sized ground or bond wire in all conduit systems; including EMT, steel and PVC types.
- .3 Install copper clad steel ground plates and make grounding connections at electrical service entrance as indicated on the drawings.
- .4 Engage the services of an independent contractor to undertake a ground resistance measurement on the grounding system prior to termination and backfill. A log of measurements shall be provided. Notify the Engineer if the resistance of any ground plate is greater than 5 ohms.
- .5 Bond all copper and metal plumbing pipes to ground.

## 2.7 JUNCTION & PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25mm (1") minimum extension all around
- .3 Covers Surface Mounted: screw-on flat steel covers.

## 2.8 SUPPORTING DEVICES

- .1 Every conduit or cable shall have at least one support. Only approved conduit supports will be accepted. Perforated pipe straps, tie wrap or wood support for conduits or outlet boxes etc., will not be accepted.
- .2 Single conduit runs: Galvanized conduit straps, ring bolt type hangers or P.V.C. saddles.
- .3 Horizontal multiple raceways runs: Conduit rack with minimum 25 percent spare capacity. Trapeze style hanger on threaded rod.
- .4 Vertical multiple raceway runs: Electrical strut fastened to structure.
- .5 Strut Channels and Components
  - .1 General: Strut shall be 1-5/8 inches wide in varying heights and welded combinations as required to meet load capacities and designs indicated on the drawings.
  - .2 Materials and Finish: Hot-dip Galvanized Steel.
    - .1 Strut shall be manufactured from steel and hot-dip galvanized after fabrication.
    - .2 Fittings shall be manufactured from steel and hot-dip galvanized after fabrication.
    - .3 All hardware shall be stainless steel Type 304 or chromium zinc ASTM F1136 Gr. 3.
  - .3 Acceptable Manufacturers: Cooper B-Line, Thomas & Betts

## 2.9 ACCESS DOORS

- .1 Provide access doors in walls and ceilings to service electrical equipment and concealed devices requiring access. Positive latch system. Minimum 18 gauge steel.
- .2 Group devices to minimize doors. Access doors in fire separations are to be ULC labelled. Doors shall match finish and be flush with surface.
- .3 All sizes and locations of doors shall be approved in writing by the Owner and or Engineer before installation.
- .4 Provide hinged doors for all access panels with a size of 450 x 450 (18" x 18") or larger.

## 2.10 CUTTING & PATCHING

- .1 At all penetrations of the roof, walls and floors and/or as indicated on the Contract Drawings provide Portals Plus Alumi-Flash, Pipe Portal, Pipe Boots and Quadraseals or Portals Plus Retrofit as manufactured by Portals Plus, Inc. and distributed by D.E.L. Roofing Equipment, 905 856 0333. Seals shall be installed to the manufacturer's recommendations, instructions and to the satisfaction of the Engineer.
- .2 Cut and patch holes located incorrectly.
- .3 Pneumatic hammers, drills, or explosive fasteners shall not be used without prior written approval from the Owner and/or Consultant.
- .4 Openings on all electrical metal boxes shall be punched or cut.

## 2.11 DISCONNECT SWITCHES

- .1 Disconnect switches shall be fusible or non-fusible as required. Refer to drawings for details regarding type of switch, voltage, amperage/HP, etc. Switches shall be supplied complete with the following features:
  - .2 CSA approved.
  - .3 Horsepower rated.
  - .4 Provision for padlocking in on or off switch position.
  - .5 Quick-make, quick-break action. 100% load make / load break rated.
  - .6 ON-OFF switch position indication on switch enclosure cover.
  - .7 Mechanically interlocked door to prevent opening when handle in ON position.
  - .8 Suitable for service entrance use
  - .9 Fuseholders for type and size of fuse indicated. Provide fuses for each fused disconnect switch and three spare fuses for each size/type of fuse specified on project.
  - .10 CSA Enclosure type 1. Where indicated as 'Weatherproof' provide CSA Enclosure type 3R.
  - .11 All materials of similar type shall be of one manufacturer. Acceptable Manufacturers: Hubbell, Bryant, Cutler Hammer, Schneider Electric, Siemens.

## 2.12 FUSES

- .1 HRC fuses rated 200 amperes and smaller shall be CSA certified HRCI-J fuses of the type(s) specified below.
- .2 Fuse interrupting rating shall be 200,000A RMS symmetrical, unless otherwise noted.
- .3 Provide two spare fuses of each type and size installed. Provide spare fuse storage cabinet.
- .4 Select fuses to provide a fully co-ordinated system for both overload and short circuit fault conditions.
- .5 Manufacturers: Cooper/Bussman, Mersen/Ferraz Shawmut/Gould, Littelfuse.

3 Execution

**3.1 GENERAL**

- .1 Verify all wall and partition locations, door swings, light switch and other device locations.
- .2 Install all equipment according to manufacturer's recommendations with adequate access and clearances.
- .3 Provide acceptable painted metal shroud over cables and conduits around exterior or public areas to prevent climbing, as required.
- .4 Install all equipment according to manufacturer's recommendations with adequate access and clearances.
- .5 All wiring to light switches to be added to finished existing walls shall be concealed if possible. At tender specify where surface equipment and conduits are proposed to be installed.
- .6 Correct improperly installed work as directed by the Consultant or authorized inspector.

**3.2 SHORT CIRCUIT COORDINATION**

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

**3.3 WIRING**

- .1 Armoured cable (AC90) is acceptable in dry locations. Use EMT conduit otherwise. Minimum lengths of armoured cable may be used in furred ceilings, hollow partitions and hollow walls. EMT only in masonry walls unless otherwise approved. No AC90 may lay on or clip to ceiling tiles. Provide OESC compliant supporting means.
- .2 Conductor length for parallel feeders to be identical.
- .3 Wire or cable used for feeders shall be free of splices.
- .4 Systems of different types and voltages (AC vs. DC) shall be installed in separate raceways.

**3.4 CONDUITS**

- .1 Provide and locate all sleeves required to pass wiring through building walls and floors and ceilings. Fill voids between conduits and sleeves with material and caulking sealant to suit application and fire rating.
- .2 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .3 Co-ordinate with all trades to locate conduits in slabs, as required, before concrete pouring, record routing on prints.
- .4 Co-ordinate and record exact routing of underground ducts and conduits. Establish elevation of ducts, schedule of work before installation.
- .5 Supply and install expansion couplings where conduits cross construction joints.
- .6 Install conduits on surface at lower trough of roof decking.
- .7 All conduit and wiring within the building (when applicable) shall be run neatly and parallel to the building structure, above finished ceilings, within finished walls or below the floor. Conceal conduits as much as practical. It shall be supported from the building structure. Minimize horizontal runs along walls. Nails or tie wires are not acceptable. Do not caddy clip to ceiling hangers.
- .8 Provide fish wire in all empty conduits.

**3.5 WIRING DEVICES**

- .1 Switches:
  - .1 Digital switches shall communicate with Hubbell room controllers.

- .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .3 Mount switches at height in accordance with Section 260500 General Electrical Requirements unless noted otherwise.
- .2 Cover plates:
  - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

### 3.6 OUTLET AND CONDUIT BOXES

- .1 Gang power outlets using gang boxes as applicable..
- .2 Mount all boxes, plumbed-true on vertical installations. Mount level on horizontal installations.
- .3 In finished areas, all boxes to be installed flush mounted.
- .4 All boxes to be supported independent of conduits or cables.
- .5 Openings in all boxes shall be punched or cut, no burning of holes allowed.
- .6 Fill all K.O. openings not used with proper filler plates.
- .7 Door swings are to be determined from the Architectural drawings for switch locations.
- .8 A variation of location of 3 m (10') shall be provided without cost to the Owner if requested before installation of equipment.

### 3.7 GROUNDING AND BONDING

- .1 Install complete permanent, continuous grounding and bonding system including, ground plates, conductors, connectors, accessories. Where EMT is used, run bond wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process, permanent mechanical connectors or inspectable wrought copper compression connectors.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Make bonding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .11 Equipment Grounding
  - .1 Install grounding connection to service entrance equipment. Provide bonding connections to typical equipment included in, but not necessarily limited to following list:
    - .1 Duct systems, enclosures, exhaust fans, control panels, distribution panels, indoor/outdoor lighting fixtures and in general all metallic surfaces that may become energized by accidental contact with faulty wiring.

- .2 Mechanical plumbing pipes (copper or steel).

### **3.8 JUNCTION AND PULL BOXES**

- .1 Install junction and pull junction boxes so they are supported independent of raceways.
- .2 Install pull boxes after every 30 m (100') of continuous raceway.
- .3 Locate pull boxes above accessible ceiling spaces in inconspicuous locations wherever possible.
- .4 Colour code pull boxes to indicate system involved.

### **3.9 CABINETS**

- .1 Mount all surface mounted equipment enclosures on an approved fire rated backing or unistrut channels.
- .2 All recessed enclosures shall have trim for recessed mounting.
- .3 Enclosures mounted in finished areas shall be finished to match.
- .4 Terminate wiring in screw type terminal blocks or strips.

### **3.10 SUPPORTING DEVICES**

- .1 Install supporting devices to maintain headroom and clearances as described for conduits and conductors.
- .2 Maintain a neat appearance and follow building lines where possible.

### **3.11 ACCESS DOORS**

- .1 Provide access panels where required for electrical equipment concealed in walls, partitions or floors. Location and type of access panels shall be to the Consultant's approval.
- .2 Paint access panels to match surrounding decor or as directed by the Consultant on site.
- .3 Keep access doors to a minimum by locating equipment in easily accessible locations.

### **3.12 EXHAUST FAN CONTROLS**

- .1 Install exhaust fan control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses are installed in starters.
- .4 Confirm motor nameplate and adjust overload devices to suit.

### **3.13 DISCONNECT SWITCHES**

- .1 Label each disconnect switch to indicate the device it controls.
- .2 Provide a separate self-supporting structure to support the disconnect device where the equipment or adjacent walls are not capable of supporting the device.
- .3 Install fuses in fused disconnect switches as detailed on drawings.

### **3.14 FUSES**

- .1 Ship fuses in original containers
- .2 Do not ship equipment with fuses installed.
- .3 Store spare fuses in original containers in fuse storage cabinet. Install fuse storage cabinet in electrical room.
- .4 Install fuses in mounting devices immediately before energizing circuit.
- .5 Prior to energization of any circuit, verify that the correct fuse is installed:
  - .1 for the calculated or assumed circuit capacity, and
  - .2 for the proper equipment and conductor protection requirements.

END OF SECTION

- 1 General
  - 1.1 GENERAL**
    - .1 All conditions of the Contract apply to the work of this Section
  - 1.2 RELATED WORK**
    - .1 General Electrical Requirements - Section 26 05 00.
  - 1.3 SCOPE**
    - .1 Labour, products, equipment and services necessary to complete the work of this Section.
  - 1.4 SHOP DRAWINGS**
    - .1 Submit shop drawings in accordance with Section 26 05 00, General Electrical Requirements and the requirements of Division 1.
- 2 Products
  - 2.1 GROUND CONDUCTORS**
    - .1 Copper conductors, soft drawn, ASTM Class B stranded.
    - .2 Insulated or bare conductors. Insulation colour green.
  - 2.2 BURIED CONNECTORS - COMPRESSION TYPE**
    - .1 Cable to rod and cable to cable.
    - .2 Acceptable Manufacturers:
      - .1 Burndy type YGHR (cable to rod) and type YGHC (cable to cable)
  - 2.3 CONNECTIONS TO STRUCTURAL STEEL**
    - .1 Exothermic connection or compression ground connector.
    - .2 Acceptable Manufacturers:
      - .1 Erico (exothermic)
      - .2 Burndy Groundlink type YGIB and cable connector
  - 2.4 MISCELLANEOUS HARDWARE**
    - .1 Galvanized steel ground studs, bolts, washers, nuts and accessories necessary for grounding system, including but not limited to:
      - .1 Grounding and bonding bushings
      - .2 Bolt type conductor connectors
      - .3 Bonding jumpers, straps
      - .4 Pressure type wire connectors
    - .2 Acceptable Manufacturers:
      - .1 Burndy
      - .2 T & B Blackburn
  - 2.5 GROUND PLATES**
    - .1 Copper-clad steel, minimum 315 x 250 / 3mm.
    - .2 Acceptable Manufacturers:
      - .1 Hydrel

.2 T & B Blackburn

## 2.6 GROUND BUS

- .1 Ground bus: copper, 50 mm x 6 mm thick complete with insulated supports, fastenings, connectors, length as indicated.

## 2.7 ALUMINUM STRUCTURES AND EQUIPMENT

- .1 Use tin or silver plated connectors for grounding connections to aluminum structures and equipment.
- .2 Acceptable Manufacturers:
  - .1 Burndy
  - .2 Thomas & Betts

## 3 Execution

### 3.1 GENERAL

- .1 Clean all paint, rust and dirt from all surfaces to which ground lugs are bolted.
- .2 Protect exposed grounding conductors from mechanical damage.
- .3 Ensure that molds, for exothermic type connections, are not used for more than 50 connections.
- .4 At junction and terminal boxes, bond grounding conductors to ground stud.
- .5 Supply bonding conductor to the main water supply pipe on the street side of main water valve and meter using plated copper ground strap bolted to pipe flange or welded bracket.
- .6 Bond solar power pole and pole base structural steel elements to ground.

### 3.2 BURIED GROUNDING

- .1 For buried grounding use compression connection types.

### 3.3 CABLES

- .1 Bond single conductor cable armour to equipment enclosure at supply end.
- .2 Bond multiconductor cable armour to equipment enclosures.
- .3 Bond grounding conductor of multiconductor armoured and non-armoured cable to ground bus or lug in equipment enclosures.

### 3.4 RACEWAYS

- .1 On raceways, lock-up tight all couplers and connections to boxes and enclosures. Install bonding jumpers at expansion joints, and where necessary. Maintain ground continuity throughout run of raceway.
- .2 Install bonding jumpers on both ends of flexible conduit. Use grounding bushing, solderless lug, clamp or cup washer and screw connection. Install grounding conductor inside flexible conduit.
- .3 EMT and non-metallic raceways: install insulated grounding conductor in raceway.
- .4 Branch and feeder circuits in rigid conduit: use raceway as bonding conductor.

### 3.5 TESTING

- .1 Refer to Section 26 05 05 section 2.6 subsection 4 for details on grounding tests.

**END OF SECTION**

1 General

1.1 GENERAL

- .1 All conditions of the Contract apply to the work of this Section.

1.2 RELATED WORK

- .1 General Work – Division 01.  
.2 Concrete – Division 03.  
.3 General Electrical Requirements - Section 26 05 00.

1.3 REFERENCES

- .1 Ontario Electrical Safety Code.  
.2 Photovoltaic System Specification Sheets and Documentation as provided by manufacturers.

1.4 SCOPE

- .1 Provide installation of all power poles, duct bank excavation, fill, and backfill, including repair/restoration of existing surfaces (i.e. pavement, sod, concrete, etc.), as required for the installation of photovoltaic system service, as outlined on the drawings.  
.2 Provide underground ducts, duct banks, pulling pits and cables as detailed on drawings.  
.3 Provide supply and installation of a 3.2 kW photovoltaic system.  
.4 Photovoltaic solar system is based on Franken Solar supplied equipment. Major components consist of:  
.1 Hanwha Q-Peak 60 cell solar panels;  
.2 Schneider Conext control system;  
.3 Trojan AGM batteries, 24Vdc-120Ah;

**Alexander Wolf**  
Solar System Specialist  
**Franken Solar Americas Inc.**  
165 Sun Pac Blvd., Unit 3  
Brampton, Ontario, L6S 5Z6  
Ph: +1 289-276-5279  
Cell: +1 647-924-8881  
**alexander.wolf@frankensolar.ca**

- .5 Provide photovoltaic solar system wiring and interconnections per photovoltaic system/component manufacturer's specifications and installation manuals.

1.5 SHOP DRAWINGS AND SUBMITTALS

- .1 Submit shop drawings in accordance with Section 26 05 00 General Electrical Requirements and the requirements of Division 01. In addition to Division 01 requirements, the solar system electrical and structural components shall further meet the following requirements:  
.2 Solar System Product Data:  
.1 Provide manufacturer's printed product literature, specifications and data sheets.  
.2 Provide manufacturer's printed literature, specifications and data sheets for structural poles and support frame structures.  
.3 Manufacturer's Instructions:

.1 Provide manufacturer's installation instructions.

.4 Shop Drawings:

.1 Provide photovoltaic system electrical shop drawings stamped and signed by a professional electrical engineer registered or licensed in Province of Ontario, Canada.

.2 Provide photovoltaic support system (poles, frame structures, support assembly) shop drawings stamped and signed by a professional structural engineer registered or licensed in Province of Ontario, Canada.

2 Products

### 2.1 MATERIAL

.1 All material shall be specification grade, new and carry CSA approval.

.2 All ducts, cables and miscellaneous materials required shall be the responsibility of this contractor.

.3 All photovoltaic system components, inclusive of power poles, solar panels, battery enclosures, inverters will be CSA and UL listed. Installation, wiring and final connections shall be the responsibility of this contractor.

3 Execution

### 3.1 GENERAL

.1 Coordinate work with photovoltaic supplier; obtain underground service locates prior to start of work.

.2 Seal and drain all underground ducts in accordance with Section 22 of the Ontario Electrical Safety Code.

.3 Use bell ends at duct terminations.

.4 Unless noted otherwise on drawings:

.1 All underground ducts shall be surrounded in 6" (150 mm) of sand in non-vehicular areas.

.2 All underground ducts shall be encased 75mm (3") of concrete where ducts pass under vehicular areas.

### 3.2 TRENCHING

.1 The width and depth of the trench shall be such as to allow room for a 75 mm sand or concrete envelope (as required) around the duct bank and allow sufficient cover.

.2 The bottom of the trench must be graded evenly and the soil in the bottom of the trench must be undisturbed. Overbreak must be filled with compacted granular material or concrete. Ensure that no water traps are formed in individual ducts.

.3 Ensure that the ducts are properly plugged prior to backfilling or concrete encasement.

### 3.3 DIRECT BURIAL OF CABLES

.1 After sand bed is in place, lay cables maintaining 75mm (3") clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150mm (6") for each 60m (200') run, maintaining minimum cable separation and bending radius requirements.

.3 Underground cable splices are not acceptable.

.4 Cable separation:

.1 Maintain 75mm (3") minimum separation between cables of different circuits.

.2 Maintain 305mm (12") horizontal separation between low and high voltage cables.

- .3 When low voltage cables cross high voltage cables maintain 305mm (12") vertical separation with low voltage cables in upper position.
- .4 Maintain 305mm (12") minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
- .5 Install treated planks on lower cables 610mm (2') in each direction at crossings.

### 3.4 CLEANING DUCTS

- .1 Clean completed duct runs by pulling an approved cleaning device through the ducts by means of a winch line. Tail the cleaning device with a second winch line to permit withdrawal in case of blockage. Clean the ducts in the presence of Consultant or authorized representative.
- .2 Provide a polypropylene rope 6 mm in diameter in each duct for future pulling of cables.
- .3 At ends of the ductbank plug the ducts and mark the duct bank location.

### 3.5 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

### 3.6 MARKERS

- .1 Install marking tape (4-mil polyethylene) buried approximately halfway between grade level and the ducts/cables. Marking tape shall be installed over the complete width and length of duct/cable run.

### 3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 General Electrical Requirements.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation of service entrance cables and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
- .5 After installing cable but before terminating, perform insulation resistance test with 1000V megger on each phase conductor.
- .6 Resistance to ground of circuits shall be not less than 50 megaohms. Remove and replace entire length of cable if cable fails to meet test criteria.

**END OF SECTION**

1 General

**1.1 GENERAL**

- .1 All conditions of the Contract apply to the work of this Section.

**1.2 RELATED WORK**

- .1 General Electrical Requirements - Section 26 05 00
- .2 Basic Materials and Methods – Section 26 05 05
- .3 Lighting – Section 26 50 00

**1.3 REFERENCES**

- .1 American National Standards / Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
- .2 Underwriter Laboratories of Canada (ULC)
- .3 International Electro-technical Commission
- .4 International Organization for Standardization (ISO)
- .5 National Electrical Manufacturers Association (NEMA)
- .6 WD1 (R2005) - General Color Requirements for Wiring Devices.
- .7 Underwriters Laboratories, Inc. (UL)
  - .1 916 – Energy Management Equipment.
  - .2 924 – Emergency Lighting

**1.4 SYSTEM DESCRIPTION**

- .1 The Lighting Control and Automation system as defined under this section covers the following equipment:
  - .2 Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay controllers with 0-10 volt dimming control for LED drivers and single relay application-specific plug load controllers.
  - .3 Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors.
  - .4 Digital Switches – Self-configuring, digitally addressable pushbutton switches.
  - .5 Digital Photosensors – Single-zone closed loop daylighting sensors. Sensors can provide switching or proportional dimming control for daylight harvesting.
  - .6 Digital Plug Load Controllers – Self-Configuring, digitally addressable one relay controllers, specifically designed and cUL listed for use as a plug load control device.
  - .7 Configuration Tools – Bluetooth Radio Modules and Smartphone App.
  - .8 NX Distributed Intelligence local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.

**1.5 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 26 05 00 General Electrical Requirements and the requirements of Division 1.
- .2 Shop drawing submission shall include:
  - .1 Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).

- .2 Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.
- .3 Product Data: Catalog sheets, specifications and installation instructions.
- .4 Include data for each device which:
  - .1 Indicates where sensor is proposed to be installed.
  - .2 Prove that the sensor is suitable for the proposed application.

## 1.6 WARRANTY

- .1 Provide a five year complete manufacturer's warranty on all products to be free of manufacturers' defects.

## 2 Products

### 2.1 MANUFACTURERS

- .1 The basis of design for the lighting controls is Hubbell Controls NX Distributed Intelligence system.
- .2 Alternate Manufacturers  

Any proposed substitutions shall be submitted in writing a minimum of 5 working days prior to the tender closing date for review by the consultant. Proposed alternate products must be accompanied by a review of the specification noting compliance on a line-by-line basis. Alternate systems shall not be supplied and/or installed without written acceptance by the Consultant.
- .3 The Contractor shall accept responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The Contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted in an alternate color to the Consultant for review and approval prior to rough-in.

### 2.2 DIGITAL WALL SWITCHES

- .1 Low voltage momentary pushbutton switches in 1 or 2 button configurations; available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening.
- .2 Wall switches shall include the following features:
  - .1 All switches mount to standard single or multi-gang wall boxes.
  - .2 Plug and play integration with NX Room Controller.
  - .3 Low voltage device: 24VDC.
  - .4 Delivers simplified configuration and control of Hubbell Lighting luminaires using SpectraSync™ color tuning technology.
  - .5 Type NX-OO: Manual-ON, Manual-OFF

### 2.3 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

- .1 Wall or ceiling mounted (to suit installation) dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.
- .2 Features include the following:
  - .1 IntelliDAPT self-adaptive technology – no manual adjustment required.
  - .2 Occupancy or vacancy operation selectable per load when used with the NX Room Controller
  - .3 All-digital sensor
  - .4 Non-volatile memory for sensor settings

- .5 500 to 2,000 square-foot coverage area (based on model)
- .6 Plug and play integration with NX Room Controller
- .7 UL and cUL listed
- .8 Low voltage device: 24 VDC
- .9 Type NX-OS-OM-DT-R

## 2.4 DAYLIGHT SENSORS

- .1 Daylight Sensors provide the necessary daylight-level information to the NX local network. Using a photodiode element, the daylight sensor continuously measures daylight levels and sends the information to the network devices which then perform daylight switching or dimming functionality based on the amount of natural light in the area.
- .2 Features include the following:
  - .1 Open loop operation.
  - .2 Foot-candle range: 3-6,000fc.
  - .3 Mounts vertically or horizontally.
  - .4 Color coded, plug-and-play integration with NX Room Controller.
  - .5 UL and cUL listed.
  - .6 Type NXDS

## 2.5 DIMMING ROOM CONTROLLERS

- .1 Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration.
- .2 The control units will include the following features:
  - .1 Single or dual relay versions for On/Off or High/Low control.
  - .2 Suitable for use with controlled receptacles.
  - .3 Optional interface for full range dimming control.
  - .4 Override push button and status LED per relay/dimmer.
  - .5 Auto configuration support for NX Occupancy Sensors, Daylight Sensors and Smart Switch Stations.
  - .6 Advanced configuration with NXBTR Bluetooth® Radio Module and smart phone App.
  - .7 Device intelligently and automatically responds to sensors and switches in the most energy- efficient manner.
  - .8 Join NX Room Controllers with CAT5 for additional loads.
  - .9 Schedules are held in the devices themselves (requires optional network connection).
  - .10 Retains data during power outages.
  - .11 Integral real time power monitoring, reports voltage and wattage.
  - .12 120-277VAC and 347VAC models
  - .13 Delivers simplified configuration and control of Hubbell Lighting luminaires using SpectraSync™ color tuning technology
  - .14 Type NXRC-1RD/2RD-UNV

## 2.6 DIGITAL DRY CONTACT OUTPUT MODULE

- .1 The Hubbell Control Solutions NXDCO Dry Contact Output Module allows a NX room controller application to control third party devices through simple dry contact closure.
- .2 The NXDCO can be connected directly to any NX SmartPORT™ or can be daisy chained with other NX SmartPORT enabled devices.
- .3 The Dry Contact Form C relay can be programmed to logically follow a wide array of NX control functions such as occupancy sensors, pushbutton stations or schedules.
- .4 The NXDCO is the ideal solution for applications requiring control of third party devices such as HVAC, screen motors, curtain motors, or any other device that can be controlled by a simple contact closure.
- .5 Type NXDCO

## 2.7 REMOTE CONTROL MODULE

- .1 The NXBTR Bluetooth® Radio Module provides a wireless communication bridge for communication via iOS® or Android™ smart device Apps.
- .2 The compact module connects to and is powered by an NX SmartPORT™.
- .3 The NXBTR uses Bluetooth technology allowing the radio to easily pair with the smart phone when placed in close proximity.
- .4 Communication with the NX system for setup and control requires installation of the NX iOS or Android App on the smart device.
- .5 Type NXBTR.

## 3 Execution

### 3.1 INSTALLATION

- .1 Do not install equipment until the following conditions can be maintained in spaces to receive equipment:
- .2 Ambient temperature: 0° to 40° C (32° to 104° F).
- .3 Relative humidity: Maximum 90 percent, non-condensing.
- .4 When using wire for connections other than manufacturer supplied Cat 5e with RJ-45 connectors, provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify termination requirements.
- .5 Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- .6 Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
- .7 Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.
- .8 Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
- .9 Sensor parameters, time delays, sensitivities, and daylighting setpoints.
- .10 Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
- .11 Load Parameters (e.g. blink warning, etc.)
- .12 Re-commissioning – After 30 days from occupancy re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Consultant / Owner of re-commissioning activity.

**3.2 FACTORY COMMISSIONING**

- .1 Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- .2 The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.
- .3 Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

**END OF SECTION**

1 General

**1.1 GENERAL**

.1 All conditions of the Contract apply to the work of this Section.

**1.2 RELATED WORK**

.1 General Electrical Requirements - Section 26 05 00.

**1.3 REFERENCES**

.1 CSA-C22.2 No. 5 - Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

.2 CSA C22.2 No.29 - Panelboards and Enclosed Panelboards.

**1.4 SCOPE**

.1 Provide panelboards complete with moulded case circuit breakers and other accessories as detailed herein and on drawings.

.2 Minimum service entrance panel short circuit ratings to be 10kAIC fully rated. Secondary distribution panels to be 10kAIC, series rating acceptable provided panel and upstream breaker combination meet cUL testing requirements.

**1.5 SHOP DRAWINGS**

.1 Submit shop drawings in accordance with Section 26 05 00, General Electrical Requirements and the requirements of Division 1.

2 Products

**2.1 MATERIAL**

.1 All panelboards and moulded case circuit breakers shall be of one manufacturer. Acceptable Manufacturers: Cutler Hammer, Schneider Electric, Siemens.

.2 All material shall be specification grade, new and carry CSA approval or special inspection approval in accordance with the requirements of the Electrical Safety Authority.

**2.2 PANELBOARDS**

.1 Refer to drawings for specific details pertaining to panelboards: mains rating, voltage, main lug or main breaker, flush or surface mounting, number of circuits, and number and size of branch circuit breakers.

.2 Install circuit breakers in panelboards before shipment.

.3 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.4 120VAC panelboards: bus and circuit breakers rated for a minimum 10kA (rms symmetrical) interrupting capacity or as indicated in panel schedules.

.5 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.6 Provide two keys for each panelboard and key panelboards alike.

.7 Copper bus with neutral of same ampere rating as mains.

.8 Mains: suitable for bolt-on circuit breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: baked grey enamel.

### 2.3 MOULDED CASE CIRCUIT BREAKERS

- .1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 Circuit breakers for 120V panelboards to have minimum 10kA symmetrical rms interrupting capacity rating.
- .4 Where series rated circuit breakers are utilized, they shall be manufacturer tested and listed per cULus. Circuit breakers to be applied following manufacturer's guidelines and accepted best practice.
- .5 Circuit breakers shall have thermal and magnetic tripping except as indicated otherwise.
- .6 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

### 3 Execution

#### 3.1 PANELBOARDS

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on a common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 – General Electrical Requirements or as indicated.
- .4 Provide a spare 32mm (1¼ ") EMT raceway into accessible ceiling space from each recessed panel. Provide nylon pull string in raceway and cap open end.
- .5 Connect loads to circuits. Complete circuit directory with typewritten legend showing location and load of each circuit.
- .6 Provide EEMAC 12 enclosure for indoor panelboards.
- .7 Provide lamacoid nameplate mechanically fastened to identify each panel. Letter size to be as described in Section 26 05 00.

#### 3.2 CIRCUIT BREAKERS

- .1 Ensure all circuit breakers mounted in panelboard have the specified interrupting capacity required for that piece of equipment.

**END OF SECTION**

1 General

**1.1 GENERAL**

.1 All conditions of the Contract apply to the work of this Section.

**1.2 RELATED WORK**

.1 General Electrical Requirements - Section 26 05 00.

**1.3 REFERENCES**

.1 C22.2 No. 250.0 – Luminaires.

.2 C22.2 No. 9.0 - General Requirements for Luminaires.

**1.4 SCOPE**

.1 Provide lighting fixtures (luminaires) complete with LED light sources, drivers and accessories as detailed herein and in the lighting fixture schedule (on drawings).

**1.5 SHOP DRAWINGS**

.1 Submit shop drawings in accordance with Section 26 05 00, General Electrical Requirements and the requirements of Division 1.

**1.6 WARRANTY**

.1 All LED lighting fixtures shall be supplied with a minimum of five years' warranty.

2 Products

**2.1 MATERIAL**

.1 All material shall be specification grade, where applicable, new and carry CSA approval or special certification as per Electrical Safety Authority requirements.

.2 Similar devices and items shall be from one manufacturer throughout the project.

.3 LED light sources and integrated electronic drivers detailed in this specification are based on Hubbell Lighting. Alternate products will also be acceptable subject to equivalent performance, compatibility with lighting controls and conformance with the specifications.

.4 Refer to Lighting Fixture Schedule on drawings for details of fixtures to be supplied. Where alternate fixtures are proposed, provide submission prior to tender close in accordance with Section 26 05 00.

**2.2 LED LAMPS**

.1 Remote phosphor technology providing increased efficiency and color consistency. Color shift shall not exceed +/- 100K over life of lamp.

.2 Rated Life: Based on IESNA LM-80-2008  
50,000 hours at 70% lumen maintenance.

.3 LED drivers shall provide 0-10V dimming where required; refer to fixture schedule on drawings for fixtures to be dimmed.

.4 Warranty: 5 years

**2.3 FIXTURE CONSTRUCTION**

.1 All interior fixtures shall comply with CSA Standard C22.2 No.9, latest edition, complete with accessories and components, complying with relevant CSA standards applicable to accessory or component.

.2 Fixture lens, where specified, shall be flat and in hinged metal frame unless otherwise specified, made from clear acrylic lenses and shall be 100% virgin acrylic minimum 3.2mm (.125") thick.

- .3 Standard fixture colour shall be baked white enamel unless noted otherwise, which shall resist chipping, corrosion and discolouration. Before finishing all metal shall be chemically degreased and neutralized. Where custom fixture colours are required, colour shall be confirmed via shop drawing submission.
- .4 All fixtures shall be supplied with wire guards.
- .5 All fixtures shall be CSA approved and/or carry certification by a certifying organization recognized by the Electrical Safety Authority.

3 Execution

**3.1 INSTALLATION**

- .1 Co-ordinate fixture locations with other trades on site prior to rough in.
- .2 Install fixtures complete with all mounting hardware and trims for a neat, finished appearance.
- .3 Ensure that all fixtures installed in built-in enclosures can be serviced for drivers replacement.

**3.2 LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

**3.3 LUMINAIRE SUPPORTS**

- .1 General:
  - .1 Support fixtures as shown on the drawings, level, plumb and true with the structure and other equipment, and in a horizontal or vertical position as intended.
  - .2 Wall or side bracket mounted fixture housings shall be rigidly installed and adjusted to give a neat flush fit to the surface on which it is mounted.
  - .3 All hangers, supports, fastenings or accessory fittings shall be protected against corrosion. Care shall be taken during the installation to assure that insulation and corrosion protection is not damaged.
- .2 Supports:
  - .1 Self-alignment ball joint hangers shall be used for rod suspended fixtures, and ceiling canopies shall be fitted tightly to the ceiling without restricting the alignment of the hanger.
  - .2 Support fixtures by hangers and mounting arrangements which will not cause the fixture frame, housing, sides or lens frame to be distorted, or prevent complete alignment of several fixtures in a row.
  - .3 Mounting methods for fixtures on or in suspended ceilings are to be as follows:
    - .1 Where cross member supports are required above the ceiling to provide support points, these are to be steel channels or angles.
    - .2 Toggle bolts of the snap-on or spring-in type are not to be used through drywall, tile or similar type ceilings.
- .3 Suspension Length:
  - .1 The suspension length for all ceiling-mounted, suspended types of lighting fixtures, as listed in the Fixture Schedule, shall be the overall length from the ceiling to the lowest point of the fixture body, reflector, or glassware in its hanging position.
  - .2 The length of the stems or chain hangers of suspended fluorescent lighting fixtures shall be adjusted to hang all fixture bodies in the same room level and in the same horizontal plane, unless specifically required to be otherwise on the electrical drawings.

.4 Chain Hangers:

- .1 Where fixtures are specified to be chain hung, the chain used shall be No. 4 Tensile bright zinc coated with a strength of 181 kg. Attachments shall be made using No. 105 'S' hooks. Wires running down chain to fixture shall be run in flexible conduit and shall be attached to chain with cable clips.

**3.4 WIRING**

- .1 Connect luminaires to lighting circuits as detailed on drawings.  
.2 Refer to Section 26 05 05, Basic Materials and Methods for acceptable wiring methods.

**3.5 CLEANING**

- .1 Immediately prior to completion of project, provide a final cleaning of fixtures in accordance with Section 26 05 00 and Division 1.

**3.6 SPARE FIXTURES**

- .1 Supply the specified spare fixtures in labeled cartons, identifying wattage and fixture reference.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 35 43: Environmental Procedures
- .3 Section 01 55 26: Traffic Control
- .4 Section 01 56 00: Temporary Barriers and Enclosures
- .5 Section 01 74 00: Cleaning and Waste Management
- .6 Section 01 74 21: Construction Demolition Waste Management and Disposal

**1.2 REFERENCES**

- .1 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS 201 – Construction Specification for Clearing, Close Cut Clearing, Grubbing, and Removal of Surface and Piled Boulders

**1.3 DEFINITIONS**

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

**1.4 STORAGE AND PROTECTION**

- .1 Prevent damage to trees, natural features, bench marks, existing buildings, existing pavement, utility lines and any other feature which are to remain.
  - .1 Repair damaged items to approval of Parks Canada Representative and Consultant at no additional cost.
  - .2 Replace trees designated to remain, if damaged, as directed by Parks Canada Representative and Consultant.

**1.5 WASTE MANAGEMENT AND DISPOSAL**

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

2 Products

**Not Used**

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 and sediment and erosion control drawings.

- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 3.2 PREPARATION

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

### 3.3 CLEARING

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

### 3.4 CLOSE CUT CLEARING

- .1 Close cut clearing to ground level.
- .2 Cut off branches, down trees, and overhanging area cleared as directed by Parks Canada Departmental Representative and Consultant.

### 3.5 ISOLATED TREES

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

### 3.6 UNDERBRUSH CLEARING

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

### **3.7 GRUBBING**

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

### **3.8 REMOVAL AND DISPOSAL**

- .1 Remove cleared and grubbed materials off site as designated by Parks Canada Departmental Representative and Consultant.
- .2 Materials to be removed in accordance with 01 74 21 – Construction Demolition
- .3 Waste Management and Disposal.
- .4 Stockpile any materials designated to remain as directed by Parks Canada Departmental Representative and Consultant and in accordance with 01 74 21 – Construction Demolition
- .5 Waste Management and Disposal.

### **3.9 FINISHED SURFACE**

- .1 Leave ground surface in condition suitable for stripping of topsoil and organic surface material as required for grading operations to approval of Parks Canada Departmental Representative and Consultant.

### **3.10 CLEANING**

- .1 Proceed in accordance with Section 01 74 - Cleaning and Waste Management.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 29 83: Payment Procedures for Testing Laboratory Services
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 55 26: Traffic Control
- .5 Section 01 56 00: Temporary Barriers and Enclosures
- .6 Section 01 74 00: Cleaning and Waste Management
- .7 Section 01 74 21: Construction Demolition Waste Management and Disposal

**1.2 REFERENCE STANDARDS**

- .1 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS.MUNI 206 – Construction Specification for Grading.
  - .2 OPSS.MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material.

**1.3 EXISTING CONDITIONS**

- .1 Examine geotechnical investigation report which is appended to these specifications.
- .2 Contractor is to carefully examine site prior to commencing operations and to advise Parks Canada Departmental Representative and Consultant of any situations or unforeseen issues which may affect performance of work.

2 Products

**2.1 MATERIALS**

- .1 Fill material: Granular 'B' Type 2 in accordance with OPSS.MUNI 1010.
  - .1 Granular 'A' in accordance with OPSS.MUNI 1010.
- .2 Excavated or graded material existing on site suitable to use as fill for grading work if approved by Parks Canada Departmental Representative and Consultant.

3 Execution

**3.1 EXAMINATION**

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

**3.2 STRIPPING OF TOPSOIL AND ORGANIC MATERIAL**

- .1 Commence topsoil and organic stripping of areas as directed by Parks Canada Departmental Representative and Consultant after area has been cleared and grubbed.
- .2 Strip topsoil and organic material down to bedrock or competent substrate as approved by Parks Canada Departmental Representative and Consultant.

- .3 Stockpile in locations as directed by Parks Canada Departmental Representative and Consultant. Stockpile height not to exceed 2 m.
- .4 Dispose of unused topsoil and organic material off site Parks Canada Departmental Representative and Consultant.

### 3.3 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Rough grade to following depths below finish grades:
  - .1 240 mm below walkways and areas where precast paving units are to be installed.
- .3 Slope rough grade away from building 1:50 minimum and as directed by Parks Canada Departmental Representative and Consultant.
- .4 Grade ditches to depth as indicated.
- .5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground.
- .6 Compact filled and disturbed areas to maximum dry density to ASTM D698, as follows:
  - .1 85% under landscaped areas.
  - .2 95% under paved and walk areas.
- .7 Do not disturb soil within branch spread of trees or shrubs to remain.

### 3.4 TESTING

- .1 Inspection and testing of base and subbase compaction will be carried out by testing laboratory designated by Parks Canada Departmental Representative. Contractor to coordinate compaction testing. Costs of tests will be paid by Parks Canada in accordance with Sections 01 29 83- Payment Procedures for Testing Laboratory Services and 01 45 00- Quality Control.

### 3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Management.
- .3 Waste Management: separate waste materials for reuse in accordance with Section 01 74 21- Construction Demolition Waste Management and Disposal.

### 3.6 PROTECTION

- .1 Protect all existing trees, fencing, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain as directed by Parks Canada Departmental Representative and Consultant. If damaged, restore to original or better condition at no additional unless directed otherwise.
- .2 Maintain access roads to prevent accumulation of construction related debris on roads.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 33 00: Submittal Procedures
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 55 26: Traffic Control
- .5 Section 01 56 00: Temporary Barriers and Enclosures
- .6 Section 01 61 00: Common Product Requirements
- .7 Section 01 74 00: Cleaning and Waste Management
- .8 Section 01 74 21: Construction Demolition Waste Management and Disposal

**1.2 PRICE AND PAYMENT PROCEDURES**

- .1 Measurement Procedures:
  - .1 Quantities will be taken from cross section showing original rock surface and actual grade line set by Parks Canada Departmental Representative and Consultant.

**1.3 REFERENCE STANDARDS**

- .1 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS.MUNI 403 – Construction Specification for Rock Excavation for Pipelines, Utilities and Associated Structures in Open Cut.

**1.4 DEFINITIONS**

- .1 Rock: any solid material in excess of 0.25m<sup>3</sup> and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material not classified as rock.
- .2 PPV: peak particle velocity.

**1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Indicate proposed method of carrying out work.

2 Products

**NOT USED**

3 Execution

**3.1 ROCK REMOVAL**

- .1 Perform rock removal in accordance with OPSS.MUNI 403.
- .2 Blasting is not permitted.
- .3 Use of hydraulic and pneumatic excavation equipment is the only accepted method.
- .4 Remove rock to alignments, profiles, and cross sections as indicated.
- .5 Use rock removal procedures to produce uniform and stable excavation surfaces. Minimize over break, and to avoid damage to adjacent structures.
- .6 Remove boulders and fragments which may slide or roll into excavated areas.

**3.2 CLEANING**

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.

- .2 Rock Disposal:
  - .1 Dispose of surplus removed rock as directed by Parks Canada Departmental Representative and Consultant.
  - .2 Do not dispose removed rock into landfill. Send material to appropriate quarry as approved by Parks Canada Departmental Representative and Consultant.
  - .3 Stockpile rock to designated area for landscaping and fill purposes.

### **3.3 PROTECTION**

- .1 Prevent damage to surroundings and injury to persons in accordance with Section 01 56 00- Temporary Barriers and Enclosures.

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 33 00: Submittal Procedures
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 55 26: Traffic Control
- .5 Section 01 56 00: Temporary Barriers and Enclosures
- .6 Section 01 61 00: Common Product Requirements
- .7 Section 01 74 00: Cleaning and Waste Management
- .8 Section 01 74 21: Construction Demolition Waste Management and Disposal
- .9 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Divisions 20 & 26: Trenching, Excavation and Backfill Required by the Mechanical and Electrical Sections.
- .2 Contractor shall be responsible for coordinating this section with all related sections.

**1.3 SITE CONDITIONS**

- .1 Examine Site:
  - .1 Note all characteristics and features affecting work. No allowance will be made for difficulties encountered or expenses incurred on account of any site conditions or any growth or item existing thereon, visible or known to exist when bid is submitted.
- .2 Underground Services:
  - .1 Notify public utilities or municipal authorities in advance of planned excavations adjacent to their services. Take care not to damage or displace encountered known and unknown services. When such services are encountered, immediately notify Consultant, and protect, brace and support active services. Where repairs become necessary, use the following procedure:
    - .2 Known Services:
      - .1 Repair at no expense to Owner.
    - .3 Unknown Services:
      - .1 Forward complete breakdown of estimated cost of such work. Proceed immediately with repairs upon receipt of written approval of cost of such repair work.
    - .4 In the case of damage to an essential service, notify Consultant immediately and repair service under Consultant's direction. Inform Consultant of services encountered which require adjustment, relocation or abandonment and arrange for disconnection and capping of pipe.

**1.4 GEOTECHNICAL SITE INVESTIGATION REPORT**

- .1 Refer to the geotechnical site investigation report prepared by GM Blueplan dated October 2017 in Appendix B. Information given in the Geotechnical Site Investigation Report was obtained for use of Owner in execution of design for the HUB Amenity Centre. It is presented in good faith to assist Contractor with general surface and sub surface conditions at the Head of Trails project site which is in very close proximity to the Hub site. The test pit dig information within the report

is site specific to the campground area and the Hub Amenity site. No guarantee is made as to its detailed accuracy relative to the Head of Trails site.

## 1.5 LEVELS

- .1 Existing grade levels shown on drawings are furnished in good faith for the guidance of the Contractor. Check and verify levels at site. Should the actual grade levels of the site be other than shown, no claims will be entertained unless notification is made in writing to the Consultant. Do not proceed with the work until Consultant's approval is received. Allow Consultant sufficient time to inspect such claim.

## 1.6 STORAGE, DELIVERY, HANDLING AND PROTECTION

- .1 Stockpile materials in designated areas. Stockpile topsoil and each type of fill material separately to prevent integration. Stockpile granular materials so as to prevent segregation.
- .2 Keep surrounding roads free of soil deposits from material hauling trucks. Load trucks carefully to prevent spillage and wind drift.
- .3 To protect neighbourhood from wind-blown sand and dust, sprinkle with water entire excavated area and stockpiled excavated materials when required.
- .4 Protect adjacent property from damage which may occur from any cause in the performance of the work of this Section.
- .5 Do not interfere with use of adjacent buildings.
- .6 Take precautions against movement, settlement or collapse of sidewalks, public services adjoining property and be liable for all damage to same.
- .7 Before commencing work verify location of survey monuments in the areas in which the work is to be executed. Should any of the monuments be disturbed due to the work be responsible for the expenditures incurred in restoring the monuments.
- .8 Take precautions against movement or settlement of existing building. Provide and place bracing and shoring necessary for the safety and support of the structure and execute the work in a manner to prevent movement, settlement, damage or injury caused thereby or resulting therefrom.
- .9 Shoring and Trench Timbering:
  - .1 In addition to requirements of local authorities, carry out in accordance with requirements of the Occupational Health and Safety Act, RSO 1990 C.0.1 and regulations for construction projects, and all other applicable regulations of the Ontario Ministry of Labour. In addition, follow recommendations of the Construction Safety Association brochure, "Shoring and Timbering in Trenches, latest edition", wherever applicable.
- .10 Shoring and Bracing:
  - .1 Erect and maintain necessary shoring and bracing for excavations in a manner that will properly retain banks of excavations and prevent cave-in. Shoring to be erected in a manner that will allow all other work to be carried out while shoring is still in place. Shoring installation shall be entirely clear of footings, foundations, walls or other such work so that it may be removed entirely or in sections when it is no longer required or when directed without causing any damage or injury to structural work that has been completed.

## 2 Products

### 2.1 MATERIALS

- .1 Fill Material:

- .1 For base under floor slabs and other locations as recommended by geotechnical investigation report, shall be Granular 'A' material in accordance with OPSS.MUNI 1010 Table 1 and 2, well graded and maximum aggregate size of 20mm (3/4"). Material shall be maintained at optimum moisture content during placing and while compacting work is in progress, in strict accordance with inspection engineer's instructions and to his approval.
- .2 For other locations as recommended by geotechnical investigation report, shall be Granular 'A' or Granular 'B' (Type I, II or III) material in accordance with OPSS.MUNI 1010 Table 1 and 2, well graded and maximum aggregate size of 37.5mm (1-1/2"). Material shall be maintained at optimum moisture content during placing and while compacting work is in progress, in strict accordance with inspection engineer's instructions and to his approval.

### 3 Execution

#### 3.1 PREPARATION

- .1 Clear and remove, from site, obstructions to excavating. Establish and maintain accurate lines and levels as required. Provide batter boards, line stakes and templates, and establish permanent reference lines and bench marks required.

#### 3.2 EXCAVATION - GENERAL

- .1 Excavate with due regard for the peculiarities of soil conditions and take precautions to protect adjacent foundations and property.
- .2 Excavate and remove sod, debris, topsoil or fill deposited within the building area. Remove topsoil to its full depth over the areas to be excavated or graded.
- .3 Stockpile topsoil in a neat pile where directed. Remove surplus topsoil not required for regrading or landscaping from the site or as directed by Parks Canada Departmental Representative.
- .4 Stockpile excavated material approved for re-use on the site so that such material will not interfere with site drainage, drainage of adjacent properties, or building operations. Remove subsoil and excavated material not required for regrading outside the building from the site, including material excavated by other Sections.
- .5 Excavate to extent, elevations and depths required for completion of work, leaving sufficient space for removal of formwork, application of and installation of weeping drains. Excavate and construct for slabs, ramps, and driveways, to lines, elevations and cross sections shown on drawings to allow finishing sections to install their work to required thicknesses.
- .6 Keep excavation free of water by bailing, pumping or system of drainage as required, and provide pumps, suction and discharge lines of sufficient capacity. Maintain until such time as permanent drainage system is installed or until Consultant's approval for removal of equipment is obtained. Take all necessary measures to prevent flow of water into excavation.
- .7 Protect bottom and sides of excavated pits and trenches from freezing.
- .8 Keep bottoms of excavations clean and clear of loose materials leveled and stepped at changes of levels except excavations made for drainage purposes which are to slope as required.
- .9 If removal of earth causes displacement of adjacent earth, remove disturbed earth at no additional cost to Owner.
- .10 Remove soft, wet or unconsolidated ground, quicksand and organic material encountered in excavating and fill void with well compacted, clean, dry fill of quality as herein specified. Where these conditions occur under or near footings, special arrangements will be made by Consultant. Similarly treat wells, cesspools, pits, etc. if encountered.
- .11 After completion of excavation and prior to placing concrete or fill, notify inspection engineer so they may make inspection of exposed bearing surfaces. In event founding levels are subjected to rain or other moisture after inspection and approval but prior to installation of concrete, notify

- inspection engineer to re-examine all exposed bearing surfaces. Do not place concrete until re-examination has taken place and approval given.
- .12 Provide protection to keep surface against which concrete or fill is to be placed free of frost. Thaw frozen surfaces against which concrete or fill is to be placed to unfrozen depth. Remove thawed softened material to firm base at no extra cost to Owner.
  - .13 Excavate for footings to firm, undisturbed subsoil capable of safely supporting respective soil bearing values shown.
  - .14 Should nature of subsoil at depths shown prove to be unsatisfactory for placing of structural work thereon, then upon Consultant's written order, excavate to greater depth until satisfactory bottom is reached. Payment for such additional excavation and backfill will be on basis of contract unit prices.
  - .15 If excavations reveal seepage zones, springs or other unexpected subsurface conditions which may necessitate revisions or additions to any drainage system, inform Consultant immediately for remedial action.
  - .16 Excavated surfaces scheduled to receive concrete skim slabs shall be protected from excessive traffic and other disturbances and shall not be left exposed for extended periods of time. Coordinate work with Section 03 30 00 to allow for immediate installation of skim slabs.

### 3.3 TRENCH EXCAVATING

- .1 Excavate with suitable machinery or by hand as may be necessary to depths and dimensions shown or required.
- .2 Cut and trim sides of trenches evenly and as near vertical as possible, shore as required to prevent cave-ins.
- .3 Keep bottoms of trenches clean and clear of loose material. Slope or grade as required. Hand trim at least last 100mm (4") of trench excavations to ensure minimum disturbance to load bearing value of trench bottoms.

### 3.4 BACKFILLING

- .1 Proceed promptly with backfilling as building progresses and work to be backfilled has been inspected and approval to backfill obtained. Place backfill in 200mm (8") thick maximum layers. Compact each layer before placing next. Maintain optimum moisture content to achieve required densities.
- .2 Backfill evenly on both sides of foundation walls to avoid unequal fill pressures on walls.
- .3 Fill over-excavations under bearing surfaces and footings, or within pyramid enclosed by 7 in 10 slope from bearing surface with concrete of same strength as specified for footings. Fill over-excavation under all other areas with approved sand/gravel mixture and compact as directed. Fill over excavation at no additional cost to Owner.
- .4 Withdraw shoring material during backfill.
- .5 Place fill around foundation walls to that footings will have a minimum 1500mm (5'-0") coverage, measured at 45 deg angle from bottom of footing to protect against frost until final grading is complete.
- .6 Compaction equipment to be of size and type to permit required compaction without causing lateral forces resulting in displacement of foundation walls. Exercise caution in this regard to avoid movement of foundations.
- .7 Backfill and fill shall not be placed over debris, organic matter, snow, ice or frozen ground. Fill shall not be placed at ambient air temperatures below 0°C without approval.
- .8 Take care to avoid damage to waterproofing or displacement of waterlines, drains, conduit and other underground installations.
- .9 Prior to placing fill for concrete floor slabs on earth, consolidate subgrade to obtain same compaction specified for fill material.

- .10 Compact soil materials to the percentages of maximum dry unit weight in accordance with ASTM D 698, and in accordance with the drawings and the Geotechnical Report.
- .11 Coordinate with Work of other Sections for the lines and levels of uncompacted subgrade required by those Sections.
- .12 Compact with mechanical tampers, areas adjoining vulnerable building components which cannot be thoroughly compacted by drawn equipment.
- .13 Install Granular 'A' where required, as recommended by Geotechnical Investigation Report.

### **3.5 TESTING**

- .1 Sequentially test each stage of backfill commencing at founding elevations and continuing through installation of subsequent lifts or material and compaction thereof.
- .2 Do not proceed with installation of any material until preceding surface or layer meets design criteria. Owner will engage and pay for independent testing agency to conduct testing in addition to tests noted in paragraph above.

### **3.6 COMPACTION**

- .1 Density of fill in place shall be in accordance with latest revision of ASTM D698-91, 98% Standard Proctor Density for all fill unless specifically noted otherwise. Fill to underside of asphalt base - 98% Standard Proctor Density.
- .2 Maintain optimum moisture content during backfill and fill compaction to achieve required density. Deposit in layers of such thickness that equipment being used for compacting can produce specified density.
- .3 Puddling or flooding with water for consolidating granular fill will not be permitted. Addition of water is limited only to extent required to provide optimum moisture level of fill material.
- .4 During and immediately after levelling, thoroughly compact each layer of fill by use of compaction equipment of size and type to permit required compaction without causing lateral forces resulting in displacement of foundation walls. Exercise caution in this regard to avoid movement of foundations.
- .5 After a period adequate to reveal settlement has passed, place additional fill and compact in all depressions. Make good any subsequent settlement without extra cost to Owner.

### **3.7 WATER ON PREPARED SURFACES**

- .1 Promptly remove by approved methods, water rising from seeping or resulting from rainfall wherever such water is on surface of subgrade soil and compacted fill.
- .2 Where proper drainage and pumping is not carried out as specified herein and any prepared subgrade soil under structural work, and any compacted fill under concrete slabs is softened or disturbed by water due to improper drainage and pumping, Contractor under this Section shall (A) without extra cost to Owner, remove unsatisfactory soil and fill; and (B) bear all incidental costs in connection with additional excavation, backfilling and structural work for footings and foundations, and additional excavation and placing and compacting of granular fill under concrete slab base course.

### **3.8 ROUGH GRADING**

- .1 Rough grade to profiles shown on required levels to allow installation of follow-up materials to produce final grades at levels indicated. Rough grade surface to be suitable to accept follow-up sections work.

### **3.9 DISPOSAL OF DEBRIS AND SURPLUS MATERIAL**

- .1 Remove from site and legally dispose of all rubbish, rocks and surplus materials resulting from site stripping, excavation and grading work.
- .2 Vehicles employed in the cartage of this material shall not be loaded beyond the rated limits, nor in such a manner as to cause spillage. Any spillage or tire tracking occurring upon public

property or upon the property of others, shall not be allowed to remain to become a hazard and a nuisance but shall be cleaned up immediately.

- .3 Break rock, concrete and unit masonry into pieces not exceeding 600mm (24") in any dimension.

**END OF SECTION**

1 General

**1.1 SUMMARY**

- .1 Supply and installation of asphalt pavement structures.
- .2 Subgrade preparation and placement of granular base are addressed in Section 31 23 33.

**1.2 RELATED REQUIREMENTS**

- .1 Section 31 23 33: Excavation, Trenching and Backfilling
- .2 Section 32 16 26: Concrete Curbs and Sidewalks

**1.3 REFERENCE STANDARDS**

- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM D242-09, Standard Specification for Mineral Filler for Bituminous Paving Mixtures
  - .2 ASTM D692/D692M-09, Standard Specification for Course Aggregate for Bituminous Paving Mixtures
  - .3 ASTM D946/D946-09a, Standard Specification for Penetration Graded Asphalt Cement for Use in Pavement Construction
  - .4 ASTM D979/D979M-12, Standard Practice for Sampling Bituminous Paving Mixtures
  - .5 ASTM D995-95b(2002), Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
  - .6 ASTM D1073-11, Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
  - .7 ASTM D5581-07ae1, Standard Test Method for Resistance To Plastic Flow Of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen)
  - .8 ASTM D2027/D2027M-10, Standard Specification for Cutback Asphalt (Medium-Curing Type)
  - .9 ASTM D3515-01, Standard Specification for Hot-Mixed, Hot -Laid Bituminous Paving Mixtures
- .2 Asphalt Institute:
  - .1 Asphalt Institute IS-91, Full-Depth Asphalt Pavements for Parking Lots, Service Stations and Driveways.
  - .2 Asphalt Institute MS-4, The Asphalt Handbook.
  - .3 Asphalt Institute SS-1, Model Construction Specifications for Asphalt Concrete.
- .3 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.
  - .2 CAN/CGSB-16.1-M89, Cutback Asphalts for Road Purposes.
  - .3 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.
  - .4 CAN/CGSB-16.3-M90, Asphalt Cements for Road Purposes.
  - .5 CAN/CGSB 1.5-M-91, Low Flash Petroleum Spirits Thinner.

**1.4 QUALIFICATIONS**

- .1 Asphalt concrete mixing plants shall conform to ASTM D995.
- .2 Provide the equipment, materials, and labour to complete the job. Variations in the size and amount of equipment will depend on the size of the area being paved.

## 1.5 BASIS OF PAYMENT

- .1 Payment will be on a stipulated price payment that includes for furnishing, hauling and placement of materials, for rolling, compaction and labour, and use of equipment, tools and incidentals necessary to complete the work of this section. Report immediately site conditions that differ significantly from those anticipated. Consultant will provide clarification or request a change to the work for an adjustment to the contract price.

## 1.6 SUBMITTALS

- .1 Provide required product information in accordance with Section 01 33 00.
- .2 Submit asphalt concrete mix design and list of equipment and materials proposed for use to Consultant for review.
- .3 Submit a certificate of compliance indicating that the asphalt meets the requirements of the specifications, standards listed above and good local construction practices.
- .4 Submit proposed design for grading and pavement construction for Consultants review. Indicated direction of flow, thickness and types of asphalt, stamped and signed by professional engineer.

## 1.7 TESTING

- .1 Materials shall be tested by accredited and approved testing laboratory and paid for per section 01 29 83.
- .2 Sampling will follow recommended practice of ASTM D979.
- .3 Submit test certificates showing suitability of materials at least 4 weeks prior to commencing work.

## 1.8 WARRANTY

- .1 Provide a materials and workmanship warranty for one year per section 01 11 00.

## 2 Products

### 2.1 HOT-MIX, HOT-LAID ASPHALT

- .1 Design and prepare plant hot-mixed, hot-laid pavement mixtures utilizing asphalt cement and aggregate in accordance with ASTM D3515 and the following requirements.

### 2.2 BITUMINOUS MATERIALS

- .1 Asphalt Cement:
  - .1 Parking Areas: Penetration grade of 200 to 300 in accordance with to ASTM D946.
  - .2 Aggregates shall be coated with a minimum film thickness of 6.5  $\mu\text{m}$  in accordance with Marshall Mix Design Criteria and requirements of ASTM D5581.
- .2 Tack Coat: Emulsified anionic asphalt, SS-1 or SS-1h mixed with water and meeting the requirements of ASTM D977.
- .3 Primer Coat: medium curing, medium viscosity cutback asphalt, MC-80 meeting the requirements of AASHTO M82 and ASTM D2027.

### 2.3 MINERAL AGGREGATE

- .1 Mineral aggregate for asphalt plant-mix shall consist of crushed stone, crushed gravel, sand, mineral filler, to ASTM D692 and ASTM D1073 and mineral filler. Mineral filler may be Portland cement, pozzolan, or commercially ground stone dust conforming to ASTM D242, and as follows:
  - .1 Coarse aggregate shall be sound, angular crushed stone, crushed gravel, or crushed slag. Uncrushed coarse aggregate may be used in base course mixtures if the mixture meets all design criteria. The fine aggregate shall be well graded, moderately sharp to sharp sands.

- .2 Mineral aggregate and asphalt shall be combined in a mixing plant to meet the following nominal gradations for asphalt concrete:

Base and Surface Asphalt for new paving

<u>Sieve Size</u>	<u>% Passing by Weight</u>	
3/4"	100	
3/8"	60-80	
#4	40-65	
#8	30-50	
#30	15-30	100
#50	10-25	95-100
#100	5-20	
#200	3-8	70-100

Asphalt content as a percentage of weight by total mix shall conform to the requirements of Asphalt Institute MS-4.

3 Execution

3.1 PREPARATION

- .1 Grades and elevations shall be established by the Contractor, and as follows:
- .1 The Contractor shall set grade stakes to the correct elevation.
  - .2 Coordinate grades with existing features and adjoining properties to ensure proper drainage.
- .2 Remove all debris, vegetation, and other deleterious materials from the site, except for trees or shrubs designated for preservation.
- .3 Grade site in accordance with required profiles and remove excess material removed from site.
- .4 Compact subgrade at the lowest moisture content such that firm closing of hand can mould a handful of soil:
- .1 Surface of subgrade after compaction shall be hard, uniform, smooth, and true to grade and cross-section. Confirm compaction by driving a heavily loaded truck over subgrade and verify that minimal deflection occurred.
  - .2 Roll subgrade to correct conditions where significant deflection occurs.
  - .3 Scarify subgrade to a depth of 150 mm (6") and recompact where rolling does not correct the soft condition.
  - .4 Remove and replace subgrade with select materials where re-compaction does not correct soft condition.
- .5 Treat subgrade with a soil sterilant at the rate specified by the manufacturer to prevent the growth of weeds prior to placing base courses.
- .6 Prepare granular base courses in accordance with Section 31 23 33.
- .7 Apply cutback asphalt prime coat to prepared granular base courses at a minimum rate of 0.7 L/m<sup>2</sup> (0.15 gal/yd<sup>2</sup>).

3.2 PAVEMENT CONSTRUCTION

- .1 Light Traffic Construction: Lay plant hot-mixed, hot laid asphalt on prepared subgrade and base courses to a total thickness of 100 mm, unless otherwise indicated on Drawings. Place material in a single thick lift during weather colder than 5 deg C (40 deg F).

- .1 Asphalt base course (HL-4) shall be laid to a compacted thickness of 50 mm.
- .2 Asphalt surface course (HL-3) shall be laid to a compacted thickness of 50 mm.
- .2 Spreading Base and Surface Courses:
  - .1 For areas greater than 840 m<sup>2</sup> (1,000 yd<sup>2</sup>):
    - .1 Asphalt base and surface courses shall be spread and struck off with a paver.
    - .2 Any irregularities in the surface of the pavement course shall be corrected directly behind the paver.
    - .3 Excess material forming high spots shall be removed with a shovel or a lute.
    - .4 Indented areas shall be filled with hot mix and smoothed with a lute or the edge of a shovel being pulled over the surface.
    - .5 Casting of mix over such areas shall not be permitted.
    - .6 For areas less than 840 m<sup>2</sup> (1,000 yd<sup>2</sup>) and in areas where it is not practical to use a paver or spreader box:
      - .7 Spread asphalt base and finish surface courses by hand.
      - .8 Use rigidly supported wood or steel forms to ensure correct grade and cross-section
      - .9 Placing by hand shall be performed carefully to avoid segregation of the mix.
      - .10 Broadcasting of the material will not be permitted.
      - .11 Any lumps that do not break down readily shall be removed.
  - .3 Roll and compact hot-mix material immediately without displacement; continue rolling until thoroughly compacted and all roller marks have disappeared.
  - .4 In areas too small for the roller, a vibrating plate compactor or hand tamper shall be used to achieve thorough compaction.
  - .5 The surface of the completed work shall be level to 6mm in 3048mm (1/4" in 10") when tested with a straightedge. Surface shall not contain irregularities that affect drainage, create puddles created than 2 ft<sup>2</sup>.

### 3.3 APPLICATION OF PAVEMENT LINE MARKINGS

- .1 Clean pavement surface in accordance with paint manufacturers written instructions.
- .2 Paint lines straight and in uniform width, at locations indicated on drawings.
- .3 Apply paint using marking machine or line stencil, and as recommended by manufacturer, to minimum 0.18mm (0.007") dry film thickness.
- .4 Line Width: Roadways and Parking Areas: As indicated on Drawings.

### 3.4 CLEANING

- .1 Remove spillage and over-spray of paint from pavement, sidewalks, building and other site features. Use methods and materials without damaging and leaving visible residue on substrates.

### 3.5 PROTECTION OF COMPLETED WORK

- .1 Keep traffic off pavement markings for a time as recommended by paint manufacturer.

**END OF SECTION**

1 General

1.1 SUMMARY

- .1 Supply and installation of concrete and to form sidewalks, as indicated in this Section.

1.2 RELATED REQUIREMENTS

- .1 Section 03 30 00: Cast-In-Place Concrete  
.2 Section 03 35 00: Concrete Finishing  
.3 Section 31 23 33: Excavation, Trenching and Backfilling  
.4 Section 32 12 16: Asphalt Paving for Parking Lots and Driveways

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM)  
.1 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete  
.2 ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)  
.3 ASTM D1752-04a(2008): Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction  
.2 Canadian Standards Association (CSA)  
.1 CSA A23.1-09/23.2-09: Concrete Materials and Methods of Concrete Construction/Test methods and Standard Practices for Concrete  
.2 CSA G30.18-09: Carbon Steel Bars for Concrete Reinforcement  
.3 CAN/CSA B651-04(R2010): Accessible Design for the Built Environment

2 Products

2.1 MATERIALS

- .1 Granular Base:  
.1 Conforming to OPSS Form No. 1010, Class 'A' aggregate:

Sieve Designation	% Passing by Dry Weight
Imperial	
22mm (7/8")	100
16mm (5/8")	75 - 100
13mm (1/2")	65 - 90
No. 4	35 - 55
No. 16	15 - 45
No. 50	5 - 22
No. 200	0 - 8

- .2 Forms:
  - .1 Form Materials: Plywood, metal, metal framed plywood, or other acceptable panel type materials to provide full depth, continuous, straight, smooth exposed surfaces.
  - .2 Use flexible or curved forms for curves with a radius of 30m or less.
  - .3 Form Release Agent: Commercially formulated form release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- .3 Steel Reinforcement:
  - .1 Plain Steel Welded Wire Reinforcement: Meeting the requirements of ASTM A185, fabricated from as-drawn steel wire into flat sheets.
  - .2 Deformed Steel Welded Wire Reinforcement: Meeting the requirements of ASTM A497, flat sheet.
  - .3 Reinforcing Bars: Deformed bars, meeting requirements of CSA G30.18, and Grade meeting requirements of Structural Engineer. Dowels and Tie-Bars: Smooth or deformed bars, meeting requirements of CSA G30.18, Grade meeting requirements of Structural Engineer, and as follows:
    - .1 Dowels:
      - .1 Plain round bars, clean, straight and free from flattened or burred ends.
      - .2 Dowels for contraction joints shall be in rigid assemblies of required dimension and spacing and held in the middle of the slab depth to proper horizontal and vertical alignment.
    - .2 Tie-Bars: Deformed steel bars.
  - .4 Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place, fabricated from steel wire, plastic, or precast concrete of greater compressive strength than concrete; equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
- .4 Concrete Materials:
  - .1 Cement Type: Normal Portland Cement in accordance with CSA A3000, Type GU.
  - .2 Concrete Admixtures: Certified by manufacturer to contain a maximum of 0.1% water-soluble chloride ions by mass of cementitious material and being compatible with other admixtures and cementitious materials; do not use admixtures containing calcium chloride:
    - .1 Corrosion Inhibiting Admixture:
      - .1 Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
      - .2 Acceptable materials: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
        - .1 FerroGard-901; Sika Corporation.
        - .2 DCI or DCI-S; Grace Construction Materials.
        - .3 Rheocrete 222+; BASF
- .5 Water: Meeting requirements of CSA A23.1/A23.2.
- .6 Concrete Aggregate: Meeting requirements of CSA A23.1/A23.2, containing no shale, and as follows:

- .1 Normal Density Fine Aggregate: Nominal maximum aggregate size in accordance with CSA A23.2-1A, uniformly graded to maintain Workability and control water bleed out, as indicated on Drawings.
- .2 Normal Density Coarse Aggregate: Aggregate selected from Group I or Group II Grading Classifications, to suit design mix, in accordance with CSA A23.2-13A, nominal maximum aggregate sizes and applications as indicated on Drawings.
- .7 Expansion and Isolation Joint Filler Strips: Meeting requirements of ASTM D1751, asphalt saturated cellulose fibre.
- .8 Curing Materials:
  - .1 Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 300 g/m<sup>2</sup> dry weight.
  - .2 Moisture Retaining Cover: ASTM C171, polyethylene film or white burlap polyethylene sheet.
  - .3 Water: Potable.
  - .4 Curing and Sealing Compound: Ultra-violet light resistant, non-yellowing acrylic polymer/water based type curing and sealing compound conforming to ASTM C309-93, Type 1, Class B, 'Sealtight VOCOMP-20' by W.R. Meadows of Canada Limited, or 'Florseal W.B.' by Sika Canada Inc., or approved equal.

### 3 Execution

#### 3.1 PREPARATION

- .1 Set out work from lines and levels shown on drawings.
- .2 Fine grade, shape and compact subgrade to minimum of 98% Standard Proctor Density.

#### 3.2 INSTALLATION

- .1 Sidewalks:
  - .1 Place granular base immediately after the subgrade is approved by the Consultant, to 150mm (6") compacted thickness.
  - .2 Fine grade, shape and compact each layer to a minimum of 98% Standard Proctor Density.
  - .3 Maintain true grade and cross section for each layer of material.
  - .4 Place asphalt planks at locations as indicated on drawings to form expansion joints at maximum of 4.5 m to 6.0 m (15' to 20') intervals with dummy joints at 1524 mm (5') O/C or as noted on drawings.
  - .5 Place welded wire mesh 38mm (1-1/2") from top surface of concrete or as noted on details. Lap mesh mats 150mm (6") and tie securely.
- .2 Concrete:
  - .1 Pour concrete on prepared granular base to required levels and dimensions. Execute work in accordance with CAN/CSA-A23.1/A23.2.
  - .2 Do not deposit concrete on frozen ground. When deposited in forms concrete shall have a temperature between 10 deg.C and 30 deg.C and these limits shall be maintained for 72 hours.
  - .3 Fill forms with an excess of concrete and, after compacting strike to the required level in such a manner as to force the course aggregate below the mortar surface; finish top surface with a wood float to an even, smooth, dense surface.
  - .4 Do not strip forms for 24 hours after pouring concrete.

- .5 After finishing and after stripping the forms, treat surfaces with approved curing compound.
- .6 By means acceptable to the Consultant protect concrete from harmful effects of sunshine, drying winds and cold running of surface water for a minimum period of 5 days.

**END OF SECTION**

1 General

**1.1 SUMMARY**

- .1 This Section specifies requirements for placement of topsoil and grading work.

**1.2 RELATED SECTIONS**

- .1 Section 32 92 19: Seeding
- .2 Section 32 93 53: Planting of Trees, Shrubs and Ground Cover

**1.3 REFERENCES**

- .1 Agriculture and Agri-Food Canada:
  - .1 The Canadian System of Soil Classification, Third Edition, 1998.
- .2 Canadian Council of Ministers of the Environment:
  - .1 PN1340-2005, Guidelines for Compost Quality.
- .3 Canadian Nursery Landscape Association (CNLA):
  - .1 Canadian Standards for Nursery Stock, 8th Edition, 2006.

**1.4 DEFINITIONS**

- .1 Compost:
  - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
  - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
- .2 Product will be sufficiently decomposed (i.e. stable) so that further decomposition does not adversely affect plant growth (C:N ratio below 25) and contain no toxic or growth inhibiting contaminants.

**1.5 SUBMITTALS**

- .1 Provide submittals in accordance with Submittal Procedures 01 33 00.
- .2 Quality control submittals:
  - .1 Soil testing: Submit certified test reports showing compliance with specified performance characteristics and physical properties as described in 2.3 below.
  - .2 Certificates: Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

**1.6 QUALITY ASSURANCE**

- .1 Pre-installation meetings: Conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

2 Products

**2.1 TOPSOIL**

- .1 Topsoil for seeded areas mixture of particulates, micro-organisms and organic matter which provides suitable medium for supporting intended plant growth.
  - .1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70% sand, minimum 7% clay and contain 2 to 10% organic matter by weight.
  - .2 Contain no toxic elements or growth inhibiting materials.

- .3 Finished surface free from:
  - .1 Debris and stones over 50 mm diameter; and
  - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
- .4 Consistence: Friable when moist.

## 2.2 SOIL AMENDMENTS

- .1 Fertilizer:
  - .1 Fertility: Major soil nutrients present in following amounts:
    - .2 Nitrogen (N): Twenty (20) to forty (40) micrograms of available N per gram of topsoil;
    - .3 Phosphorus (P): forty (40) to fifty (50) micrograms of phosphate per gram of topsoil;
    - .4 Potassium (K): Seventy-five (75) to one-hundred-ten (110) micrograms of potassium per gram of topsoil;
    - .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination/establishment of intended vegetation; and
    - .6 pH value: 6.5 to 8.0.
- .2 Compost:
  - .1 Decomposing organic matter such as cow manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
  - .2 Processed organic matter containing 40% (by dry weight) or more organic matter as determined by Walkley-Black or Loss on Ignition (LOI) test.
  - .3 Product will be sufficiently decomposed (i.e. stable) so that further decomposition does not adversely affect plant growth (C:N ratio below 25) and contain no toxic or growth inhibiting contaminants.
  - .4 Composted bio-solids to: CCME Guidelines for Compost Quality, Category A.
- .3 Sand: Washed coarse silica sand, medium to course textured.
- .4 Limestone:
  - .1 Ground agricultural limestone.
  - .2 Gradation requirements: Percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .5 Fertilizer: Industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

## 2.3 SOURCE QUALITY CONTROL

- .1 Contractor is responsible for supplying and mixing the amendments to meet the requirements of 2.1 above and in accordance with recommendations from the Soil Tests.
- .2 Soil testing by recognized testing facility for pH, P and K and organic matter.
- .3 Testing of topsoil will be carried out by testing laboratory approved by Departmental Representative.
  - .1 Soil sampling, testing and analysis in accordance with Provincial standards.
- .4 Take soil samples prior to topsoil stripping from areas to be stripped and cleared.

3 Execution

**3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

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

**3.2 PREPARATION OF SUBGRADE**

- .1 Verify that grades are correct.
  - .1 If discrepancies occur, notify Parks Canada Departmental Representative.
  - .2 Parks Canada Departmental Representative and do not commence work until instructed.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.
  - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
  - .2 Remove debris which protrudes more than 75 mm above surface.
  - .3 Dispose of removed material off-site.
- .4 Loosen areas which are to receive topsoil, seed and plant material to a minimum depth of 25 mm.
  - .1 Prepare these areas to provide a continuous loose subgrade layer. Do not place topsoil until the subgrade layer has been accepted by the Department Representative. Placing topsoil on a compacted subgrade will be rejected.

**3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL**

- .1 Place screened imported topsoil after Parks Canada Departmental Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For seeded areas keep subsoil 15 mm below finished grade.
- .4 Spread topsoil to the following minimum depths after settlement:
  - .1 150 mm deep for seeded areas;
  - .2 900 mm deep for tree pits. Excavate and provide 6.0 m<sup>3</sup> of topsoil per tree pit. This requirement supersedes other standard tree pit details that may be shown in this Contract; and
  - .3 450 mm deep of triple mix in a continuous layer for shrub beds. This requirement supersedes other standard shrub planting details that may be shown in this Contract.
- .5 Manually spread topsoil around trees, shrubs and obstacles.

**3.4 SOIL AMENDMENTS**

- .1 Thoroughly mix the recommended soil amendments, recommended in the Soil Testing Report into the full specified depth of the topsoil.

**3.5 FINISH GRADING**

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
  - .1 Prepare loose friable bed by means of cultivation and subsequent raking.

- .2 Consolidate topsoil to required bulk density using equipment approved by Parks Canada Departmental Representative.
- .3 Leave surfaces smooth, uniform and firm against deep foot printing.

**3.6 ACCEPTANCE**

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

**3.7 SURPLUS MATERIAL**

- .1 Dispose of materials that are not required off-site. Retain excess topsoil on-site or as directed by Parks Canada Departmental Representative.

**END OF SECTION**

1 General

**1.1 RELATED SECTIONS**

- .1 Section 32 93 53: Planting of Trees, Shrubs and Ground Cover

**1.2 GENERAL**

- .1 Work Included: To carry out maintenance of plant material for the duration of the warranty period that extends one (1) year from the date of Substantial Performance of the Work. Refer to Section 32 93 00 – Planting of Trees, Shrubs and Ground Covers.

- .1 Ensure health and vigor of trees, shrubs, and ground covers

.2 Default

- .1 In the event that the landscape maintenance contractor fails to respond to maintenance and warranty requests within 14 days from the Parks Canada Departmental Representative's written notification, the defective work of this section shall be rectified at the landscape contractor's expense.

**1.3 QUALIFICATION OF LANDSCAPE MAINTENANCE CONTRACTOR**

- .1 Maintenance work will be done by experienced, qualified personnel of horticultural and planting experience.

**1.4 MAINTENANCE INSPECTIONS AND REPORTING PROCEDURES**

- .1 The Work of this Section will be inspected by the Parks Canada Departmental Representative and the consultant on the anniversary of the first year of the maintenance period. A maintenance report will be provided to landscape maintenance contractor based on findings of inspection.
- .2 Report in writing to the Parks Canada Departmental Representative the maintenance Work performed and a schedule of Work to be performed on a seasonal basis: Spring Report by May 1, Summer Report by September 1, and a Fall Report by November 1. Immediately report damages resulting from vandalism or other causes beyond the landscape contractor's control to the Parks Canada Departmental Representative.
- .3 Make periodic inspections of plants during the maintenance period and notify the Parks Canada Departmental Representative in writing of preventative or corrective measures necessary to maintain the plants in good, healthy condition. Inspection of the Site will be carried out by the landscape maintenance contractor on a bi-weekly basis. Inspections will focus on assessment of plant vigour, weed growth to establish corrective measures, and other Site specific observations related to plant health.
- .4 Coordinate all Work with the Parks Canada Departmental Representative to ensure that there is no interference with the operation and maintenance of the Site.

2 Products

**Not Used**

3 Execution

**3.1 MAINTENANCE OF TREES, SHRUBS, AND GROUND COVERS**

- .1 Include in the Work of this Section maintenance to ensure vigorous and healthy growth. Maintenance will consist of, but not be limited to, the following: pruning; cultivating; monthly weeding; fertilizing; mulching; watering; repair of trunk wrapping; securing of tree stakes; tightening of wires; resetting to proper grade or upright position; spraying to keep free of pests, insects and disease; and barriers to prevent damage by persons or animals. Thoroughly water evergreens in late fall prior to freeze-up to saturate soil around root system. Reform damaged watering saucers.

- .2 Remove unwanted vegetation from mulched planting beds during the maintenance period.

### **3.2 ADJUSTMENT AND REPLACEMENT**

- .1 Perform adjustment and replacement Work with materials of the same type and quality as outlined in the Contract Drawings and Section 32 93 53 – Planting of Trees, Shrubs and Ground Covers. Replacement Work will have a warranty of the same length and with the same conditions as outlined in Section 32 93 53 – Planting of Trees, Shrubs and Ground Covers. The landscape maintenance contractor shall provide a renewed warranty that starts from time of approval of the replacement work of this section.
- .2 Replace plant stock that is dead, or not in a flourishing growing state, or does not meet the requirements set out in the Specifications. Remove dead stock immediately. Replace stock at the proper time during the next planting season. Tag or mark replacement material in a permanently visible manner, and notify the Consultant in writing of the date on which the replacement was planted. Include a sketch showing the location of replaced plants.
- .3 After settlement has occurred at the planting pits, fill in to the specified grade with planting soil mixture.

### **3.3 WEED CONTROL**

- .1 Tree and shrub pit areas: Remove weeds from planting berm/saucer and planting bed mulch on a regular basis. Top up mulch to ensure 75 mm depth during the maintenance period.
- .2 Application of herbicide to control grass growth around trees and shrubs shall be coordinated with a licensed herbicidal applicator. Any application of herbicide shall be confirmed with Consultant prior to being carried out.
- .3 Remove stakes and guys at the end of the maintenance period.

### **3.4 FERTILIZING**

- .1 Fertilize plant material as necessary to maintain plants in a healthy vigorous growing condition.

### **3.5 WATERING**

- .1 Water all plant material every 3 weeks for the period between mid May and mid August, five (5) times per season for the first two growing seasons for a total of ten (10) waterings.
- .2 Provide additional watering if required to keep plants well watered to ensure vigorous, healthy growth.

**END OF SECTION**

1 General

**1.1 SUMMARY**

- .1 This Section specifies planting requirements for trees, shrubs and ground cover.

**1.2 RELATED SECTIONS**

- .1 Section 32 93 10: Landscape Maintenance

**1.3 QUALIFICATIONS OF CONTRACTOR**

- .1 Experienced, qualified personnel under the direction and supervision of a foreman of horticultural and planting experience will carry out planting and related work.
- .2 The work of this Section will be carried out while the Parks Canada Departmental Representative is on site and directly supervising the planting operation.

**1.4 REFERENCES**

- .1 Ontario Provincial Standard Specification (OPSS):
  - .1 OPSS 801, The Protection of Trees.
  - .2 Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).
  - .3 Canadian Association for Environmental Analytical Laboratories (CAEAL).
  - .4 Canadian Nursery Trades Association: Canadian Standards for Nursery Stock, Latest Edition.
  - .5 American Association of Nurserymen (AAN): Z60.1, Nursery Stock.
  - .6 Hortus Third, Liberty Hyde Bailey, Hortorium.
  - .7 Agriculture Canada Publication 1507, The Pruning Manual.

**1.5 DEFINITIONS**

- .1 Measurement:
  - .1 In size grading Balled and Burlapped (B&B) and wire basket (W.B.) trees, caliper takes precedence over height.
  - .2 Take trunk caliper 150 mm above the ground level (up to and including 100 mm caliper size) and 300 mm above the ground level for larger diameter trees.
  - .3 Measure size of container-grown stock by height and width of plant.
  - .4 Measure herbaceous stock by pot size, not top growth.

**1.6 SUBMITTALS**

- .1 Information Submittals:
  - .1 The Contractor will provide source and availability of plant material specified on the Plant List(s) to Parks Canada Departmental Representative four (4) weeks prior to commencing the Work.
  - .2 The Contractor will provide a detailed planting schedule for plant material specified on the Plant List(s) to Parks Canada Departmental Representative four (4) weeks prior to commencing the Work.
  - .3 Product labels/data sheets on manufactured products specified.
  - .4 Description of required maintenance activities and activity frequency.
  - .5 Description of watering program context and frequency to maintain required moisture conditions for optimum growth.
  - .6 Topsoil test results and fertilizer recommendations for planting soil.

- .2 Product Samples: Submit two (2) samples of plant bed mulch, trunk protection devices and accessories for tree-staking/guying for approval prior to initiating planting.
  - .1 Retain approved samples on Site in a readily available location.
  - .2 Products used will conform to approved samples.
- .3 Topsoil Testing: Test on-site topsoil within thirty (30) working days of planting schedule. Topsoil testing will be the responsibility of the Contractor and will involve the following:
  - .1 Arrange for and be responsible for costs related to soil testing at a certified soil testing laboratory. Testing laboratory means a facility accredited by the Canadian Association for Environmental Analytical Laboratories (CAEAL)/Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), to complete the tests as required by the submission requirements;
  - .2 Submit two (2) copies of soil analysis and recommendations to Parks Canada Departmental Representative prior to importing or amending planting soil;
  - .3 Test for N (nitrogen), P (phosphorus), K (potassium), Mg (magnesium), soluble salt content, organic matter, soil sterilants, hydraulic conductivity, particle size distribution and pH;
  - .4 Laboratory will also provide a fertilizer recommendation that outlines the required improvements to produce an optimum growing environment for the establishment of "young nursery stock";
  - .5 Submit laboratory soil analysis and soil amendment recommendations to Parks Canada Departmental Representative for review before acting on the recommendations;
  - .6 Conform to soil amendment recommendations of the laboratory as approved by Parks Canada Departmental Representative; and
  - .7 The Contractor will adjust specified fertilizer recommendations and rates, as well as addition of other additives and re-test the planting soil as required by Parks Canada Departmental Representative at no additional cost to Parks Canada Departmental Representative.
- .4 Planting Soil Mixture Testing: Utilize approved topsoil and amend as required to produce planting soil mixture. Carry out planting soil analysis as defined above and provide fertilizer recommendations for "young nursery stock".

#### 1.7 DELIVERY, STORAGE AND HANDLING

- .1 The Contractor will arrange for inspection of plant material outlined in the Plant List(s) at its source with the consultant. Acceptance of the plant material at its source does not prevent rejection of the plant material upon delivery to the site or during the planting operation.
- .2 Delivery of plant material will be coordinated with planting operations in order to ensure minimum time lapse between digging and replanting of the plant material.
- .3 All plant material supplied and planted under this Contract will be protected from damage in accordance with OPSS 801, during construction operations. Plant material damaged by the Contractor's operations will be replaced at Contractor's own expense.
- .4 All plant material will be inspected upon delivery to the site prior to unloading. A copy of the delivery receipt will be provided at the time of delivery. Off spec material will be removed from site immediately and replacements shipped to the site within two (2) Working Days.
- .5 Plant material will be inspected again prior to planting. Off spec material will be removed from the site immediately and replacements shipped to the site within two (2) Working Days.
- .6 Plant Material:
  - .1 Plants will be contained as specified in the Plant List(s) and meet the minimum height and caliper dimension requirements.

- .2 Plants will carry a tag from the nursery identifying the nursery, botanical description, container size and plant height/spread/caliper.
  - .3 Transport plants specified as Balled & Burlapped/Wire Basket with solid root balls wrapped with 150 gram Hessian burlap. Securely bind burlapped rootballs with twine, natural fibre cord, or wire for shipment and handling. Drum-lace balls with a diameter of 800 mm or more.
  - .4 Transport plants with frozen ball only when they are complete with root system intact.
  - .5 Transport plants with branches tied in order to prevent damage and pad trunks to avoid abrasion from equipment during transport. Avoid binding of plant material with rope or wire that would damage bark, break branches or destroy the natural shape of the plant.
  - .6 Transport plants in enclosed vehicles or covered by tarps. Do not permit plants that will be desiccated by wind. Plants arriving on site in unprotected transport will not be accepted.
  - .7 Prevent drying out of roots, root balls, trunks, branches and leaves of plants from the time of removal at place of origin until they are planted.
  - .8 All deciduous trees that have budded out and coniferous trees will be thoroughly sprayed with an anti-desiccant immediately before transport to the site. Apply a sufficient amount over trunks, branches and foliage. Plants may be re-sprayed after delivery to the site and once planted if deemed necessary by Parks Canada Departmental Representative.
  - .9 Balled and burlapped, wire basket and container grown plant material will not be stored on the site unless the rootball or container is protected from the sun and wind and kept moist.
  - .10 While temporarily stored at the site, plant material will be placed in the shade where possible and soil, dampened straw or similar material will be placed around the root ball and keep moist at times.
  - .11 Plants with broken or abraded trunks or branches, or with broken cracked root balls, or plants that are desiccated, will be rejected upon arrival at the site.
  - .12 Plant material deemed unacceptable will immediately be removed from the site by the Contractor.
- .7 Deliver planting materials in standard containers. Containers will be marked identifying contents of container, weight, analysis and name of manufacturer.
  - .8 Store and protect fertilizer, bonemeal, limestone, mulch and similar products to prevent damage from moisture.

## 1.8 WARRANTY

- .1 The warranty will provide for removal and replacement with new plants those transplanted or newly planted plants found defective or will be dead or not in a vigorous, thriving condition during a period of one (1) year after the date of Substantial Performance of the Work. The Contractor's duties and obligations for correction or removal and replacement of defective work will be in accordance with the requirements specified in the General Conditions.
- .2 Replace defective plants with new plants free of dead or dying branches and branch tips and bearing foliage of a normal density, size and colour. Closely match new plants to adjacent specimens of the same species and meet the requirements of this Specification. Deciduous trees that require replacement will include the removal of the wire basket, root mass and tree.
- .3 Plant replacement plants, for those plants that die during a season unfavorable for planting, during the first month of the next favorable planting season.
- .4 Plants damaged or lost due to vandalism, or acts of neglect by others are not subject to this warranty, but during the period of one (1) year after the Date of Substantial Performance of the Work, the cost to replace defective plants is set as the initial market price.

- .5 The warranty period for replacement plants will be the same as the warranty period applied to the original plants and will extend from the date of acceptance of the replacement.
- .6 Final inspection of plant material will be carried out by Parks Canada Departmental Representative at the end of the warranty period. At this time, plants will be in healthy, vigorous growing condition.

#### 1.9 MAINTENANCE

- .1 Commence to maintain plant material immediately after planting and maintain plant material in a vigorous growing condition throughout the warranty period.
- .2 Maintenance Period: Begin maintenance immediately after planting and continue for a period after the date of Substantial Performance of the Work per the Subcontract Conditions.
- .3 In accordance with the accepted submittal on the care and maintenance of plants and as follows:
  - .1 Maintain by watering, pruning, cultivating and weeding as required for healthy growth. Restore planting saucers;
  - .2 Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required;
  - .3 Install and maintain integrity of rodent protection measures (tree guards);
  - .4 Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease;
  - .5 Remove guys, stakes and other supports at the end of maintenance period;
  - .6 Maintenance includes temporary protection fences, barriers and signs as required for protection;
  - .7 Coordinate watering to provide deep root watering to newly installed trees; and
  - .8 Install winter protection (burlap) to coniferous trees and remove the following spring during the maintenance period.

#### 1.10 SCHEDULING AND SEQUENCING

- .1 The Contractor will provide to Parks Canada Departmental Representative a detailed schedule outlining the proposed planting sequence.
- .2 Plant Deliveries: Give written notice to Parks Canada Departmental Representative at least five (5) working days in advance of each delivery date.
- .3 Planting Season: Conduct planting during times of the year that are normal for such work as determined by accepted local practice.
  - .1 Installation of B&B/W.B. and container grown plant material will be carried out from the time the ground is frost free to October 15.
- .4 Plant trees and shrubs after the installation of hard structures and surfaces and upon the establishment of final grades. Planting work will be completed prior to initiating seeding work. Plant materials will be installed within a period of time that will allow for seeding of lawns and grasses during an acceptable time of year.
- .5 The location of plant material will be staked out on the ground for review by Parks Canada Departmental Representative and the consultant. Excavation will commence following Parks Canada Departmental Representative and consultant inspection and approval of staking.

#### 1.11 ENVIRONMENTAL REQUIREMENTS

- .1 Execute work of this Section under suitable weather conditions and in a suitable growth season for each specified material and as approved by Parks Canada Departmental Representative.

2 Products

**2.1 PLANT MATERIAL**

- .1 All plant material will be nursery grown and meet the specifications as set out in the latest Guide Specifications for Nursery Stock prepared by the Canadian Nursery Trades Association (CNTA) for size, height, spread, grading quality and method of cultivation.
- .2 All plant material will be supplied from nurseries situated no more than one (1) hardiness zone difference from the site's hardiness zone.
- .3 Nomenclature (Names of Plants): In accordance with "Hortus Third" and conforming to the International Code of Nomenclature of Cultivated Plants and the latest edition of Standardized Plant Names.
- .4 Plants: No.1 grade, nursery-grown in fertile soil, with ample spacing, regular cultivation, weed and pest control, required moisture and pruning.
- .5 Balled and burlapped, wire basket and container grown plant material will be dug and potted in accordance with the latest edition of the Guide Specification for Nursery Stock, prepared by the Canadian Nursery Trades Association/Landscape Canada.
- .6 Plant List(s): Plant lists are outlined on Contract Drawings.
- .7 Provide the quantity, size, genus, species and variety of trees, shrubs, ground covers and seedlings indicated on the contract drawings.
- .8 Quality and Size:
  - .1 Nursery-grown, habit of growth normal for species, sound, healthy, vigorous, free from insects and injuries, well-branched and densely foliated when in leaf.
  - .2 Plant material will not be collected or dug from native stands or an established woodlot.
  - .3 Plants will be free of disease and insect pests, eggs or larvae.
  - .4 Tree and shrub plants will possess characteristics of the specified kind, with leaders intact, undamaged and uncut, growing from an unutilated root system. Stems will be free from sun scalds, frost cracks, rodent damage, abrasions, fire and crust. Old injuries will be completely callused over. Pruning wounds will show vigorous bark on edges and parts show live green cambium tissue when cut.
  - .5 Plant material sizes will be acceptable up to 40% above the measurements specified in the Plant List(s). Measure plants before pruning with branches in their normal position.
  - .6 Plant material will not be cut back from larger sizes in order to meet the specified Plant List(s) requirements.
  - .7 Balled and Burlapped Plants: Firm, intact ball of earth encompassing enough of the fibrous and feeding root system to enable full plant recovery.
    - .1 Burlap, rope and tie material will be manufactured from natural organic fibers.
  - .8 Wire Basket Plants: Plants dug mechanically, intact soil ball of earth placed in a burlap lined wire basket, cross-laced wire basket, situate trunk in centre of basket.
  - .9 Container-Grown Plants: Self-established root systems, sufficient to hold earth together after removal from container, without being root bound.
    - .1 Stock: Grown in delivery containers for at least six (6) months but not over two (2) years.
    - .2 Well developed and well distributed root system throughout the container, such that the roots visibly extend to the inside face of the growing container.
- .9 Label each tree, shrub, ground cover and seedling specimen with a securely attached waterproof tag bearing a legible designation of botanical and common name.

- .10 Replacement trees, shrubs, ground covers and other plant material: Same species, size and quality as specified for the plant being replaced.
- .11 Substitutions: Substitutions to the plant list(s) will not be permitted unless prior written approval for a substitution from Parks Canada Departmental Representative has been obtained. Plant substitutions will be of a similar species and of equal or greater size than those originally specified. No additional cost will be entertained for substituted plant material.

## 2.2 TOPSOIL

- .1 On-site topsoil from topsoil stripping operations will be used for tree pits and continuous soil corridors for trees.
- .2 Topsoil stripped from cleared and grubbed forest floor shall be used in the planting area. Additional topsoil shall be imported to fulfill planting and seeding requirements.
- .3 Topsoil will be capable of sustaining vigorous plant growth and be free of the following:
  - .1 Admixture of subsoil, lumps and stones greater than 10 mm in diameter;
  - .2 Coarse vegetative material greater than 10 mm in diameter and 100 mm in length;
  - .3 Weeds, weed seeds and rhizomes; and
  - .4 Toxic material and soil sterilants that will inhibit plant development.

## 2.3 PLANTING SOIL MIX

- .1 Planting Soil Mixture for trees, shrubs, shrub beds and large multi-stem trees.
  - .1 Salvaged topsoil consisting of 80% sandy loam topsoil and 20% compost and well-rotted sheep's or cow manure.
  - .2 Do not mix when topsoil is in a muddy or frozen condition.

## 2.4 ANTI-DESICCANT

- .1 Anti-desiccant emulsion will be a product specifically manufactured to provide a flexible surface film to reduce transpiration yet not impede passage of carbon dioxide and oxygen. Anti-desiccants are will be one (1) of the following:
  - .1 Folicote, a wax emulsion as supplied by J.VIK. Supplies, 1894 7th Street, P.O. Box 910, St. Catharines, Ontario L2R 6Z4, telephone (416) 641-5599;
  - .2 Siliconate 51T, a silicon as supplied by Rhone – Poulenc Canada Inc., 2000 Argentia Plaza 111, Suite 400, Mississauga, Ontario, L5N 1V9, telephone (416) 821-4450;
  - .3 Jocryl 1938, an acrylic polymer as supplied by S.C. Johnson and Sons, 17 Still Water Crescent, Brampton, Ontario, L6X 3K6, telephone (416) 453-4505; or
  - .4 Approved equivalent.
- .2 Emulsion to form a permeable film over plant surfaces and mixed according to the manufacturer's instruction.
- .3 Transpiration retarding material will be used where plant material is moved during the growing season.

## 2.5 GUYING AND STAKING

- .1 For deciduous and coniferous trees:
  - .1 Steel T-bar: 50 mm by 50 mm by 5 mm by 1.8 metres. T-bars will be new with a 6 mm hole drilled 150 mm from the top to accommodate a tie wire.
  - .2 Tree Ties: No. four (4) chain lock tree ties as manufactured by Green Brothers, Ltd or approved equivalent.
  - .3 Guy Wires and Tree Tie Wire: Wire for tying and guying trees will be galvanized, 12 gauge, ductile steel.

- .4 Hose: New or used two (2) ply, reinforced rubber garden hose, not less than 13 mm diameter.
- .5 Guy Wire Turnbuckle: Zinc-coated, with 162mm lengthwise opening and at each end 13 mm diameter threaded openings fitted with screw eyes. Turnbuckle will be "Spannix" as manufactured by C. Fensch Limited, P.O. Box 67, Grimsby, Ontario, telephone (416) 945-3817 or approved equivalent.

## 2.6 TRUNK PROTECTION

- .1 Plastic: 100 mm dia. white exterior, black interior corrugated PVC pipe 600 mm high. Protect against rodent damage.
- .2 Plastic Rodent Guards: 600 mm high, to be used on whips.

## 2.7 BONEMEAL

- .1 Bonemeal: Raw bonemeal, commercial brand, finely ground, with minimum analysis of 2% and 11% phosphoric acid.

## 2.8 LIME

- .1 Lime (used where pH of topsoil is less than 6.0): Limestone containing minimum 85% of calcium and magnesium carbonates combined, finely ground to pass number 10 mesh sieve, with minimum one-half (1/2) passing number 100 mesh sieve.
- .2 Rate of application will be determined according to pH of topsoil.

## 2.9 MANURE

- .1 Well-rotted, unleached sheep or cattle manure; free from harmful chemicals and other injurious substances and sawdust, shavings or similar refuse; at least eight (8) months old, but no more than two (2) years old and with no more than 25% straw, leaves or other acceptable materials for planting use.

## 2.10 COMPOST

- .1 Decomposing organic matter such as cow manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
- .2 Processed organic matter containing 40% (by dry weight) or more organic matter as determined by Walkley-Black or Loss on Ignition (LOI) test.
- .3 Product will be sufficiently decomposed (i.e. stable) so that further decomposition does not adversely affect plant growth (C:N ratio below 25) and contain no toxic or growth inhibiting contaminants.
- .4 Composted bio-solids: To CCME Guidelines for Compost Quality, Category A.

## 2.11 FERTILIZER

- .1 Fertilizers: Commercial, complete, of neutral character; in granular, packet, or pellet form, 75% of nitrogen will be slow release form, 50% of the elements of which will be derived from organic sources.
- .2 Fertilizer requirements:
  - .1 Trees: 10-6-4 at 1 kg per 25 mm of tree caliper or as outlined in planting soil analysis fertilizer recommendations.
  - .2 Planting Beds: 12-6-4 at 1 kg per cubic metre of planting soil or as outlined in planting soil analysis fertilizer recommendations.
- .3 Slow-release and natural organic fertilizers will be incorporated into the planting soil. Quick-release fertilizers will be broadcast after planting and then watered in. Do not mix quick-release forms with the planting soil used to backfill the planting pit.
- .4 Incorporate fertilizer into the planting soil mixture in quantities sufficient to overcome chemical deficiencies of soil identified by planting soil analysis report.

## 2.12 PLANTING BED, TREE AND SHRUB SAUCER MULCH

- .1 Shredded pine bark mulch by Gro-Bark-derived from pine, shredded, free from twigs, leaves, branches, noxious weed seed and foreign material harmful to plant growth and other extraneous material. Mulch with artificial dyes will be rejected.
- .2 The Contractor will provide a sample of the above or approved equivalent mulch sources for review and approval by Parks Canada Departmental Representative prior to delivery of mulch to the site.
- .3 The Contractor will be responsible for pick-up and delivery of approved mulch from source of supply to the site.

## 2.13 ROOT STIMULANT

- .1 "Wurzil" root stimulant dip by The Professional Gardener Co. Ltd., 915-23rd Avenue S.E., Calgary, Alberta, T2G 1P1, telephone (403) 263-4200 or approved equivalent.

## 2.14 WATER

- .1 Water will be potable and free of impurities and chlorine that would inhibit germination and growth.
- .2 Water temperature will not be more than 10°C below the ambient air temperature.
- .3 The Contractor may obtain water from the City of Waterloo or City of Kitchener, but will make their own arrangements.
- .4 Water tanks used for the application of water will be clean and free of contaminants that will be hazardous to the growth and development of plant material or to the general environment.
- .5 Pumps used for watering plant material will be capable of reaching the limits of the site. The outlet end of the hose will be 25 mm in diameter with a quick shut-off valve connected to a functioning water injection pipe. The outlet end of the hose must be vandal-resistant or equipped with "anti-vandal" system.

## 2.15 WOODEN SURVEY STAKE/TREE/SHRUB LAYOUT

- .1 Wood stake measuring 600 mm in length. Colour flagging tape will be used to differentiate between stake markers.

## 3 Execution

### 3.1 EXAMINATION

- .1 Planting work will be carried out to conform to the best horticultural practices.
- .2 Ensure that grading and backfilling has been completed in accordance with the Contract Drawings.
- .3 Examine the site before commencing the Work and inform Parks Canada Departmental Representative if site conditions will not permit the completion of work of this Section as specified.
- .4 Keep the site well drained. Keep landscape excavations dry.
- .5 Do not plant material until it has been accepted by Parks Canada Departmental Representative.
- .6 Do not remove labels from plants until they have been inspected and accepted after planting by Parks Canada Departmental Representative.
- .7 Clean up immediately soil or debris spilled onto pavement and dispose of deleterious materials off-site, at no additional cost to Parks Canada Departmental Representative.
- .8 Ensure that barrier fencing is in place to protect existing vegetation being retained prior to commencing cultivation of planting areas.

### 3.2 LOCATION OF PLANTS

- .1 Stake the position of plant material and planting beds as shown on the Planting Plan unless obstructions are encountered, in which case notify Parks Canada Departmental Representative. The location of trees and planting beds, where indicated, are approximate and may require adjustments in the field due to site conditions. The staked location of plant material will be review by Parks Canada Departmental Representative. Excavation will commence following Parks Canada Departmental Representative inspection and approval of staking.
- .2 Trees and Shrubs: The location of trees and shrubs has been defined on the Contract Drawings. Refer to the Tree, Shrub and Ground Cover Plant List for quantities designated by Planting Area. The location of plants and shrubs must not hide the view of the LRT's drivers or CCTV cameras.
  - .1 All shrubs will be situated within a common planting bed unless otherwise noted or illustrated.
- .3 Request Parks Canada Departmental Representative to observe and approve of new planting locations, topsoil placement and grading. Adjust as necessary before planting begins.

### 3.3 PREPARATION

- .1 Planting Soil: Delay mixing of fertilizer into planting soil if planting will not follow the preparation of planting soil within three (3) days.
- .2 Excavation for Planting:
- .3 Excavate for oversized tree pits and continuous soil corridors to the extents shown on the Planting Plan.
  - .1 Excavate for the shrub beds to the limits shown on the Planting Plan to a depth of 450 mm.
- .4 Dispose of unsuitable and excess excavated material from tree pits and planting beds at no additional cost to Parks Canada Departmental Representative.
- .5 Salvaged topsoil from existing forest floor will be placed in the woodland tree planting area, the shrub planting area and the seeded open space area, to a depth of 150 mm and graded to produce an irregular surface.

### 3.4 PLANTING

- .1 Plant material will not be placed in the planting pit until evidence of frost has left the ground.
- .2 Set plants plumb so that they are in the same relationship to finished grade, after settlement, as they were in the nursery or pot.
- .3 Face plants to give best appearance when viewed from prime vantage points and prominent views (sidewalk, building, street) to the acceptance of Parks Canada Departmental Representative.
- .4 Do planting in a continuous operation, completing total areas including mulching rather than focusing on completing individual species.
- .5 Plant trees before planting surrounding smaller shrubs and seeding.
- .6 B&B Plants: Place in pit by lifting and carrying by its ball (do not lift by branches or trunk). Lower into pit and place rootball on compacted ground. Set straight in pit center with tip of rootball 75 mm above the adjacent finish grade.

### 3.5 BACKFILLING

- .1 Backfill with planting soil in maximum 150 mm lifts and tamp placed planting soil to remove air pockets between lifts. Take care not to injure root system. When excavation is two-thirds (2/3) full, water thoroughly before placing remainder of backfill in order to eliminate air pockets. When the planting pit has been backfilled to finished grade, the final backfill layer will be used to form an earthen berm/saucer around the outside perimeter of the planting pit. The berm/saucer will be a maximum of 100 mm high and a maximum of 150 mm wide. The berm/saucer will be formed

using the excavated soil material. If the pit is on a slope, the lower edge and sides will be built up to contain and hold water. Water immediately after completion of backfilling.

- .2 Balled and Burlapped (B&B)/Wire Basket (W.B.) Plants:
  - .1 Remove synthetic material prior to backfilling.
  - .2 Partially backfill pit to support plant.
  - .3 Backfill in maximum 150 mm lifts and compact to remove air pockets until planting pit is one-third (1/3) full.
  - .4 Remove burlap and binding from sides and top one third of root ball. Do not pull burlap from under rootballs. Remove upper one-third (1/3) of wire basket from entire circumference from W.B. plants.
  - .5 When excavation is approximately two-thirds (2/3) full, water thoroughly before placing remainder of backfill to eliminate air pockets. Complete backfilling in 150 mm lifts until finished grade is achieved.
  - .6 Never cover the top of the rootball with soil.
  - .7 Establish tree saucer and water as outlined above.
  - .8 Provide an earth saucer at the base of individual trees and shrubs. Diameter of saucer to correspond to planting pit diameter as outlined on planting detail drawings.

### 3.6 GUYING AND STAKING

- .1 All trees will be staked and tied immediately following planting to ensure vertical alignment and plant stability in accordance with Contract Drawings.
- .2 Staking: Support deciduous trees 40 mm in caliper and less with one (1) stake. For deciduous trees with a caliper greater than 40 mm use two (2) stakes spaced equally about each tree in line with the tree trunk. Support coniferous trees up to 1.5 metres in height with two (2) stakes spaced equally about each tree in line with tree trunk. Support conifers greater than 1.5 metres in height with three (3) stakes spaced equally about each tree.
- .3 Guying: Support coniferous trees greater than 1.5 m with one (1) guy wire for each stake.
- .4 Rubber hose will be used as a cover over tie to protect the tree bark from damage. The rubber hose will be cut to a sufficient length to encircle the tree trunk loosely and provide the necessary support.
- .5 Bright red plastic surveyor's tape will be tied to guy wires. The tape will be tied halfway up the length of the wire and will be clearly visible. Guy wires will be tightened using galvanized turnbuckles.
- .6 Adjust tension in guy wires and ties as required during the warranty period.
- .7 Remove stakes and guy wires at the end of the warranty period.

### 3.7 FERTILIZER

- .1 Add as top dressing depending on plant size and manufacturer's recommendations upon completion of planting operation or during the guarantee period.

### 3.8 MULCH INSTALLATION

- .1 Immediately after planting, prior to the initial watering and seeding, install mulch within two (2) days after installation of plant material.
- .2 Mulch will be applied in a uniform continuous blanket to the surface area surrounding each individual tree and shrub. Depth of mulch will be 75 mm (after settlement). Excess mulch will be turned over to Parks Canada for future adjustments.
- .3 For trees, the mulch surface area will extend over the full extent of the planting pit and the earth berm/saucer and include an additional 300 mm radius beyond the circumference of the earth berm/saucer.

- .4 Keep mulch 150 mm to 250 mm away from the trunk of plant material to prevent rodent nesting and disease (rot).
- .5 Saturate the planting area with water after placing mulch.

### **3.9 WATERING**

- .1 Watering of plant material will commence immediately following installation. Apply sufficient water to saturate the root zone.
- .2 Initial watering will be uniformly applied to each individual tree by two injection applications directly into the soil. Both injections will be located at the outer edge of the planting pit and will penetrate the ground to a depth of 450 mm. The second injection will be 180° from the initial injection.
- .3 Water will be uniformly applied to avoid dislocating mulch, soil and plant material.
- .4 Do not overwater or drown plants.
- .5 Keep plants well watered to ensure a vigorous, healthy growing condition during establishment period.
- .6 The Contractor will maintain appropriate hydrological conditions using available water or imported potable water as required maintaining plant material in a vigorous, healthy growing condition.

### **3.10 PRUNING AND REPAIR**

- .1 All pruning will be carried out in accordance with Agriculture Canada Publication 1507-1977 "The Pruning Manual".
- .2 Prune only after planting and in accordance with standard horticultural practice to preserve the natural character of the plant. Perform in the presence of Parks Canada Departmental Representative.
- .3 Remove dead wood, suckers and broken or injured branches.
- .4 Do not remove leaders. Do not plant trees without a prominent, vigorous leader.
- .5 Use sharp, clean tools. Make cuts smooth, clean and flush to base members. Leave no stubs.
- .6 Cut back cambium to living tissue where cuts are made and at bruises, scars and other injuries. Shape wood to prevent the retention of water.

### **3.11 WEED CONTROL**

- .1 Maintain a weed-free condition within planting areas.

### **3.12 PROTECTION OF INSTALLED WORK**

- .1 Protect planting areas and plants against damage for the duration of the maintenance period.

### **3.13 ADJUSTMENT AND REPLACEMENT**

- .1 Perform adjustment and replacement work with materials of the same type and quality as outlined in the Plant List(s) on Contract Drawings. Replacement work will have a guaranty of the same length with the same conditions as outlined in this Specification. Date of renewed guarantee will be from the time of approval of replacement work. The Contractor will document replacement materials on the Record Drawings identifying the plant material location, plant species name, quantity, reason for replacement and date of replacement. A copy of replacement work carried out will be provided to Parks Canada Departmental Representative within fifteen (15) working days of Substantial Performance of the Work.

### **3.14 WATERING DURING THE MAINTENANCE PERIOD**

- .1 Refer to Section 32 93 10 Landscape Maintenance for extra watering required during the warranty period.

END OF SECTION

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 33 00: Submittal Procedures
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 55 26: Traffic Control
- .5 Section 01 56 00: Temporary Barriers and Enclosures
- .6 Section 01 61 00: Common Product Requirements
- .7 Section 01 74 00: Cleaning and Waste Management
- .8 Section 01 74 21: Construction Demolition Waste Management and Disposal
- .9 Section 31 23 33: Excavating, Trenching and Backfilling
- .10 Section 33 36 00: Wastewater Utility Holding Tanks

**1.2 REFERENCES**

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C110/A21.10-08, American National Standard for Ductile-Iron and Gray Iron Fittings for Water.
  - .2 ANSI/AWWA C153/A21.53-11, Standard for Ductile-Iron Compact Fittings.
  - .3 ANSI/AWWA C500-09, Standard for Metal-Seated Gate Valves for Water Supply Service.
  - .4 ANSI/AWWA C504-10, Standard for Rubber-Seated Butterfly Valves.
  - .5 ANSI/AWWA C651-05, Standard for Disinfecting Water Mains.
  - .6 ANSI/AWWA C800-05, Standard for Underground Service Line Valves and Fittings.
  - .7 ASTM B88M-05(2011), Standard Specification for Seamless Copper Water Tube [Metric].
- .2 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS.MUNI 401 – Construction Specification for Trenching Backfilling and Compacting.
  - .2 OPSS.MUNI 403 – Construction Specification for Rock Excavation for Pipelines, Utilities and Associated Structures in Open Cut.
  - .3 OPSS.MUNI 441 – Construction Specification for Watermain Installation in Open Cut.
  - .4 OPSS.MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material
- .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.

- .2 CAN/CSA-B137.3-09, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
- .3 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.
- .4 Pipe certification to be on pipe.

### 1.4 DELIVERY, STORAGE AND HANDLING

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

### 1.5 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Do not interrupt water service for more than 3 hours.
- .3 Notify fire department of planned or accidental interruption of water supply to hydrants.
- .4 Provide and post "Out of Service" sign on hydrant not in use.

## 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 PE 3406. ASTM F714, type PE 3408.
  - .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 PIPE PROTECTION

- .1 Provide means of protection for iron pipe in corrosive soils in accordance with local practices and authorities having jurisdiction.

### 2.3 VALVES AND VALVE BOXES

- .1 Valves to open clockwise.
- .2 Gate valves: to ANSI/AWWA C500, standard iron body, brass mounted wedge valves with non-rising stems, suitable for 1 Pa with flanged joints.
- .3 Cast iron valve boxes: three piece sliding type adjustable over minimum of 450 mm complete with valve operating extension rod, 25 x 25, 150 mm below cover.
  - .1 Base to be large round type with minimum diameter of 300 mm.
  - .2 Top of box to be marked "WATER"/"EAU".

### 2.4 SERVICE CONNECTIONS

- .1 Copper tubing: to ASTM B88M type K, annealed.
- .2 Polyethylene pressure pipe:
  - .1 To CAN/CSA-B137.1, type PE, series 160.

- .3 Copper tubing joints: compression type suitable for 1 MPa working pressure.
- .4 Polyethylene pipe joints: plastic insert type serrated sleeves with four stainless steel screws and band-type clamps per joint.
- .5 Brass Corporation stops: red brass to ASTM B62, compression type having threads to ANSI/AWWA C800.
- .6 Brass inverted key-type curb stops: red brass to ASTM B62, compression type without drains.
  - .1 Curb stops to have adjustable cast iron service box with stem to suit depth of bury.
  - .2 Top of cast iron box marked "WATER"/"EAU".
- .7 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.

## **2.5 PIPE BEDDING AND SURROUND MATERIAL**

- .1 Granular material to: OPSS.MUNI 1010.
  - .1 Crushed or screened stone, gravel or sand.

## **2.6 BACKFILL MATERIAL**

- .1 Granular 'B' Type 2 as per OPSS.MUNI 1010.

## **2.7 PIPE DISINFECTION**

- .1 Sodium hypochlorite to ANSI/AWWA B300.
- .2 Disinfect water mains in accordance with ANSI/AWWA C651 and in accordance with local requirements.

## **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 Parks Canada Departmental Representative and Consultant.
  - .2 Inform Parks Canada Departmental Representative and Consultant 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 Parks Canada Departmental Representative and Consultant.

### **3.2 PREPARATION**

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

### **3.3 TRENCHING**

- .1 Do trenching work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Trench alignment and depth require Parks Canada Departmental Representative's and Consultant'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 of 150 mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 95 % minimum of maximum dry density to ASTM D698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling with compacted bedding material.

### 3.5 PIPE INSTALLATION

- .1 Terminate building water service at 1 m outside building wall.
  - .1 Install coupling necessary for connection to building plumbing.
  - .2 If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Lay pipes in accordance with OPSS.MUNI 441.
  - .1 Do not use blocks except as specified.
- .3 Join pipes in accordance with OPSS.MUNI 441.
- .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.
- .6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .7 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
- .8 Do not lay pipe on frozen bedding.
- .9 Do hydrostatic and leakage test and have results approved by Parks Canada Departmental Representative and Consultant.
- .10 Backfill remainder of trench.

### 3.6 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.

### 3.7 SERVICE CONNECTIONS

- .1 Terminate building water service 1 m outside building wall.
  - .1 Install coupling necessary for connection to building plumbing.
  - .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker 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.
- .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 single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .7 Leave corporation stop valves fully open.
- .8 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .9 Install curb stop with corporation box on services NPS 2 or less in diameter.
  - .1 Set box plumb over stop and adjust top flush with final grade elevation.
  - .2 Leave curb stop valves fully closed.
- .10 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.

### **3.8 HYDROSTATIC AND LEAKAGE TESTING**

- .1 Do tests in accordance with ANSI/AWWA C600 and OPSS.MUNI 44.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Parks Canada Departmental Representative and Consultant at least 24 hours in advance of proposed tests.
- .4 Perform tests in presence of Parks Canada Departmental Representative and Consultant.
- .5 Undertake any repairs and repeat all testing at no additional cost until satisfactory results are achieved.

### **3.9 BACKFILL**

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Compact backfill to at least 95% maximum density to ASTM D698.

### **3.10 FLUSHING AND DISINFECTING**

- .1 Flushing and disinfecting operations: witnessed by Parks Canada Departmental Representative and Consultant.
  - .1 Notify Parks Canada Departmental Representative and Consultant at least 4 days in advance of proposed date when disinfecting operations will begin.

### **3.11 CLEANING**

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

**END OF SECTION**

1 General

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 29 00 – Payment Procedures
- .2 Section 01 33 00 – Submittal Procedures
- .3 Section 01 35 43 – Environmental Procedures
- .4 Section 01 55 26 – Traffic Control
- .5 Section 01 56 00 – Temporary Barriers and Enclosures
- .6 Section 01 61 00 - Common Product Requirements
- .7 Section 01 74 00 – Cleaning and Waste Management
- .8 Section 01 74 21 – Construction Demolition Waste Management and Disposal

**1.2 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort 600 kN-m/m<sup>3</sup>.
  - .2 ASTM D2680-01(2009), Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
  - .3 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - .4 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 CAN/CGSB-34.9-M94, Pipe, Asbestos Cement, Sewer.
- .3 CSA International
  - .1 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.
- .4 Ontario Provincial Standard Specifications (OPSS)
  - .1 OPSS.MUNI 401 – Construction Specification for Trenching, Backfilling and Compacting
  - .2 OPSS.MUNI 410 – Construction Specification for Pipe Sewer Installation in Open Cut
  - .3 OPSS.MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material.

### 1.3 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 Parks Canada Representative and Consultant 24 hours minimum in advance of any interruption in service.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.5 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.
  - .2 Store and protect pipes from damage.
  - .3 Replace defective or damaged materials with new.

## 2 Products

### 2.1 PLASTIC PIPE

- .1 Type PSM Polyvinyl Chloride (PVC): to CSA B182.2.
  - .1 Standard Dimensional Ratio (DR): 28.
  - .2 Locked-in gasket and integral bell system.
  - .3 Nominal lengths: 6 m.
- .2 Acrylonitrile - Butadiene - Styrene (ABS): to CSA B182.2.

### 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 OPSS.MUNI 1010.

### 2.4 BACKFILL MATERIAL

- .1 As indicated.
- .2 Granular 'B' Type 2, in accordance with OPSS.MUNI 1010.

3 Execution

**3.1 PREPARATION**

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

**3.2 TRENCHING**

- .1 Do trenching Work in accordance with Section 31 23 33- Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer or sewer connection.
- .3 Trench alignment and depth require approval of Parks Canada Representative and Consultant prior to placing bedding material and pipe.

**3.3 GRANULAR BEDDING**

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth of 150 mm.
- .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% maximum density to ASTM D698.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

**3.4 INSTALLATION**

- .1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Parks Canada Representative and Consultant.
- .2 Handle pipe using methods approved by Parks Canada Representative and Consultant.
  - .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 Parks Canada Representative and Consultant.

- .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 Parks Canada Representative and Consultant to prevent creep during down time.
- .11 Plug lifting holes with pre-fabricated plugs approved by Parks Canada Representative and Consultant, set in shrinkage compensating grout.
- .12 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes.
  - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .14 Use prefabricated saddles or field connections approved by Parks Canada Representative and Consultant, for connecting pipes to existing sewer pipes.
  - .1 Joints to be structurally sound and watertight.

### 3.5 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Parks Canada Representative and Consultant 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.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum density to ASTM D698.
- .6 Compact each layer from [mid height]of pipe to underside of backfill to at least 95% maximum density to ASTM D698.
- .7 When field test results are acceptable to Parks Canada Representative and Consultant, place surround material at pipe joints.

### 3.6 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround in uniform layers not exceeding 150mm compacted thickness up to grades as indicated.
- .3 Compact backfill to at least 95% maximum density to ASTM D698.

### 3.7 SERVICE CONNECTIONS

- .1 Install pipe to CSA B182.1, manufacturer's instructions and specifications.
- .2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal unless directed otherwise by Parks Canada Representative and Consultant.
- .3 Service connections to main sewer: Tee, standard Wye fittings and approved saddles.
- .4 Service connection pipe: not to extend into interior of main sewer.
- .5 Make up required horizontal and vertical bends from 45 degrees bends or less, separated by straight section of pipe with minimum length of 4 pipe diameters.
  - .1 Use long sweep bends where applicable.
- .6 Plug service laterals with water tight caps or plugs as approved by Parks Canada Representative and Consultant.
- .7 Place location marker at ends of plugged or capped unconnected sewer lines.
  - .1 Each marker: 38 x 89mm stake extending from pipe end at pipe level to 0.6m above grade.
  - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

### 3.8 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Parks Canada Representative and Consultant draw tapered wooden plug with diameter of 50mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .5 Do infiltration and exfiltration testing as specified herein and in accordance with OPSS.MUNI 410.
  - .1 Perform tests in presence of Parks Canada Representative and Consultant.
  - .2 Notify Parks Canada Representative and Consultant 24 hours minimum in advance of proposed tests.
- .6 Television and photographic inspections:
  - .1 Carry out inspection of installed sewers by video camera, digital camera or by other related means.
  - .2 Provide means of access to permit Parks Canada Representative and Consultant to do inspections.

### 3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Management.
  - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

**END OF SECTION**

1 General

**1.1 SECTION INCLUDES**

- .1 Materials and installation for precast concrete wastewater utility storage tank.

**1.2 RELATED REQUIREMENTS**

- .1 Section 01 29 00: Payment Procedures
- .2 Section 01 33 00: Submittal Procedures
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 56 00: Temporary Barriers and Enclosures
- .5 Section 01 61 00: Common Product Requirements
- .6 Section 01 74 00: Cleaning and Waste Management
- .7 Section 31 23 33: Excavating Trenching and Backfilling.

**1.3 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m<sup>3</sup>).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association, (CSA International)
  - .1 CAN/CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
  - .2 CAN/CSA-A23.4/A251, Precast Concrete-Materials and Construction/Qualification Code for Architectural and Structural Precast Concrete Products.
  - .3 CAN/CSA-B66, Prefabricated Septic Tanks and Sewage Holding Tanks.
  - .4 CSA B1800, Plastic Non-pressure Pipe Compendium – B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
    - .1 CSA B182.2, PVC Sewer Pipe and Fittings (PSM Type).

**1.4 DESIGN REQUIREMENTS**

- .1 Design precast concrete wastewater utility holding tank in accordance with CAN/CSA-B66, and to carry handling stresses and indicated service loads.
- .2 Tank to have total storage capacity of 5500 imp gallons.

**1.5 SUBMITTALS**

- .1 Submit under provisions of Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit manufacturer's data sheets on each product to be used, including, but not limited to, the following:
  - .1 Preparation instructions and recommendations.
  - .2 Storage and handling requirements and recommendations.
  - .3 Installation manual and operating guidelines.

.3 Shop Drawings: Tank manufacturer shall submit the following for review and approval prior to fabrication of the tanks:

- .1 Detailed shop drawings of each tank complete with all accessories supplied by the manufacturer.
- .2 Design calculations for items designed by manufacturer.
- .3 Methods of handling and erection.
- .4 Openings, sleeves, inserts and related reinforcement.

## 1.6 QUALIFICATIONS

.1 Manufacturers and erectors of precast concrete elements shall be certified by CSA as meeting requirements of CAN/CSA-A23.4/A251, for Category SC and SP products.

## 1.7 WARRANTY

.1 Provide manufacturer's standard limited warranty.

## 2 Products

### 2.1 GENERAL

- .1 Wastewater utility holding tank to have minimum capacity as noted on drawings and below.
- .2 Tank shall be 7700 imperial gallon (35,000 L) capacity and a low profile type with dimensions as 3302 mm wide x 7010 mm long x 2025 mm high.
- .3 Provide access and pipe openings as shown on the drawings.

### 2.2 CONCRETE MIXES AND MATERIALS

- .1 Concrete mixes and materials: to CAN/CSA-B66 and CAN/CSA-A23.1/A23.2.
- .2 Use type 10 cement.

### 2.3 MANUFACTURE

- .1 Manufacture units in accordance with CAN/CSA-A23.4/A251, except where specified otherwise. Piping as indicated on drawings.
- .2 FINISHES
- .3 Finish tank to commercial grade to CAN/CSA-A23.4/A251.

### 2.4 ACCESS

.1 Provide access holes to surface to facilitate cleaning inspection and maintenance.

### 2.5 TANK BEDDING AND SURROUND MATERIAL

- .1 Granular material - Aggregate Materials and following requirements:
  - .1 Bedding material - Granular 'A' per OPSS MUNI 1010.
  - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.2.

Sieve Designation	% Passing
200 mm	-
75 mm	-
50 mm	-
37.5 mm	-
25 mm	-
19 mm	-
12.5 mm	100
9.5 mm	-
4.75 mm	80-100

Sieve Designation	% Passing
2.00 mm	50- 90
0.425 mm	10- 50
0.180 mm	-
0.075 mm	0- 10

## 2.6 BACKFILL MATERIAL

- .1 Granular 'B' per OPSS MUNI 1010.

## 2.7 MODULAR WALL SEALS

- .1 Provide modular wall seals.

## 3 Execution

### 3.1 INSTALLATION

- .1 Place bedding and surround material in unfrozen condition.
- .2 Do excavation in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .3 Place tank bedding material in accordance with details as indicated. Compact to 95% maximum dry density to ASTM D698.
- .4 Make inlet and outlet joints of wastewater utility storage tanks watertight, using modular wall seals.
- .5 Conduct leakage test on tanks in presence of Owner's Representative, before backfilling. Fill tank to level of effluent pipe, and allow to stand for 24 hours. Allowable leakage is zero.
- .6 Do backfilling in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
  - .1 Compact to 90% maximum dry density to ASTM D698.

**END OF SECTION**

# Appendix **A**

## **GM BluePlan Engineering Geotechnical Investigation**

Prepared By:



---

# Geotechnical Investigation - Cyprus Lake Campgrounds Bruce Peninsula National Park – Tobermory, ON

Parks Canada c/o AECOM Canada Ltd.

**GMBP File: 217291**

**October, 2017**



Parks  
Canada

Parcs  
Canada

## TABLE OF CONTENTS

<b>1. INTRODUCTION .....</b>	<b>1</b>
<b>2. BACKGROUND .....</b>	<b>2</b>
2.1 Site Location and Features.....	2
2.2 Geology and Physiography.....	3
<b>3. SITE INVESTIGATION.....</b>	<b>3</b>
3.1 Fieldwork.....	3
3.2 General Sub-Surface Conditions .....	4
3.2.1 “HUB”.....	4
3.2.2 Campground Washroom Facilities .....	4
3.3 Summarized Subsurface Conditions.....	5
3.3.1 Topsoil and Organics .....	5
3.3.2 Sand and Gravel Fill.....	5
3.3.3 Sand Fill.....	6
3.3.4 Silty Sand with trace Gravel .....	6
3.3.5 Silty Sand and Gravel with Cobbles .....	6
3.3.6 Clayey Silty Till with Sand, Gravel and Cobbles.....	6
3.3.7 Bedrock (Weathered).....	7
3.3.8 Bedrock (Competent).....	7
3.4 Groundwater Conditions.....	7
<b>4. DISCUSSION AND RECOMMENDATIONS.....</b>	<b>7</b>
4.1 ‘Hub’ and Washroom Buildings.....	7
4.1.1 Foundation Loading .....	8
4.1.2 Slab-On-Grade Construction .....	9
4.1.3 Seismic Design .....	9
4.1.4 Excavation and Backfill .....	10
4.2 “Hub” Parking Lot Construction .....	11
4.3 “Hub” Septic and Greywater .....	11
4.4 Initial Screening – Chemical Testing of Soil.....	12
4.4.1 Chemical Analyses – Environmental Quality .....	12
4.4.2 Chemical Analyses – Corrosivity .....	12

---

5. STATEMENT OF LIMITATIONS ..... 13

## **APPENDICES**

**APPENDIX A: TESTHOLE LOCATION PLANS**

**APPENDIX B: RECORD OF TESTHOLE LOGS**

**APPENDIX C: GRAIN-SIZE ANALYSIS**

**APPENDIX D: CHEMICAL ANALYSIS RESULTS AND CERTIFICATE OF ANALYSIS**

---

**PARKS CANADA C/O AECOM CANADA LTD.**

**GEOTECHNICAL INVESTIGATION - CYPRUS LAKE CAMPGROUNDS**

**OCTOBER, 2017**

**GMBP FILE: 217291**

---

## **1. INTRODUCTION**

Parks Canada is proposing five component upgrades at the Cyprus Lake facility within Bruce Peninsula National Park (GMBP - Figure No. 1). Parks Canada has issued a proposal document for these proposed upgrades, which are identified as the following:

- **Component #1 – “The Hub”** (Community Facility with full service washrooms/showers, parking and outdoor activities).
- **Component #2 – EE-1** (Buried electrical corridor located in the Birches Campground).
- **Component #3 – EE-2** (This component is included within the Park’s proposal document, but is only included as a feasibility element at the design stage and may be addressed at a later date).
- **Component #4 – Electrical Backup** (This component is included within the Park’s proposal document, but is only included as a feasibility element at the design stage and may be addressed at a later date).
- **Component #5 – Washroom Facilities (x9)** (The proposed individual washroom facilities are located within the existing three campgrounds - Tamarack, Birches, Poplars).

Based on the outlined works within the aforementioned proposal document, GM BluePlan Engineering Limited (GMBP) was contacted by Parks Canada consultant – AECOM Canada Ltd. (AECOM) to complete a geotechnical investigation using shallow excavated testholes for Components #1, #2, and #5. It should be noted that EE-1 (Component #2) is a proposed underground electrical corridor, and findings of the geotechnical investigation and recommendations for this component have been presented in a letter report by GMBP dated September 12, 2017. As a result, the remaining investigative findings and recommendations are presented to assist with the design of the structural buildings components and the sewage system in Component #1 and #5.

The purpose of the geotechnical investigation was to assist Parks Canada staff and their consultants with the structural and civil design of the various elements of the above noted project components.

It was agreed that the initial geotechnical investigation was primarily to investigate the shallow soil overburden and the interface of the bedrock. It should be noted that rock coring did not form part of the initial scope and is considered a separate task. Additional geotechnical investigations to assess the deeper seated bedrock would be determined based on the review of initial shallow investigations.

Based on the preliminary concept layout drawings provided by AECOM (which are enclosed as Figures to this report), the areas of development are identified and locations are as follows:

- New “Hub” Building – Located opposite to The Birches Campground entrance, and is currently a gravel lot which is being used as a centralized garbage collection depot for the Birches Campground (Located on the eastern side of Cyprus Lake Road).
- Tamaracks Campground washrooms (x4)
  - Replacement of Existing Buildings #3/4
  - Replacement of Existing Buildings #5/6
  - Replacement of Existing Buildings #7/8
  - Replacement of Existing Buildings #9/10
- Birches Campground washrooms (x3)
  - Replacement of Existing Buildings #13/14
  - Replacement of Existing Buildings #24
  - Proposed Building – Campsite #155
- Poplars Campground washrooms (x2)
  - Replacement of Existing Buildings #15/16
  - Replacement of Existing Buildings #17/18

These concept layout drawings were provided by AECOM and are attached for additional reference.

The field investigation included completing testholes in proximity to the proposed location of the “Hub”, washrooms, and the proposed sewage system area. The purpose of the investigation is to comment on the soil bearing capacity and suitability for foundation construction for the proposed buildings. In addition, a review of the subgrade conditions for the sewage system and the “Hub” parking lot construction; and subsequent recommendations for the reuse of any excavated soils are to be considered.

## **2. BACKGROUND**

### **2.1 Site Location and Features**

Cyprus Lake Campground is located within the Bruce Peninsula National Park, just south of Tobermory and is accessed from Highway 6. The campgrounds border the shores of Cyprus Lake, and the Campgrounds also provide access to “the Grotto” and Lake Huron via interconnected trails and the head of the trails parking lot.

The Campgrounds are generally divided into three un-serviced camping areas, which are operated by Parks Canada. In addition to a relatively new reception building (located near the Campground entrance), there are three campgrounds named; Tamaracks, Birches & Poplars. These campgrounds generally have a few gender specific washroom buildings with basic features (toilets, showers and sinks), which are located in centralized locations across each campground.

## **2.2 Geology and Physiography**

The "Physiography of Southern Ontario", Chapman and Putnam, 1985 identifies the Cyprus Lake site as within the "Bruce Peninsula" physiographic region. Aside from a few localized features, this area is generally characterized by very little overburden on the irregular grey dolostone bedrock. The dip of the bedrock is toward the west, sloping upwards from the Lake Huron shore to the Georgian Bay shore on the peninsula. The shore of the Bruce Peninsula on Lake Huron is low lying with boulders, gravel and sand bars. There are also some finger strips of wetlands that extent inland. The Soil Survey within Bruce County indicates the surficial soils as mainly bare bedrock with small pockets of soil or muck scattered in the area. The thin layer of overburden soil is also noted by the Ministry of Environment (MOE) well records, where rock is encountered within as a little as one foot from the surface in many of the wells.

## **3. SITE INVESTIGATION**

### **3.1 Fieldwork**

An initial site meeting was conducted on August 30<sup>th</sup>, 2017, to meet with Brandon Golden of Parks Canada and various personnel from AECOM, who are the project design consultants. In addition, a representative from SMC Geomatics also attended the meeting to identify the topographic survey requirements for the various proposed structures and land development across the site(s). In addition to the conceptual plans (enclosed), a base plan showing elevations will be prepared by SMC Geomatics in conjunction with AECOM for the proposed works. During this meeting the proposed testhole locations were generally selected and the existing utility locations were clarified by Parks staff, to ensure no conflicts will present during the excavation of the investigative testholes.

Following the September long weekend (Labor Day), the testhole excavations were completed on September 5<sup>th</sup>, 2017, using a John Deere mini track-mounted excavator (model JD27c). A series of eight (8) shallow testholes were excavated in the area of the proposed "Hub" building, septic and parking area. Also, a series of four (4), three (3), and two (2) testholes were excavated in the Tamaracks, Birches, and Poplars campgrounds respectively for the proposed separate washroom facilities. The locations of the testholes are presented on the attached respective Testhole Location Plans in Appendix 'A' of this report.

The subsurface conditions were observed by the field staff and selected soil samples were collected for laboratory testing and further classification. While the excavations were occurring, the subsurface soils were probed with a steel rod to infer the relative compactness of the subgrade soils.

The soil and groundwater conditions observed in the field were logged and recorded as shown on the attached Testhole Logs in Appendix 'B'. As noted above, the ground surface at each testhole was surveyed and related to the site benchmark by SMC Geomatics.

### 3.2 General Sub-Surface Conditions

To assist with general review of the data, we have summarized the soil and bedrock conditions at each area as follows:

#### 3.2.1 "HUB"

As shown on the attached Testhole Location Plan (GMBP – Figure No. 2), Testholes No. 1 and 2 were located in the vicinity of the proposed septic field for the "Hub" building. Testhole No. 3, 4 and 5 were located in the vicinity of the proposed building. As well, Testhole No. 4 was near the proposed electrical transformer for the proposed "Hub" building. Testhole No. 6, 7 and 8 were located in the area of the proposed parking lot and the elliptical roadway for accessing the "Hub" building.

Except for Testhole No. 8 which encountered rock at the surface, the Testholes in the Hub area varied in depth from 0.5m to 1.2m. The stratigraphy encountered in Testhole No. 1 revealed surficial topsoil underlain by silty sand with trace gravel, underlain by clayey silt till, which was ultimately underlain by bedrock. Testhole No. 2 encountered similar subgrade stratigraphy, but without the lower layer of the clayey silt till with sand gravel and cobble layer above the bedrock. Soil samples were obtained from Testholes No. 1 and Testhole No. 2 to determine the grain size of the soils and to determine a percolation rate (T-time using the Hazen Formula) for the collected samples. Results are attached in Appendix 'C'. However, it is noted from the recorded surface elevations of Testholes No. 1 & 2 that there is 0.80 meters of elevation difference and the inferred bedrock contact elevations between these Testholes has an elevation difference of 1.42 meters in the same gradient.

In general, the sub-surface conditions across the remainder of the "Hub" site consist of similar soils as noted above in the septic bed location, with decreasing soil overburden thickness to the bedrock as the exploratory testholes progressed northerly across the "Hub" site. It should be noted that the soil thickness at Testhole No. 3 (southern side of "Hub" site) was 1.0 meter thick and Testhole No. 8 (northern side of the parking area) encountered bedrock at surface. In areas where imported granular fill exists at the surface (Testhole No. 4 and No. 7), it appears that the historic topsoil layer was not removed prior to the installation of the granular fill, as a blended matrix of organics and gravel exists above the bedrock.

#### 3.2.2 Campground Washroom Facilities

##### Tamaracks:

The locations of the testholes are presented in Appendix 'A' – Figure L-5. As shown on the attached Testhole Logs, the investigative testholes were generally able to be extended to depths ranging between 0.40 to 1.70m prior to inferred bedrock contact.

The removable soils encountered are generally summarized as surficial granular fill (existing road/paths), underlain or mixed with organics, which are underlain by silty sand with trace gravel and/or clayey silt till with sand, gravel and cobbles.

#### Birches:

The locations of the testholes are presented in Appendix 'A' – Figure L-6. As shown on the attached Testhole Logs, the two southern most investigative testholes (Birches -155 & Birches-24) extended through a thin surficial layer of sand and gravel fill (0.15 – 0.30 meter thick) and contacted the underlain bedrock. The third testhole (Birches 13/14) was able to be advanced 1.5 meters below surface. This testhole encountered various layers of surficial fill above the trapped layer of organics prior to encountering the native undisturbed silty sand with gravel and cobbles. Underlain to these soils exists the inferred bedrock.

#### Poplars:

The locations of the testholes are presented in Appendix 'A' – Figure L-8. As shown on the attached Testhole Logs, the investigative testholes generally extended through surficial fill and trapped organic layer, prior to encountering native undisturbed soils. The southernmost testhole (Poplars 15/16) encountered weathered bedrock directly below the layer of organics. The northernmost testhole (Poplars 17/18) encountered a 0.40 meter thick layer of clayey silt till with gravel and cobbles prior to contacting the bedrock.

### **3.3 Summarized Subsurface Conditions**

While the attached Testhole Logs are to be referenced for detailed stratigraphy at each testhole, the following summarizes the findings as per various layers.

#### **3.3.1 Topsoil and Organics**

Topsoil and organic soils along with other deleterious materials were encountered at surface in the undeveloped areas. Where historical developments (mainly roadways) exist, trapped layers of organics exist below the installed fill materials, as the organics were not typically removed prior to the installation of fill. Based on the recorded soil stratigraphy, the organic layers range in depths between 0.05 meters to 0.30 meters in thickness across the various sites within the project scope.

#### **3.3.2 Sand and Gravel Fill**

The testholes excavated in the existing gravel driveway within the “Hub” area encountered surficial imported sand and gravel fill layer (generally 19 mm crushed granular) that was 0.15m in thickness and was generally underlain by a layer of mixed organics.

Generally all of the testholes excavated for the washroom building were located directly adjacent to the existing roadways and pathways surrounding the proposed washroom buildings.

Therefore, where this surficial imported gravel fill exists, it is generally 19 mm crushed granular and ranges between 0.15 to 0.30 meters in thickness. It was also noted that this surficial fill is underlain by either a layer of mixed organics or directly underlain by bedrock.

### **3.3.3 Sand Fill**

Sand fill was only encountered in the testholes at Birches 13/14 & Poplars 17/18. This layer of fill presented as both brown and grey in colour and was noted to be fine graded. In both locations the sand fill layer was located above the historical surficial organic and ranges in thickness between 0.15 to 0.25 meters.

### **3.3.4 Silty Sand with trace Gravel**

Within the "Hub" investigation, reddish brown silty sand with trace gravel was encountered in the southern portion of the investigative area. Generally, these soils exist directly below the surficial organics. These soils are generally present in the proposed septic area and the proposed building area (southern and eastern portions of the "HUB" site), and range in thickness between 0.20 to 0.50 meters. Based on the in-situ density, these soils are considered to be in a loose to compact state and laboratory moistures confirm in-situ moisture levels ranging between 8.8% to 12.4%.

Due to the existence of these soils in the proposed septic field location, grain-size determinations were completed on samples collected from HUB-TH-1 (0.4mbgs) & HUB-TH-2 (0.3mbgs). Based on these gradation results (enclosed in Appendix 'C' for additional reference), the soil composition appears to consist of 83.9% to 85.2% granular content (sand and gravel), with 14.8% to 16.1% plastic soil content (silt and clay). The findings are discussed in the septic design section of this report.

Within the proposed washroom facilities, the silty sand with trace gravel soils were only encountered in Tamaracks 5/6 and Tamaracks 7/8 locations. It is noted that these soils also exist directly below the surficial organics and either overburden clayey silt till or bedrock. However, the thickness of these soils was noted to range between 0.20 meters (at the Tamaracks 5/6 location) to 0.70 meters thick (at Tamaracks 7/8 location).

### **3.3.5 Silty Sand and Gravel with Cobbles**

A layer of brown silty sand and gravel with cobbles was only encountered in the testhole located at Birches 13/14 site. This layer of soil was noted to underlay the historical organic layer which is underlain to existing surficial fill. At this location, the silty sand and gravel with cobbles was noted to be well graded and was in a moist (7.0% moisture content) and compact state. These soils presented in a relatively thick band (minimum of 1.05 meters thick). A boulder or bedrock was encountered, resulting in the termination of the investigative testhole at that depth.

### **3.3.6 Clayey Silty Till with Sand, Gravel and Cobbles.**

Brown and grey clayey silt till with sand, gravel and cobbles was encountered in testholes HUB-TH-1, 3, 6. In addition, similar soils were also encountered at Tamaracks-3/4, 5/6, 7/8, and Poplars-17/18.

In all occurrences, these soils were in a dense to very dense state and were encountered directly above the underlain bedrock. The collected sample from HUB-TH-1 was found to have a moisture content of 8.9%.

This same sample was also tested for grain-size determination, as these soils exist within the proposed septic envelope. Based on the soil grading completed in our laboratory, the soil consists of 10.4% gravel, 42.0% sand, 34.8% silt and 12.8% clay.

### **3.3.7 Bedrock (Weathered)**

Weathered bedrock was generally encountered across the entire site, and was typically located below the removable soils and above the intact bedrock. This “weathered” bedrock was able to be excavated with some effort using the JD 27c excavator and typically revealed 50 mm thick bedding planes. However, the thickest layer of weathered bedrock encountered in the testholes was only 0.20 meters thick.

### **3.3.8 Bedrock (Competent)**

Bedrock was encountered across the entire site, and was typically the cause for the termination of the investigative testholes. The bedrock is considered as “competent” based on the evidence of massive particles and the integrity of the surface and resistance when attempting to excavate the rock or a fissure or crevice to continue advancing the excavations. Based on the observations, the removal of this rock would require rock removal equipment (ie: hoe-ram) to fracture the rock and unconfine the rock for removal by excavation.

## **3.4 Groundwater Conditions**

In general, the investigative testholes were relatively dry with the soils generally being reported as moist. However, a minor groundwater condition was encountered in the testholes at Poplars 17/18 at 0.5m bgs. This minor infiltration was attributed to a “perched” condition between the interface of the surficial organic layer and the subgrade soils.

Based on the observations, significant amounts of groundwater are not anticipated at the depths required for the shallow foundation elements or the proposed tank installation if kept in the overburden or shallow bedrock. Trapped and perched water may be encountered locally.

## **4. DISCUSSION AND RECOMMENDATIONS**

### **4.1 ‘Hub’ and Washroom Buildings**

#### **‘Hub’**

Based on the conceptual designs and discussions with the AECOM design team and client representative, the proposed ‘Hub’ building will be constructed as two buildings with a covered breezeway between.

The facilities are understood to include seasonal shower facilities (including accessible), washrooms, laundry facilities, indoor and outdoor recreation areas, along with associated parking for the facility. Based on this conceptual design information and the seasonal usage, it is understood that a frost protected foundation with an interior slab-on-grade will be the considered for the proposed 'Hub' building structure.

Due to the potentially significant water usage from the 'Hub' building and its facilities, it is understood that a large sewage system (> 10,000 L/day flows and conceptual septic field of approximately 50m x 90m) will be required to handle the wastewater and effluent from the proposed building. However, to reduce the overall effluent output, it is understood that a grey water system may also be constructed and outlet under the proposed parking area to the north of the 'Hub' building location. It should be noted that the grassed surface of the septic area is being considered to be utilized as an outdoor activity area, with surficial features installed for public use.

### **Washrooms**

It is understood that these washrooms are will be approximately 7.3 meters by 9.5 meters with a proposed 22730 L (5000 gal) shallow profile buried holding tank. Based on these dimensions, the proposed washrooms will be approximately 2.5 times larger than one of the existing structures. With most of the washroom sites, the proposed washroom buildings should fit within the extent of the current clearings. Unlike the historical washroom buildings, where the tanks are installed under the buildings, it is proposed to have the tanks installed across the access roads in the clearings where the other washroom will be removed.

With the holding tank being separated from the building structure, structural frost protected foundations (including any internal piers, as it is understood to be a seasonal unheated building) are recommended. It is understood that the interior of the building will have an insulated slab-on-grade. It is expected that, historical disturbances (in areas where the existing washrooms have tanks approximately 1.5 meters in depth installed below the current structures) will have to be addressed with either deeper foundations or engineered compacted fill to ensure the newly proposed structure has suitable and uniform structural bearing.

#### **4.1.1 Foundation Loading**

##### **'Hub'**

For preliminary discussion purposes, it is assumed that the area of the proposed 'Hub' building would be built up using imported compacted fill, with the proposed building floor to be near an elevation of 200.00m. With typical 1.5 meter deep frost protected foundation walls, the theoretical grade for the building footings would be near the existing ground surface. With the presence of historical granular fill and the potential for unstripped organic soils at or near this anticipated footing elevation, it is recommended that the site be stripped of any organic and deleterious soils and the grade raised with imported granular fill.

The granular is to be compacted to 100% of the material's Standard Proctor Maximum Dry Density (SPMDD) and be installed in lifts, not exceeding 300mm in thickness. Compaction testing (typically conducted by a third party geotechnical consultant) will be required to verify the compacted densities to permit the required foundation loading.

With the required densities verified on the installed granular fill, a bearing capacity of 150 kPa at Serviceability Limit State (SLS) and 210 kPa at Ultimate Limit State (ULS) can be utilized for design purposes.

Depending on the selected finish floor grade, the 'Hub' foundations may also encounter bedrock at the proposed foundation depths. Upon the quality of the bedrock being confirmed by a geotechnical consultant, is also anticipated to permit a bearing capacity of 150 kPa at Serviceability Limit State (SLS) and 210 kPa at Ultimate Limit State (ULS).

If greater design bearing capacities are required for the design, a follow-up review can be considered for isolated pier footings placed on competent rock.

### **Washroom Facilities**

Based on the current site grading of the washroom areas, a 1.5 meter deep frost protected foundation wall and footing is recommended, so the proposed foundation will extend below the level of disturbance from the existing washroom structures. Deeper footings or engineered fill may be required in areas of the holding tanks. Therefore, the proposed foundations are to be located below any historical surficial installed fill, and would likely contact competent clayey silt till (with sand, gravel and cobbles) or bedrock. Based on the anticipated footing elevations, a bearing capacity of 150 kPa at Serviceability Limit State (SLS) and 210 kPa at Ultimate Limit State (ULS) can be utilized for design purposes.

#### **4.1.2 Slab-On-Grade Construction**

It is anticipated that both the "Hub" complex and the proposed campground washrooms designs will include a concrete slab-on-grade floor. As a result, the entire area of the buildings will have to be stripped of surficial fill and/or topsoil and of any underlying layers of organic material that may have been covered by fill. The backfill material under the slab should consist of imported Granular 'B' meeting OPSS 1010 Type 1 or 2, and be compacted in 200mm layers to 98% of the material's Standard Proctor Maximum Dry Density (SPMDD).

As a moisture break and leveling course, 0.20m of Granular 'A' should be placed and compacted to 98% SPMDD for the final granular layer.

#### **4.1.3 Seismic Design**

As per 4.1.8.4 of the Ontario Building Code (OBC), site classification for the underlying ground shall conform to Table 4.1.8.4A.

While the bedrock is at or near surface in the general area, the shallow footings would be placed in the upper undisturbed soil or imported engineered fill, and therefore, the Site Class for the “Hub” building and proposed washrooms is interpreted to be “D”. The associated parameters should be reviewed by the Structural Engineer as part of the design for the project works.

#### 4.1.4 Excavation and Backfill

As previously indicated, it is anticipated that the “Hub” building floor and grading will be raised significantly and therefore, excavations should be near the existing surface and straight forward.

The proposed individual campground washrooms will likely encounter different excavation conditions as these structures will be replacing the existing structures which have ±1.5 meter deep holding tanks below the superstructure, with the holding tanks acting like the foundations. Since the proposed washrooms are greater than 2 times the floor area of the existing washrooms, it is expected that the excavations will extend beyond the limits of disturbance from the historical holding tank/washroom installations.

Nevertheless, the on-site soils to be excavated can be classified as follows in accordance with the Ontario Health and Safety Act (OSHA) for Constructions Projects (Regulation 213/91).

Loose to Compact Silty Sand with Gravel .....	Type 3
Dense Clayey Silt Till with Sand, Gravel & Cobbles .....	Type 2
Upper Weathered Bedrock .....	Type 1

Where the excavations are made in the encountered fill or the silty sand with trace gravel, the excavation is to be cut back at an angle of 45° from the bottom of the excavation or from the rock interface. If the excavations are made within the clayey silt till, the lowest 1.2 meters of the excavation can be excavated near vertical and the remainder of the excavation must be cut back at an angle of 45° from that point.

If necessary for servicing and septic tank installation (“Hub”), excavation into the competent rock can be near vertical, provided all loose material has been removed and there is no potential of rock spalling while the trench is open and workers have access.

For backfilling the exterior of the structure, it is not expected that the existing Granular from the existing graded areas will yield a significant amount of suitable material. Surrounding the “Hub”, there may be a potential for harvesting the native silty sand with trace gravel, however, it would be considered suitable only if it is at the optimum moisture content and can be compacted as specified. Alternatively, imported granular (satisfying the OPSS 1010 grading requirements of Granular “B”) is expected to be necessary for backfilling the proposed “Hub” building and the proposed campground washrooms, and will be required to be compacted as specified.

The final grades are not known for the proposed parking lot and elliptical roadway on the north side of the “Hub”. However, based on the presence of rock, it is suggested that the parking lot be raised sufficiently to allow removal of trees, roots and organics, with minimum rock excavation. Raising the grade will provide better positive subgrade drainage and allow a thicker granular subbase to be constructed. The thicker granular subbase and subgrade will reduce some of the potential for differential frost heave and settlement encountered with a mix of native bedrock and various subgrade soils which will be capped with imported granular fill.

## 4.2 “Hub” Parking Lot Construction

It is recommended that the proposed parking and elliptical driveway for the “Hub” be constructed as follows:

**Table No. 1 – Recommended Pavement Structure**

Pavement Component	Access Route/Heavy Duty Pavement Thickness (mm)	Light Duty Pavement Thickness (mm)	Specified Compaction (%)
HL-3 Surface Course	50	60*	92% to 96.0% MRD
HL-4 Base Course	50	-	92% to 96.0% MRD
OPSS Granular ‘A’	150	150	100% SPMDD
OPSS Granular ‘B’ – Type I	300**	300**	100% SPMDD

\* To facilitate construction in shoulder seasons, two lifts consisting of 40mm of HL-3 and 40mm of HL-4 can be considered to replace the one 60mm lift of HL-3 in light duty areas.

\*\* Due to the irregular topography of the rock subgrade within the proposed parking lot, additional Granular may be required below the minimum 300mm to level off the subgrade after stripping the organics and breaking high points of rock.

## 4.3 “Hub” Septic and Greywater

As noted above, the proposed septic field will be located south of the “Hub” building, with greywater outlet generated from the building being piped to a tile field outlet located between center parking stalls in the landscaped area to the north of the “Hub”.

Based on the initial discussions, it is understood that the designed sewage flows will exceed 10,000L/day, which will result in a large septic bed area. It is understood that the play areas and surficial recreational features of the site may be located on top of the proposed septic bed, located south of the proposed “Hub” building.

To assist with the conceptual design of the sewage system, three (3) samples of the overburden below the topsoil were processed in our laboratory for grain size distribution and the determination of the respective percolation rates (T-Times). Results are presented in Appendix ‘C’ for review by the respective designers. Based on the size of the septic field and the presented elevation/topographic survey data (which identifies various rock outcroppings), it is expected that the septic design will have to be modified accordingly. Due to the varying soil conditions and size of the system, it is to be noted that where the subgrade soils are utilized as part of the design, additional evaluation of the subgrade soils is required across the entire area to confirm the consistency of actual site conditions and design assumptions.

For the location of the proposed greywater outlet, visible rock at surface was encountered across that area. Although the parking area/greywater outlet will likely be in a fill condition due to the construction of the parking lot sub-base, appropriate imported material will be required to be installed to facilitate the proposed greywater discharge into the fill soils.

#### **4.4 Initial Screening – Chemical Testing of Soil**

During the site visit, and excavation work, no obvious visual signs of impact were noted at the testhole locations. It should be noted that since there was no evidence of Petroleum Hydrocarbons within the excavations, no PHC or PAH testing was completed.

As per typical submissions to Parks Canada, selected soil samples from various areas of the site were submitted for initial screening and analysis of general metal and inorganics. Maxxam Analytics Inc. (Maxxam) is an accredited laboratory by the Canadian Association for Laboratory Accreditation (CALA) and by the Standards Council of Canada for the analysis requested. Copies of the laboratory Certificate of Analysis are provided in Appendix 'D'.

In addition, three soil samples were sent to determine specific soil parameters with regards to soil corrosivity, conductivity and resistivity. The Certificates of Analysis are also provided in Appendix 'D'.

##### **4.4.1 Chemical Analyses – Environmental Quality**

With respect to the metals and inorganics, the reported concentrations for the sample (Hub-TH#5) were below the criteria noted in Table 1 – Background Agricultural or Other (Coarse Grained). For the sample from Hub-TH#1, the concentration of 51 ug/g for Cobalt exceeded the above criteria. Additional samples should be collected for analysis to investigate occurrence of exceedance and potential soil management during construction.

##### **4.4.2 Chemical Analyses – Corrosivity**

Five soil samples were submitted for sulphides, soluble chloride, conductivity, pH, and soluble sulphate. CSA A23.1 – 2009 describes the degree of sulphate exposure for concrete as being moderate for soils having sulphate values between 0.10% and 0.20%, severe for values between 0.20% and 2.0%, and very severe for values greater than 2.0%. Based on the reported results of less than 0.020%, negligible impact from the soil to well consolidate concrete would be expected.

The moisture content, sulfide, resistivity and conductivity indicate that the conditions are low to moderately corrosive to underground metallic structures. The reported pH levels are generally near neutral.

## 5. STATEMENT OF LIMITATIONS

The discussion and recommendations in this report are based upon information gathered at the testhole locations and available geological and physiographical information of general nature for the area. Sub-surface and groundwater conditions are variable and will differ in area beyond the investigated testholes. As a result, conditions may become apparent during further investigation or construction, which would not be detected or anticipated at the time that the site investigation was performed and when this report was prepared. The information in this report is intended for the sole use of Parks Canada and its agents. GM BluePlan Engineering Limited accepts no liability for use of this information by third parties on the basis of information provided in this preliminary are made at the sole risk of the third parties.

The final shape and location of the proposed "Hub" building, parking lot and washroom buildings have not been confirmed and therefore comments made within this report are made in general only to assist the owner and designers for the project in question. Furthermore, the number of testholes may not be sufficient to determine all the factors that may affect the construction methods and costs. For this reason, Contractors bidding on this project or undertaking the construction should make their own interpretation of the factual information presented within this report and then draw their own conclusion on the sub-surface conditions and how it will affect the methods and cost of construction.

It is our recommendation that additional testholes be excavated in the proposed "Hub" development, and more specifically in the septic field to better delineate the rock depth and quantify the required rock excavation where rock depths affect the selected designs. We recommend that we be retained to ensure that all the necessary stripping, sub-grade preparation, and compaction requirements are met, and to be available to confirm that the soil conditions do not deviate from those presented within this report.

All of which is respectfully submitted

GM BLUEPLAN ENGINEERING LIMITED

Per:



Derek Brewster, C.Tech

Reviewed by:

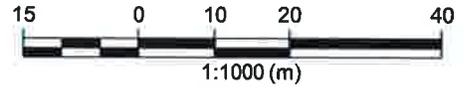


Wm. E. Dubeau, P.Eng.



**FIGURES:**

217291  
Bruce Peninsula  
National Park



SCALE = 1:1,000  
SEPTEMBER 2017

SITE LOCATION PLAN

CYPRUS LAKE BIRCHES  
CAMPGROUND  
INFRASTRUCTURE  
IMPROVEMENTS

Figure No. 1



217291  
Bruce Peninsula  
National Park

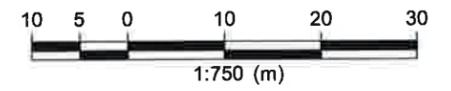


LEGEND

HUB-TH-4  
GRND 198.08



TEST HOLE LOCATION,  
NUMBER AND GROUND  
ELEVATION

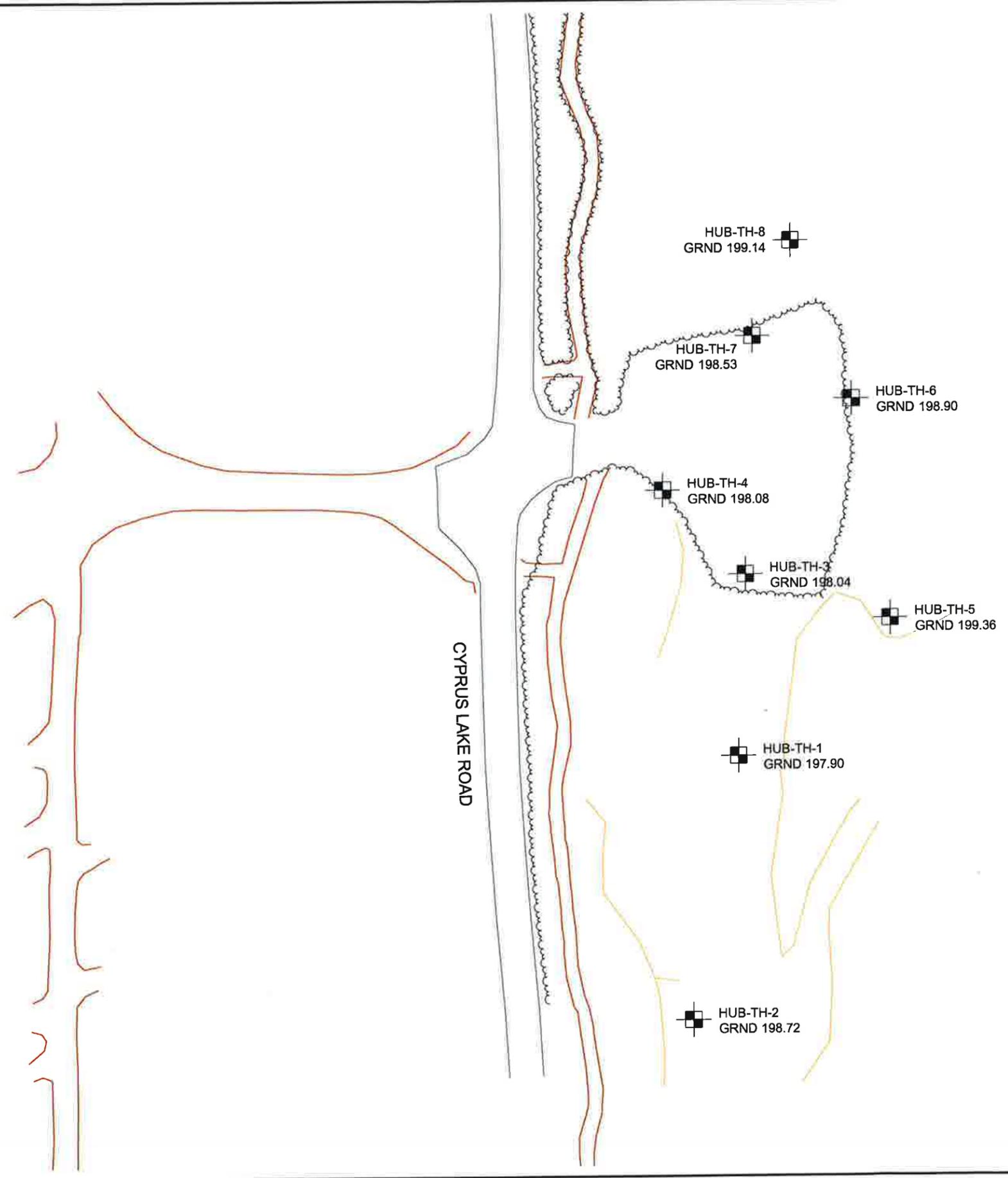


SCALE = 1:750  
SEPTEMBER 2017

TEST HOLE  
LOCATION PLAN

CYPRUS LAKE - "HUB"  
CAMPGROUND  
INFRASTRUCTURE  
IMPROVEMENTS

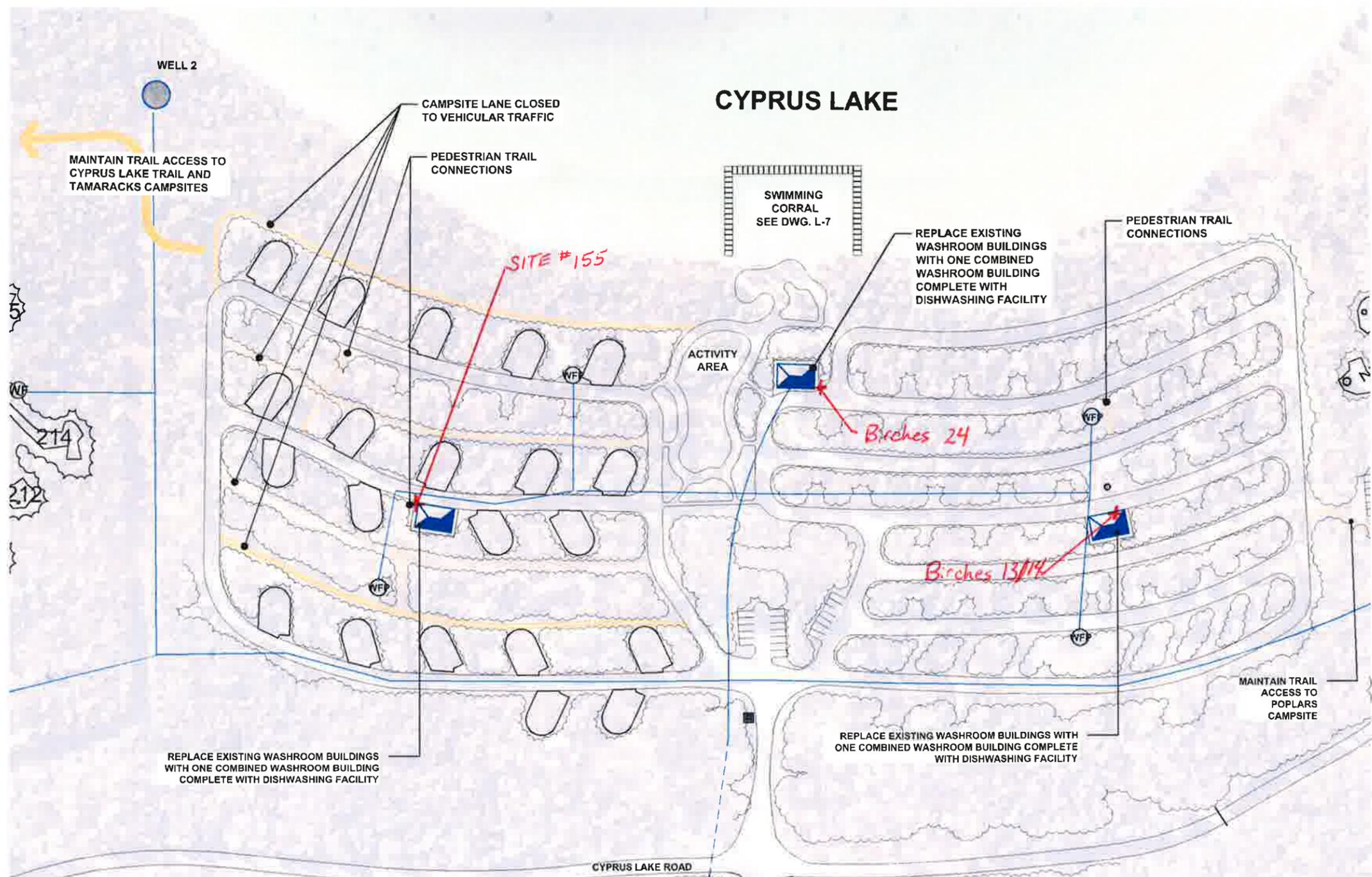
Figure No. 2



FILE:C:\Civil 3D Projects\217291 TH Plan-K.dwg LAYOUT:Testhole Plan 2  
LAST SAVED BY:Kboers, 9/11/2017 9:15:24 AM PLOTTED BY:Ken Boers - GM BluePlan 9/11/2017 3:00:46 PM

**APPENDIX A:  
TESTHOLE LOCATION PLANS**





- Legend**
- PEDESTRIAN TRAIL CONNECTION
  - PARKING LAYOUT CONCEPT
  - PROPOSED WATER FOUNTAIN
  - EXISTING WATER FOUNTAIN
  - WATER LINE
  - EXISTING GARBAGE DISPOSAL
  - NEW WASHROOM BLDG. FOR DETAILS SEE DWG. A-3

*Testhole Location  
Plan  
September, 2017*

NOTE:  
FOR ELECTRICAL INFORMATION REFER TO  
SERIES 'E' SHEETS

**BRUCE PENINSULA NATIONAL PARK  
CONSTRUCTION COST  
BUDGET REPORT**

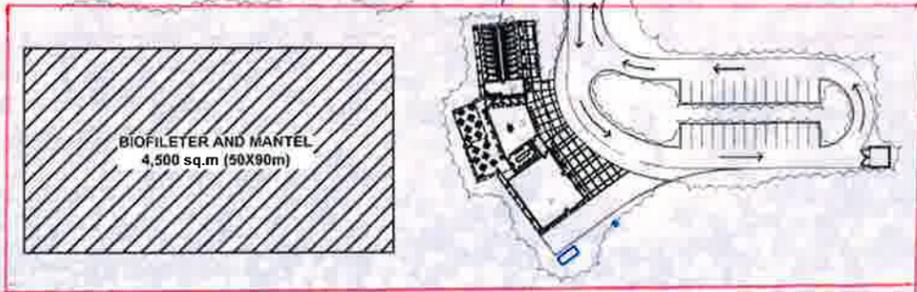
**SITE 2 - CYPRUS LAKE  
BIRCHES CAMPGROUND  
PROPOSED INFRASTRUCTURE IMPROVEMENTS**

September 2016      1:750      Datum: NAD 83, ZONE 17  
Source: Parks Canada, LIO

P#:60438560      V#:

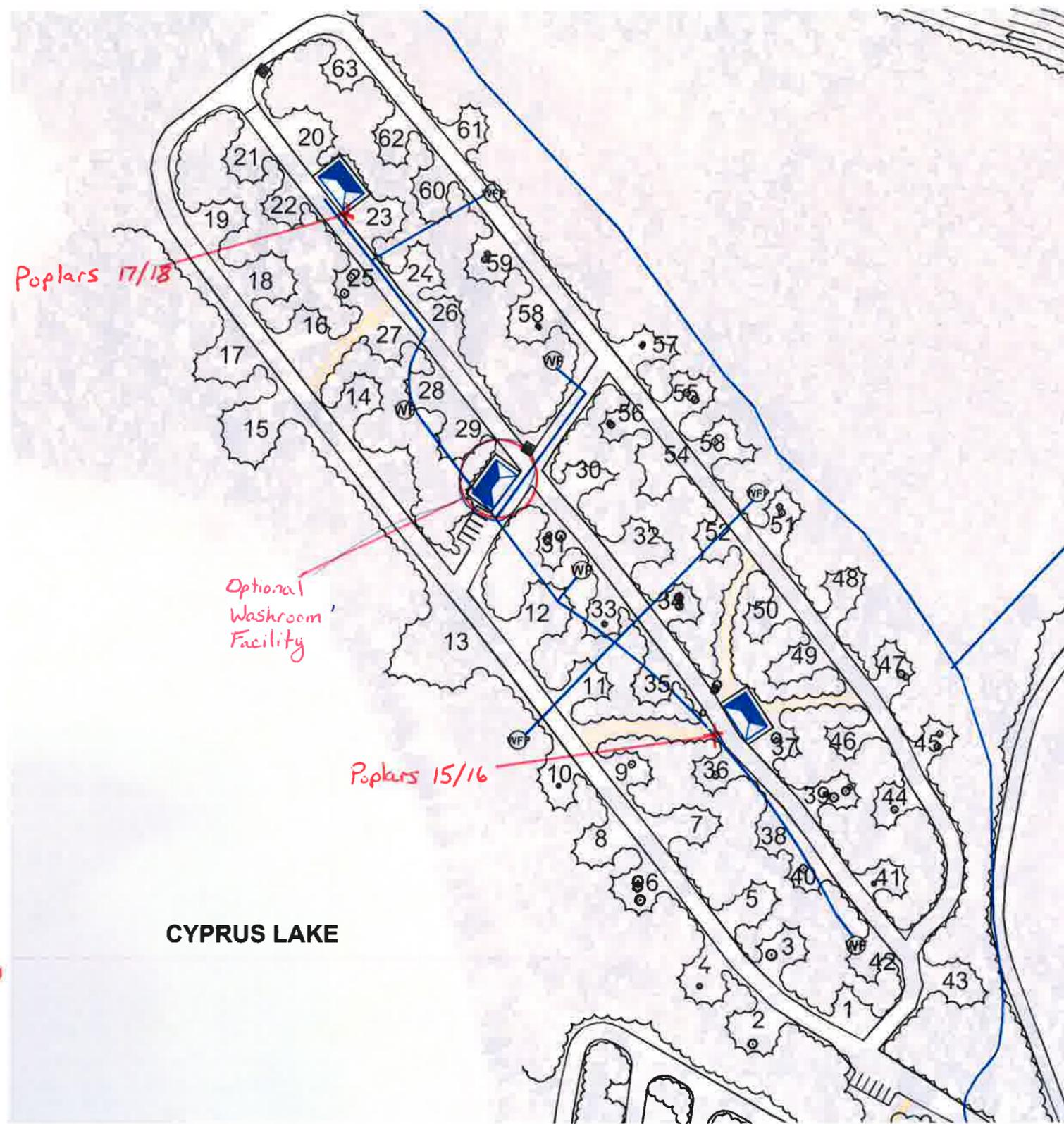
**AECOM**      Figure L-6

*Note: Testhole locations are approximate and elevations are assumed as 100.00m at surface, unless otherwise noted.*



*For "Hub" Testhole Location Plan, refer to Figure No. 2.*

This drawing has been prepared for the use of AECOM's client and may not be used, reproduced or relied upon by third parties, except as agreed by AECOM and its client, as required by law or for use by governmental reviewing agencies. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without AECOM's express written consent.



Note: Testhole locations are approximate and elevations are assumed as 100.00m at surface, unless otherwise noted.



**Legend**

- PEDESTRIAN TRAIL CONNECTION
- PARKING LAYOUT CONCEPT
- PROPOSED WATER FOUNTAIN
- EXISTING WATER FOUNTAIN
- WATER LINE
- EXISTING GARBAGE DISPOSAL
- EXISTING SURVEYED TREE
- NEW WASHROOM BLDG. FOR DETAILS SEE DWG. A-3



Testhole Location  
Plan  
September, 2017

NOTE:  
FOR ELECTRICAL INFORMATION REFER TO  
SERIES 'E' SHEETS

**BRUCE PENINSULA NATIONAL PARK  
CONSTRUCTION COST  
BUDGET REPORT**

**SITE 2 - CYPRUS LAKE  
POPLARS CAMPGROUND  
PROPOSED INFRASTRUCTURE IMPROVEMENTS**

September 2016	1:1500	Datum: NAD 83, ZONE 17 Source: Parks Canada, LIO
P#: 60438560	V#:	

**AECOM**

Figure L-8

This drawing has been prepared for the use of AECOM's client and may not be used, reproduced or relied upon by third parties, except as agreed by AECOM and its client, as required by law or for use by governmental reviewing agencies. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without AECOM's expressed written consent.

**APPENDIX B:  
RECORD OF TESTHOLE LOGS**

Project No: 217291

# Log of Testhole: HUB-TH-1

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY
Depth	Elevation	Symbol	Description	% Moisture 5 15 25	Ground Water and Sampling Details
0	197.90		Ground Surface		
	197.75		Black topsoil and organics with trace tree roots and gravel. Moist and loose.		
1			Reddish brown silty sand with trace gravel. Moist and loose to compact.		
	197.40		Brown and grey clayey silt till with sand, gravel and cobbles. Moist and dense to very dense.	8.8	
2			Brown and grey clayey silt till with sand, gravel and cobbles. Moist and dense to very dense.		
3			Brown and grey clayey silt till with sand, gravel and cobbles. Moist and dense to very dense.		
	196.80		Weathered limestone bedrock. Moist and hard.	8.9	
4	196.70		Weathered limestone bedrock. Moist and hard.		
			Excavation Terminated due to Intact Bedrock Contact.		
5					
6					

Notes:

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Equipment: JD 27c - Track Mini-I

Project No: 217291

## Log of Testhole: HUB-TH-2

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	198.72		Ground Surface				
	198.57		Black topsoil and organics with trace tree roots and gravel. Moist and loose.				
1			Reddish brown silty sand with traces of weathered bedrock (cobble size). Moist and loose to compact.	12.4			
2	198.22		Excavation Terminated due to Intact Bedrock Contact.				
3							
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-I

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: HUB-TH-3

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	198.04		Ground Surface				
			Black topsoil and organics with trace tree roots and gravel. Moist and loose.				
	197.84						
			Reddish brown silty sand with trace gravel. Moist and loose to compact.				
1							
	197.64						
			Brown and grey clayey silt till with sand, gravel and cobbles. Moist and dense to very dense.				
2							
3							
	197.04		Excavation Terminated due to Intact Bedrock Contact.				
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: HUB-TH-4

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	198.08		Ground Surface				
	197.93		Sand and gravel <b>fill</b> (19mmØ crushed sand and gravel). Moist and compact.				
	197.78		Sand and gravel <b>fill</b> mixed with some organics and tree roots. Moist and compact.				
	197.58		Weathered limestone bedrock. Moist and hard.				
			Excavation Terminated due to Intact Bedrock Contact.				

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: HUB-TH-5

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	199.36		Ground Surface				
			Black topsoil and organics with trace tree roots and gravel. Moist and loose.				
1	199.16		Reddish brown silty sand with traces of weathered bedrock (cobble size). Moist and loose to compact.				
2	198.66				14.8		
			Excavation Terminated due to Intact Bedrock Contact.				
3							
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: HUB-TH-6

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	198.90		Ground Surface				
			Black topsoil and organics with trace tree roots and gravel. Moist and loose.				
1	198.65		Reddish brown silty sand with trace gravel. Moist and loose to compact.				
							
2	198.40		Brown and grey clayey silt till with sand, gravel and cobbles. Moist and dense to very dense.				
							
3	198.00		Excavation Terminated due to Intact Bedrock Contact.				
							
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: HUB-TH-7

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	198.53		Ground Surface				
	198.38		Sand and gravel <b>fill</b> (19mmØ crushed sand and gravel). Moist and compact.				
	198.23		Sand and gravel <b>fill</b> mixed with some organics and tree roots. Moist and compact.				
	198.03		Weathered limestone bedrock. Moist and hard.				
			Excavation Terminated due to Intact Bedrock Contact.				

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

# Log of Testhole: HUB-TH-8

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	199.14		Ground Surface				
			Weathered limestone bedrock. Moist and hard.				
	198.94		Excavation Terminated due to Intact Bedrock Contact.				
1							
2							
3							
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-I

## GM BluePlan Engineering Limited

people engineering environments  
Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: Tamaracks-3/4

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	197.24		Ground Surface				
			Brown sand and gravel fill (19mm Ø crushed sand and gravel). Moist and compact.				
	197.04						
	196.99		Black topsoil and organics with trace tree roots and gravel. Moist and loose.				
1			Brown and grey clayey silt till with sand, gravel and cobbles. Moist and dense to very dense.				
2							
3							
4							
5							
6	195.54		Excavation Terminated due to boulder or intact Bedrock Contact.				
						8.5	

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

# Log of Testhole: Tamaracks-5/6

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	190.01		Ground Surface				
			Brown sand and gravel <b>fill</b> (150mm Ø). Moist and compact.				
1	189.71						
	189.61		Black topsoil and organics with trace tree roots and gravel. Moist and loose.				
			Brown silty sand with trace gravel. Moist and loose to compact.				
2	189.41						
			Brown and grey clayey silt till with sand, gravel and cobbles. Moist and dense to very dense.				
3							
				8.5			
4							
5							
	188.31						
6			Excavation Terminated due to boulder or intact Bedrock Contact.				

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: Tamaracks-7/8

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	193.73		Ground Surface				
			Brown sand and gravel <b>fill</b> mixed with black organics. Moist and loose.				
1	193.43		Brown silty sand with trace gravel. Moist and loose to compact.				
2							
3	192.73		Excavation Terminated due to intact Bedrock Contact.				
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: Tamaracks-9/10

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY
Depth	Elevation	Symbol	Description	% Moisture 5 15 25	Ground Water and Sampling Details
0	194.94		Ground Surface		
			Brown sand and gravel fill (19mm Ø crushed sand and gravel) mixed with weathered bedrock fragments. Moist and compact.		
1	194.64				
	194.54		Weathered limestone bedrock. Moist and hard.		
			Excavation Terminated due to intact Bedrock Contact.		
2					
3					
4					
5					
6					

Notes:

**GM BluePlan Engineering Limited**

people engineering environments

Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA

1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3

519-376-1805 Fax 519-376-8977 www.gamsby.com

Equipment: JD 27c - Track Mini-I



Project No: 217291

## Log of Testhole: Birches-13/14

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	193.13		Ground Surface				
	192.98		Sand and gravel <b>fill</b> (19mmØ crushed sand and gravel). Moist and compact.				
	192.83		Fine grey sand <b>fill</b> . Moist and loose.				
1	192.68		Black topsoil and organics with tree roots. Moist and soft.				
2			Brown silty sand and gravel with cobbles. Moist and compact.				
3							
4							
5	191.63		Excavation Terminated due to Boulder or Bedrock Contact.				
6							

7.0

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: Birches-155

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	194.98		Ground Surface				
			Sand and gravel fill (19mmØ crushed sand and gravel). Moist and compact.				
1	194.68		Excavation Terminated due to Intact Bedrock Contact.				
2							
3							
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: Birches-24

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	190.88		Ground Surface				
	190.73		Sand and gravel fill (19mmØ crushed sand and gravel). Moist and compact.				
			Excavation Terminated due to Intact Bedrock Contact.				
1							
2							
3							
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-I

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: Poplars-15/16

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	190.82		Ground Surface				
			Brown sand and gravel fill (19mm Ø crushed sand and gravel). Moist and compact.				
	190.57						
1			Black topsoil and organics with trace tree roots and gravel. Moist and loose.				
	190.42						
			Weathered limestone bedrock (50mm thick bedding planes). Moist and hard.				
2	190.22						
			Excavation Terminated due to Intact Bedrock Contact.				
3							
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments  
 Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



Project No: 217291

## Log of Testhole: Poplars-17/18

Project: BPNP - Cyprus Lake Campground Upgrades

Excavation Date: September 4, 2017

Client: Parks Canada - via AECOM

Field Technician: D. Brewster, C.Tech

Location: Cyprus Lake

Excavation Company: Munn Excavating Ltd.

SUBSURFACE PROFILE				PROPERTIES	HYDROLOGY		
Depth	Elevation	Symbol	Description	% Moisture			Ground Water and Sampling Details
				5	15	25	
0	188.54		Ground Surface				Minor groundwater infiltration @ 0.5m bgs.
	188.39		Brown sand and gravel <b>fill</b> (19mm Ø crushed sand and gravel). Moist and compact.				
			Brown fine sand <b>fill</b> . Moist and loose.				
1	188.14		Black topsoil and organics with trace tree roots and gravel. Moist and loose.				
	188.04		Reddish brown and grey clayey silt till with sand, gravel and cobbles. Moist and dense to very dense.				
2			Excavation Terminated due to Intact Bedrock Contact.	13.4			
3	187.64						
4							
5							
6							

Notes:

Equipment: JD 27c - Track Mini-l

**GM BluePlan Engineering Limited**

people engineering environments

Guelph, Owen Sound, Listowel, Kitchener, London, Hamilton, GTA  
 1260 Second Ave East, Unit 1, Owen Sound, ON N4K 2J3  
 519-376-1805 Fax 519-376-8977 www.gamsby.com



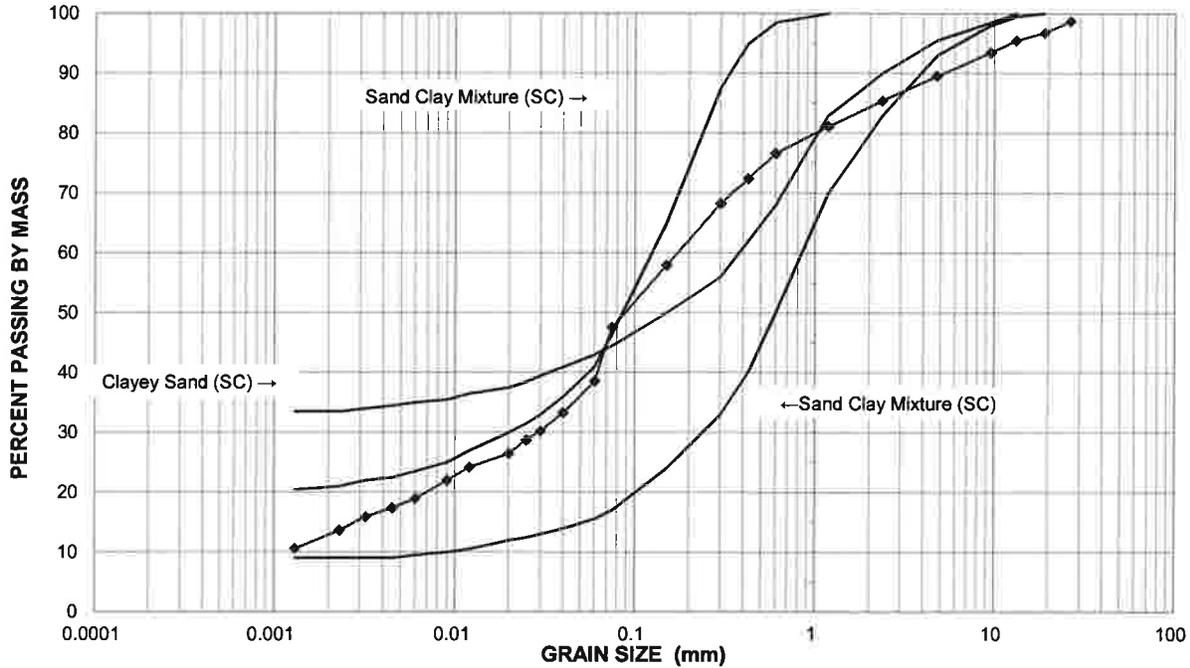
**APPENDIX C:  
GRAIN-SIZE ANALYSIS**

**PARTICLE SIZE ANALYSIS**

PROJECT: M.T. - Cyprus Lake Campground Renewal, Tobermory  
 LOCATION: North Bruce Peninsula  
 CLIENT: AECOM Canada Ltd  
 SOIL TYPE: Clayey Silt Till with Sand, Gravel and Cobbles  
 GRAPH #: 8 - Clayey Sands, Sand-Clay Mixtures

FILE NO.: 217291  
 LAB SAMPLE NO.: S-2651  
 SAMPLE DATE: September 5, 2017  
 SAMPLED BY: D. Brewster  
 SOURCE: HUB-TH-1, 1.0 m BG

**PARTICLE SIZE DISTRIBUTION**



SIEVE SIZE PARTICLE DIA. (mm)	PERCENT PASSING		HYDROMETER PARTICLE DIA. (mm)	PERCENT PASSING	
	SAMPLE			SAMPLE	
26.5	98.7		0.0600	38.6	
19	96.8		0.0400	33.3	
13.2	95.5		0.0300	30.3	
9.5	93.5		0.0250	28.8	
4.75	89.6		0.0200	26.5	
2.36	85.5		0.0120	24.2	
1.180	81.1		0.0090	22.0	
0.600	76.6		0.0060	19.0	
0.425	72.5		0.0045	17.4	
0.300	68.3		0.0032	15.9	
0.150	57.9		0.0023	13.7	
0.075	47.6		0.0013	10.6	

**D<sub>10</sub> : 0.001 mm      D<sub>60</sub> : 0.18 mm      Cu : 180**

**Coefficient of Permeability: 1.0 x 10<sup>-6</sup> cm/sec      "T" Time : 50 mins/cm**

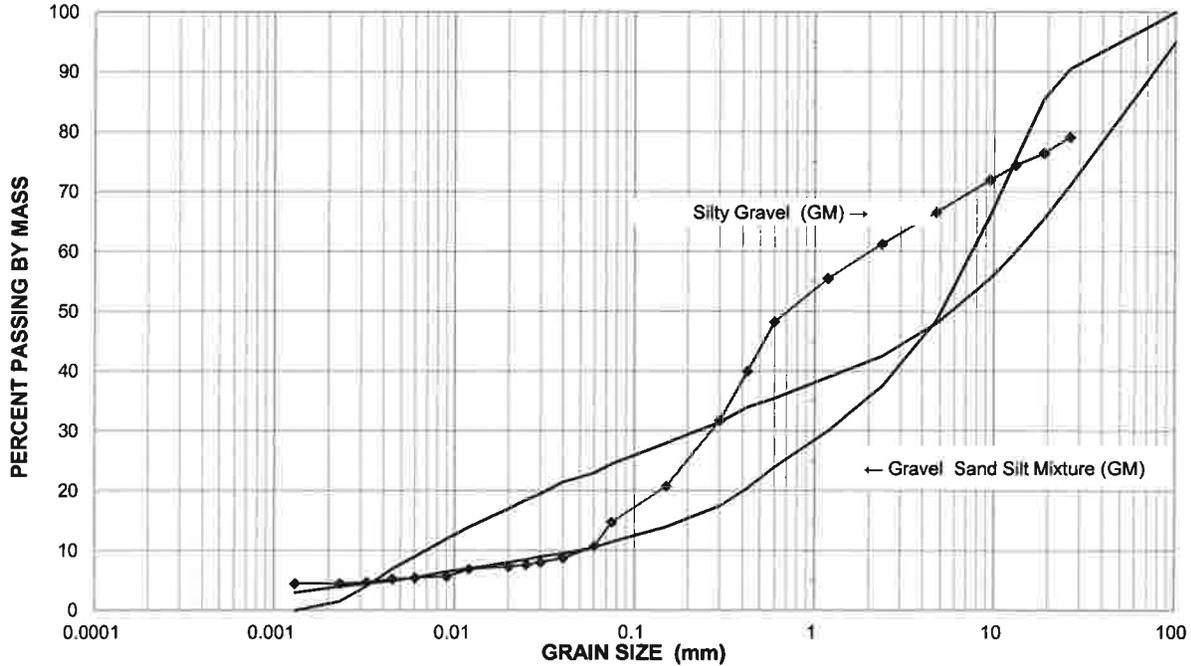
**Comments:** No cobbles present in collected sample

**PARTICLE SIZE ANALYSIS**

PROJECT: M.T. - Cyprus Lake Campground Renewal, Tobermory  
 LOCATION: North Bruce Peninsula  
 CLIENT : AECOM Canada Ltd  
 SOIL TYPE: Silty Sand with trace Gravel  
 GRAPH # : 3 - Silty Gravels, Gravel Sand Silt Mixtures

FILE NO.: 217291  
 LAB SAMPLE NO.: S-2652  
 SAMPLE DATE: September 5, 2017  
 SAMPLED BY: D. Brewster  
 SOURCE: HUB-TH-1, 0.4 m BG

**PARTICLE SIZE DISTRIBUTION**



SIEVE SIZE PARTICLE DIA. (mm)	PERCENT PASSING		HYDROMETER PARTICLE DIA. (mm)	PERCENT PASSING	
	SAMPLE			SAMPLE	
26.5	79.1		0.0600	10.7	
19	76.4		0.0400	8.8	
13.2	74.4		0.0300	8.1	
9.5	72.0		0.0250	7.6	
4.75	66.6		0.0200	7.4	
2.36	61.3		0.0120	6.9	
1.180	55.5		0.0090	5.7	
0.600	48.3		0.0060	5.5	
0.425	40.0		0.0045	5.2	
0.300	31.8		0.0032	4.8	
0.150	20.7		0.0023	4.5	
0.075	14.8		0.0013	4.5	

D<sub>10</sub> : 0.05 mm      D<sub>60</sub> : 2.1 mm      Cu : 42

Coefficient of Permeability: 2.5 x 10<sup>-3</sup> cm/sec      "T" Time : 10-15 mins/cm

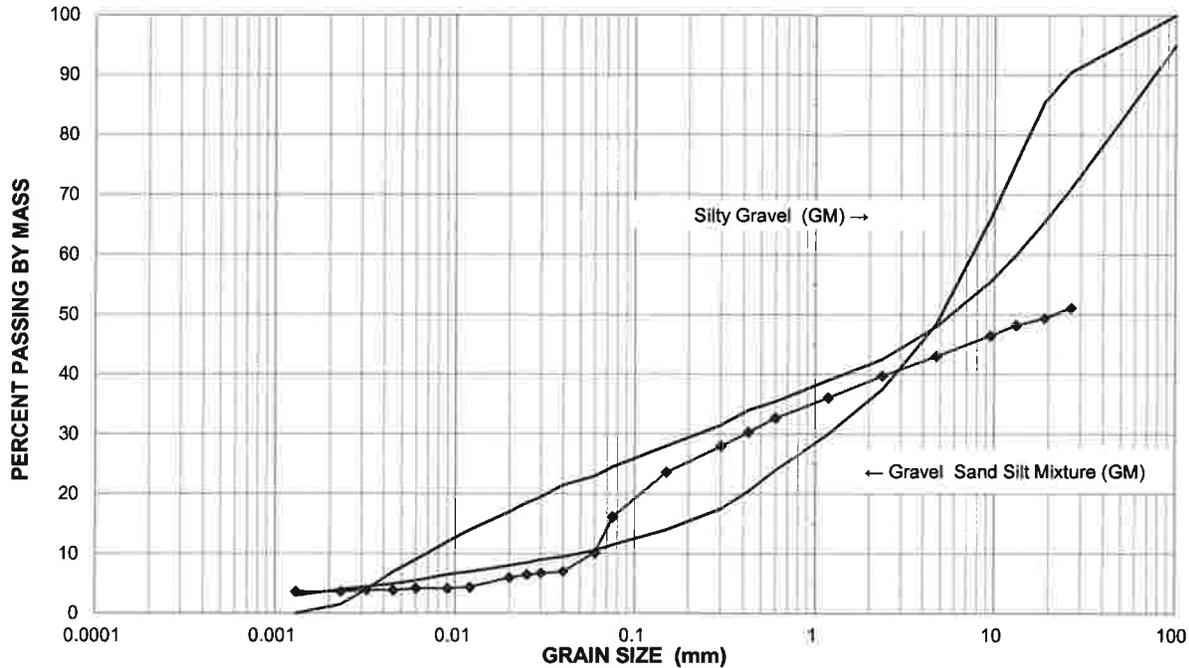
Comments:

**PARTICLE SIZE ANALYSIS**

PROJECT: M.T. - Cyprus Lake Campground Renewal, Tobermory  
 LOCATION: North Bruce Peninsula  
 CLIENT : AECOM Canada Ltd  
 SOIL TYPE: Silty Sand with trace Gravel  
 GRAPH # : 3 - Silty Gravels, Gravel Sand Silt Mixtures

FILE NO.: 217291  
 LAB SAMPLE NO.: S-2653  
 SAMPLE DATE: September 5, 2017  
 SAMPLED BY: D. Brewster  
 SOURCE: HUB-TH-2, 0.3 m BG

**PARTICLE SIZE DISTRIBUTION**



←		FINE	MEDIUM	COARSE	FINE	COARSE
CLAY		SILT		SAND		GRAVEL
SIEVE SIZE PARTICLE DIA. (mm)	PERCENT PASSING		HYDROMETER PARTICLE DIA. (mm)		PERCENT PASSING	
	SAMPLE		SAMPLE		SAMPLE	
26.5	51.1	0.0600	10.1			
19	49.4	0.0400	7.0			
13.2	48.2	0.0300	6.8			
9.5	46.4	0.0250	6.5			
4.75	43.0	0.0200	6.0			
2.36	39.8	0.0120	4.4			
1.180	36.1	0.0090	4.2			
0.800	32.7	0.0080	4.2			
0.425	30.3	0.0045	3.9			
0.300	28.0	0.0032	3.9			
0.150	23.6	0.0023	3.6			
0.075	16.1	0.0013	3.6			

**D<sub>10</sub> : 0.06 mm      D<sub>60</sub> : 31.1 mm      Cu : 520**

**Coefficient of Permeability: 3.6 x 10<sup>-3</sup> cm/sec      "T" Time : 10-15 mins/cm**

**Comments: Cobble sizes bedrock fragments noted in sample**

**APPENDIX D:  
CHEMICAL ANALYSIS RESULTS AND  
CERTIFICATE OF ANALYSIS**

Your Project #: 217291  
 Site Location: CYPRUS LAKE IMPROVEMENT  
 Your C.O.C. #: 610131-18-01

**Attention:Reporting Contacts**

GM BluePlan Engineering Limited  
 1260 - 2nd Ave E  
 Unit 1  
 Owen Sound, ON  
 CANADA N4K 2J3

**Report Date: 2017/10/13**  
**Report #: R4777437**  
**Version: 3 - Revision**

**CERTIFICATE OF ANALYSIS – REVISED REPORT**

**MAXXAM JOB #: B7J5101**

**Received: 2017/09/08, 09:22**

Sample Matrix: Soil  
 # Samples Received: 6

Analyses	Quantity	Date	Date	Laboratory Method	Reference
		Extracted	Analyzed		
Chloride (20:1 extract)	4	N/A	2017/09/12	CAM SOP-00463	EPA 325.2 m
Conductivity	4	N/A	2017/09/12	CAM SOP-00414	OMOE E3530 v1 m
Strong Acid Leachable Metals by ICPMS	2	2017/09/12	2017/09/12	CAM SOP-00447	EPA 6020B m
pH CaCl2 EXTRACT	4	2017/09/11	2017/09/11	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	4	2017/09/08	2017/09/12	CAM SOP-00414	SM 22 2510 m
Sulphate (20:1 Extract)	4	N/A	2017/09/12	CAM SOP-00464	EPA 375.4 m

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 217291  
Site Location: CYPRUS LAKE IMPROVEMENT  
Your C.O.C. #: 610131-18-01

**Attention:Reporting Contacts**

GM BluePlan Engineering Limited  
1260 - 2nd Ave E  
Unit 1  
Owen Sound, ON  
CANADA N4K 2J3

**Report Date: 2017/10/13**  
**Report #: R4777437**  
**Version: 3 - Revision**

**CERTIFICATE OF ANALYSIS – REVISED REPORT**

**MAXXAM JOB #: B7J5101**

**Received: 2017/09/08, 09:22**

Encryption Key



Ashton Gibson  
Project Manager  
13 Oct 2017 14:19:04

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ashton Gibson, Project Manager

Email: AGibson@maxxam.ca

Phone# (905) 817-5700

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

**SOIL CORROSIVITY PACKAGE (SOIL)**

Maxxam ID		FBW141	FBW141	FBW142		
Sampling Date		2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00		
COC Number		610131-18-01	610131-18-01	610131-18-01		
	UNITS	HUB-TH#1 - 1.0M BG	HUB-TH#1 - 1.0M BG Lab-Dup	TAMARAKS 7/8 - 0.6M BG	RDL	QC Batch
<b>Calculated Parameters</b>						
Resistivity	ohm-cm	7600		5700		5155146
<b>Inorganics</b>						
Soluble (20:1) Chloride (Cl)	ug/g	<20		<20	20	5157838
Conductivity	mS/cm	0.132		0.174	0.002	5158423
Available (CaCl2) pH	pH	7.67		7.52		5157265
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	<20	20	5157839
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate						

Maxxam ID		FBW143	FBW144	FBW144		
Sampling Date		2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00		
COC Number		610131-18-01	610131-18-01	610131-18-01		
	UNITS	POPLARS 17/18 - 0.6M BG	BIRCHES 13/14 - 0.6M BG	BIRCHES 13/14 - 0.6M BG Lab-Dup	RDL	QC Batch
<b>Calculated Parameters</b>						
Resistivity	ohm-cm	6100	7300			5155146
<b>Inorganics</b>						
Soluble (20:1) Chloride (Cl)	ug/g	<20	<20	<20	20	5157838
Conductivity	mS/cm	0.165	0.136	0.139	0.002	5158423
Available (CaCl2) pH	pH	7.53	7.60			5157265
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20		20	5157839
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate						

**O.REG 153 ICPMS METALS (SOIL)**

Maxxam ID		FBW139	FBW140		
Sampling Date		2017/09/05 14:00	2017/09/05 14:00		
COC Number		610131-18-01	610131-18-01		
	UNITS	HUB-TH#1 - 0.4M BG	HUB-TH#5 - 0.5M BG	RDL	QC Batch
<b>Metals</b>					
Acid Extractable Antimony (Sb)	ug/g	<0.20	<0.20	0.20	5159368
Acid Extractable Arsenic (As)	ug/g	4.5	5.3	1.0	5159368
Acid Extractable Barium (Ba)	ug/g	33	35	0.50	5159368
Acid Extractable Beryllium (Be)	ug/g	0.45	0.54	0.20	5159368
Acid Extractable Boron (B)	ug/g	8.2	7.0	5.0	5159368
Acid Extractable Cadmium (Cd)	ug/g	<0.10	<0.10	0.10	5159368
Acid Extractable Chromium (Cr)	ug/g	30	36	1.0	5159368
Acid Extractable Cobalt (Co)	ug/g	51	9.8	0.10	5159368
Acid Extractable Copper (Cu)	ug/g	30	16	0.50	5159368
Acid Extractable Lead (Pb)	ug/g	9.2	10	1.0	5159368
Acid Extractable Molybdenum (Mo)	ug/g	<0.50	0.53	0.50	5159368
Acid Extractable Nickel (Ni)	ug/g	27	24	0.50	5159368
Acid Extractable Selenium (Se)	ug/g	<0.50	<0.50	0.50	5159368
Acid Extractable Silver (Ag)	ug/g	<0.20	<0.20	0.20	5159368
Acid Extractable Thallium (Tl)	ug/g	0.13	0.14	0.050	5159368
Acid Extractable Uranium (U)	ug/g	0.39	0.40	0.050	5159368
Acid Extractable Vanadium (V)	ug/g	35	37	5.0	5159368
Acid Extractable Zinc (Zn)	ug/g	29	30	5.0	5159368
RDL = Reportable Detection Limit QC Batch = Quality Control Batch					

**TEST SUMMARY**

**Maxxam ID:** FBW139  
**Sample ID:** HUB-TH#1 - 0.4M BG  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	5159368	2017/09/12	2017/09/12	Viviana Canzonieri

**Maxxam ID:** FBW140  
**Sample ID:** HUB-TH#5 - 0.5M BG  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	5159368	2017/09/12	2017/09/12	Viviana Canzonieri

**Maxxam ID:** FBW141  
**Sample ID:** HUB-TH#1 - 1.0M BG  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5157838	N/A	2017/09/12	Alina Dobreanu
Conductivity	AT	5158423	N/A	2017/09/12	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5157265	2017/09/11	2017/09/11	Tahir Anwar
Resistivity of Soil		5155146	2017/09/12	2017/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5157839	N/A	2017/09/12	Alina Dobreanu

**Maxxam ID:** FBW141 Dup  
**Sample ID:** HUB-TH#1 - 1.0M BG  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	5157839	N/A	2017/09/12	Alina Dobreanu

**Maxxam ID:** FBW142  
**Sample ID:** TAMARAKS 7/8 - 0.6M BG  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5157838	N/A	2017/09/12	Alina Dobreanu
Conductivity	AT	5158423	N/A	2017/09/12	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5157265	2017/09/11	2017/09/11	Tahir Anwar
Resistivity of Soil		5155146	2017/09/12	2017/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5157839	N/A	2017/09/12	Alina Dobreanu

**Maxxam ID:** FBW143  
**Sample ID:** POPLARS 17/18 - 0.6M BG  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5157838	N/A	2017/09/12	Alina Dobreanu
Conductivity	AT	5158423	N/A	2017/09/12	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5157265	2017/09/11	2017/09/11	Tahir Anwar

**TEST SUMMARY**

**Maxxam ID:** FBW143  
**Sample ID:** POPLARS 17/18 - 0.6M BG  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Resistivity of Soil		5155146	2017/09/12	2017/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5157839	N/A	2017/09/12	Alina Dobreanu

**Maxxam ID:** FBW144  
**Sample ID:** BIRCHES 13/14 - 0.6M BG  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5157838	N/A	2017/09/12	Alina Dobreanu
Conductivity	AT	5158423	N/A	2017/09/12	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5157265	2017/09/11	2017/09/11	Tahir Anwar
Resistivity of Soil		5155146	2017/09/12	2017/09/12	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5157839	N/A	2017/09/12	Alina Dobreanu

**Maxxam ID:** FBW144 Dup  
**Sample ID:** BIRCHES 13/14 - 0.6M BG  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5157838	N/A	2017/09/12	Alina Dobreanu
Conductivity	AT	5158423	N/A	2017/09/12	Neil Dassanayake

**GENERAL COMMENTS**

Revised Report[2017/1013]: Sample IDs revised per client request.

**Results relate only to the items tested.**

### QUALITY ASSURANCE REPORT

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5157265	Available (CaCl2) pH	2017/09/11			99	97 - 103			0.11	N/A
5157838	Soluble (20:1) Chloride (Cl)	2017/09/12	108	70 - 130	101	70 - 130	<20	ug/g	NC	35
5157839	Soluble (20:1) Sulphate (SO4)	2017/09/12	112	70 - 130	107	70 - 130	<20	ug/g	NC	35
5158423	Conductivity	2017/09/12			100	90 - 110	<0.002	mS/cm	2.2	10
5159368	Acid Extractable Antimony (Sb)	2017/09/12	99	75 - 125	95	80 - 120	<0.20	ug/g		
5159368	Acid Extractable Arsenic (As)	2017/09/12	99	75 - 125	102	80 - 120	<1.0	ug/g	NC	30
5159368	Acid Extractable Barium (Ba)	2017/09/12	99	75 - 125	93	80 - 120	<0.50	ug/g		
5159368	Acid Extractable Beryllium (Be)	2017/09/12	99	75 - 125	101	80 - 120	<0.20	ug/g		
5159368	Acid Extractable Boron (B)	2017/09/12	95	75 - 125	98	80 - 120	<5.0	ug/g		
5159368	Acid Extractable Cadmium (Cd)	2017/09/12	97	75 - 125	100	80 - 120	<0.10	ug/g	NC	30
5159368	Acid Extractable Chromium (Cr)	2017/09/12	103	75 - 125	105	80 - 120	<1.0	ug/g	2.4	30
5159368	Acid Extractable Cobalt (Co)	2017/09/12	103	75 - 125	103	80 - 120	<0.10	ug/g	12	30
5159368	Acid Extractable Copper (Cu)	2017/09/12	103	75 - 125	103	80 - 120	<0.50	ug/g	1.5	30
5159368	Acid Extractable Lead (Pb)	2017/09/12	102	75 - 125	99	80 - 120	<1.0	ug/g	4.1	30
5159368	Acid Extractable Molybdenum (Mo)	2017/09/12	101	75 - 125	101	80 - 120	<0.50	ug/g		
5159368	Acid Extractable Nickel (Ni)	2017/09/12	103	75 - 125	105	80 - 120	<0.50	ug/g	4.8	30
5159368	Acid Extractable Selenium (Se)	2017/09/12	102	75 - 125	101	80 - 120	<0.50	ug/g		
5159368	Acid Extractable Silver (Ag)	2017/09/12	100	75 - 125	97	80 - 120	<0.20	ug/g		
5159368	Acid Extractable Thallium (Tl)	2017/09/12	100	75 - 125	100	80 - 120	<0.050	ug/g		
5159368	Acid Extractable Uranium (U)	2017/09/12	99	75 - 125	98	80 - 120	<0.050	ug/g		
5159368	Acid Extractable Vanadium (V)	2017/09/12	104	75 - 125	102	80 - 120	<5.0	ug/g		
5159368	Acid Extractable Zinc (Zn)	2017/09/12	102	75 - 125	101	80 - 120	<5.0	ug/g	2.5	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

**VALIDATION SIGNATURE PAGE**

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

*Cristina Carriere*

---

Cristina Carriere, Scientific Service Specialist

---

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Your Project #: MB7J5101  
Site Location: CYPRUS LAKE IMPROVEMENT  
Your C.O.C. #: B7J5101-M058-01-01

**Attention: Ashton Gibson**

MAXXAM ANALYTICS  
CAMPOBELLO  
6740 CAMPOBELLO ROAD  
MISSISSAUGA, ON  
CANADA L5N 2L8

**Report Date: 2017/09/12**  
**Report #: R2442641**  
**Version: 1 - Final**

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B777528**  
**Received: 2017/09/09, 11:10**

Sample Matrix: Soil  
# Samples Received: 4

Analyses	Quantity Extracted	Date	Date	Laboratory Method	Analytical Method
		2017/09/11	2017/09/12		
Moisture	4	2017/09/11	2017/09/12	BBY8SOP-00017	BCMOE BCLM Dec2000 m
Sulphide in Soil	4	2017/09/11	2017/09/11	BBY6SOP-00006	SM 22 4500 S2- D m

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: MB7J5101  
Site Location: CYPRUS LAKE IMPROVEMENT  
Your C.O.C. #: B7J5101-M058-01-01

**Attention: Ashton Gibson**

MAXXAM ANALYTICS  
CAMPOBELLO  
6740 CAMPOBELLO ROAD  
MISSISSAUGA, ON  
CANADA L5N 2L8

**Report Date: 2017/09/12**  
Report #: R2442641  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B777528**

**Received: 2017/09/09, 11:10**

Encryption Key



Maxxam  
12 Sep 2017 14:48:17

Please direct all questions regarding this Certificate of Analysis to your Project Manager.  
Jenna Williamson, Project Manager 1  
Email: JWilliamson@maxxam.ca  
Phone# (604) 734 7276



=====  
This report has been generated and distributed using a secure automated process.

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B777528  
Report Date: 2017/09/12

MAXXAM ANALYTICS  
Client Project #: MB7J5101  
Site Location: CYPRUS LAKE IMPROVEMENT

**RESULTS OF CHEMICAL ANALYSES OF SOIL**

<b>Maxxam ID</b>		RX9114	RX9115	RX9116		
<b>Sampling Date</b>		2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00		
<b>COC Number</b>		B7J5101-M058-01-01	B7J5101-M058-01-01	B7J5101-M058-01-01		
	<b>UNITS</b>	<b>HUB-TH#1 (FBW141)</b>	<b>TAMARAKS 7/8 (FBW142)</b>	<b>POPLARS 17/18 (FBW143)</b>	<b>RDL</b>	<b>QC Batch</b>
<b>MISCELLANEOUS</b>						
Sulphide	ug/g	0.67	<0.50	0.59	0.50	8754128
RDL = Reportable Detection Limit						

<b>Maxxam ID</b>		RX9117	RX9117		
<b>Sampling Date</b>		2017/09/05 14:00	2017/09/05 14:00		
<b>COC Number</b>		B7J5101-M058-01-01	B7J5101-M058-01-01		
	<b>UNITS</b>	<b>BIRCHES 13/14 (FBW144)</b>	<b>BIRCHES 13/14 (FBW144) Lab-Dup</b>	<b>RDL</b>	<b>QC Batch</b>
<b>MISCELLANEOUS</b>					
Sulphide	ug/g	<0.50	0.58	0.50	8754128
RDL = Reportable Detection Limit					
Lab-Dup = Laboratory Initiated Duplicate					

Maxxam Job #: B777528  
Report Date: 2017/09/12

MAXXAM ANALYTICS  
Client Project #: MB7J5101  
Site Location: CYPRUS LAKE IMPROVEMENT

**PHYSICAL TESTING (SOIL)**

<b>Maxxam ID</b>		RX9114	RX9115	RX9116		
<b>Sampling Date</b>		2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00		
<b>COC Number</b>		B7J5101-M058-01-01	B7J5101-M058-01-01	B7J5101-M058-01-01		
	<b>UNITS</b>	<b>HUB-TH#1 (FBW141)</b>	<b>TAMARAKS 7/8 (FBW142)</b>	<b>POPLARS 17/18 (FBW143)</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Physical Properties</b>						
Moisture	%	8.4	14	12	0.30	8754300
RDL = Reportable Detection Limit						

<b>Maxxam ID</b>		RX9117	RX9117		
<b>Sampling Date</b>		2017/09/05 14:00	2017/09/05 14:00		
<b>COC Number</b>		B7J5101-M058-01-01	B7J5101-M058-01-01		
	<b>UNITS</b>	<b>BIRCHES 13/14 (FBW144)</b>	<b>BIRCHES 13/14 (FBW144) Lab-Dup</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Physical Properties</b>					
Moisture	%	8.4	8.7	0.30	8754300
RDL = Reportable Detection Limit					
Lab-Dup = Laboratory Initiated Duplicate					

Maxxam Job #: B777528  
Report Date: 2017/09/12

MAXXAM ANALYTICS  
Client Project #: MB7J5101  
Site Location: CYPRUS LAKE IMPROVEMENT

**TEST SUMMARY**

**Maxxam ID:** RX9114  
**Sample ID:** HUB-TH#1 (FBW141)  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8754300	2017/09/11	2017/09/12	Lolita Obusan
Sulphide in Soil	SPEC/COL	8754128	2017/09/11	2017/09/11	Mandheraj Chana

**Maxxam ID:** RX9115  
**Sample ID:** TAMARAKS 7/8 (FBW142)  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8754300	2017/09/11	2017/09/12	Lolita Obusan
Sulphide in Soil	SPEC/COL	8754128	2017/09/11	2017/09/11	Mandheraj Chana

**Maxxam ID:** RX9116  
**Sample ID:** POPLARS 17/18 (FBW143)  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8754300	2017/09/11	2017/09/12	Lolita Obusan
Sulphide in Soil	SPEC/COL	8754128	2017/09/11	2017/09/11	Mandheraj Chana

**Maxxam ID:** RX9117  
**Sample ID:** BIRCHES 13/14 (FBW144)  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8754300	2017/09/11	2017/09/12	Lolita Obusan
Sulphide in Soil	SPEC/COL	8754128	2017/09/11	2017/09/11	Mandheraj Chana

**Maxxam ID:** RX9117 Dup  
**Sample ID:** BIRCHES 13/14 (FBW144)  
**Matrix:** Soil

**Collected:** 2017/09/05  
**Shipped:**  
**Received:** 2017/09/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8754300	2017/09/11	2017/09/12	Lolita Obusan
Sulphide in Soil	SPEC/COL	8754128	2017/09/11	2017/09/11	Mandheraj Chana

Maxxam Job #: B777528  
Report Date: 2017/09/12

MAXXAM ANALYTICS  
Client Project #: MB7J5101  
Site Location: CYPRUS LAKE IMPROVEMENT

**GENERAL COMMENTS**

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.0°C
-----------	-------

**Results relate only to the items tested.**

Maxxam Job #: B777528  
Report Date: 2017/09/12

**QUALITY ASSURANCE REPORT**  
MAXXAM ANALYTICS  
Client Project #: MB7J5101  
Site Location: CYPRUS LAKE IMPROVEMENT

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8754128	Sulphide	2017/09/11	80 (1)	75 - 125	86	75 - 125	<0.50	ug/g	15 (2)	30
8754300	Moisture	2017/09/12					<0.30	%	3.5 (2)	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

(1) Matrix Spike Parent ID [RX9117-01]

(2) Duplicate Parent ID [RX9117-01]

Maxxam Job #: B777528  
Report Date: 2017/09/12

MAXXAM ANALYTICS  
Client Project #: MB7J5101  
Site Location: CYPRUS LAKE IMPROVEMENT

**VALIDATION SIGNATURE PAGE**

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Andy Lu, Ph.D., P.Chem., Scientific Specialist

---

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Your Project #: B7J5101/217291  
 Site Location: CYPRUS LAKE IMPROVEMENT  
 Your C.O.C. #: B7J5101-MFOY-01-01

**Attention:SUBCONTRACTOR**

MAXXAM ANALYTICS INC.  
 MISSISSAUGA CAMPO  
 6740 Campobello Rd  
 MISSISSAUGA, ON  
 Canada L5N 2L8

**Report Date: 2017/09/14**  
**Report #: R2318859**  
 Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B755660**

**Received: 2017/09/12, 10:30**

Sample Matrix: SOIL  
 # Samples Received: 4

<b>Analyses</b>	<b>Quantity</b>	<b>Date Extracted</b>	<b>Date Analyzed</b>	<b>Laboratory Method</b>	<b>Primary Reference</b>
Redox Potential***	4	2017/09/13	2017/09/13	QUE SOP-00151	SM 2580 B

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Note: RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

\*\*\* This analysis is not subject to MDDELCC accreditation.

Your Project #: B7J5101/217291  
Site Location: CYPRUS LAKE IMPROVEMENT  
Your C.O.C. #: B7J5101-MFOY-01-01

**Attention:SUBCONTRACTOR**

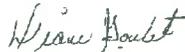
MAXXAM ANALYTICS INC.  
MISSISSAUGA CAMPO  
6740 Campobello Rd  
MISSISSAUGA, ON  
Canada L5N 2L8

**Report Date: 2017/09/14**  
**Report #: R2318859**  
**Version: 1 - Final**

**CERTIFICATE OF ANALYSIS**

**MAXXAM JOB #: B755660**  
**Received: 2017/09/12, 10:30**

Encryption Key



Diane Goulet  
Project Manager Assistant  
14 Sep 2017 16:06:25

Please direct all questions regarding this Certificate of Analysis to your Project Manager.  
Diane Goulet, Project Manager Assistant  
Email: DGoulet@maxxam.ca  
Phone# (418)658-5784 Ext:6442

=====

This report has been generated and distributed using a secure automated process.  
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B755660  
Report Date: 2017/09/14

MAXXAM ANALYTICS INC.  
Client Project #: B7J5101/217291  
Site Location: CYPRUS LAKE IMPROVEMENT

**CONVENTIONAL PARAMETERS (SOIL)**

Maxxam ID		EO1698	EO1699	EO1700	EO1701	
Sampling Date		2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00	
COC Number		B7J5101-MFOY-01-01	B7J5101-MFOY-01-01	B7J5101-MFOY-01-01	B7J5101-MFOY-01-01	
	Units	FBW141-HUB-TH#1	FBW142-TAMARAKS 7/8	FBW143-POPLARS 17/18	FBW144-BIRCHES 13/14	QC Batch

CONVENTIONALS						
Redox Potential	mV	140	130	130	130	1836707
QC Batch = Quality Control Batch						

Maxxam Job #: B755660  
Report Date: 2017/09/14

MAXXAM ANALYTICS INC.  
Client Project #: B7J5101/217291  
Site Location: CYPRUS LAKE IMPROVEMENT

### GENERAL COMMENTS

All results are calculated on a dry weight basis except where not applicable.

#### CONVENTIONAL PARAMETERS (SOIL)

Please note that the results have not been corrected for QC recoveries nor for the method blank results.

**Results relate only to the items tested.**

Maxxam Job #: B755660  
Report Date: 2017/09/14

MAXXAM ANALYTICS INC.  
Client Project #: B7J5101/217291  
Site Location: CYPRUS LAKE IMPROVEMENT

**QUALITY ASSURANCE REPORT**

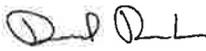
QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
1836707	CB8	Spiked Blank	Redox Potential	2017/09/13		99	%	80 - 120
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.								

Maxxam Job #: B755660  
Report Date: 2017/09/14

MAXXAM ANALYTICS INC.  
Client Project #: B7J5101/217291  
Site Location: CYPRUS LAKE IMPROVEMENT

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

David Provencher, B.Sc., Chemist, Senior Analyst

---

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

CLIENT: GM BluePlan Engineering Limited  
 PROJECT #: 217291, MAXXAM JOB: B7J5101

**Maxxam Guideline Comparison Tables**

INORGANIC PARAMETERS

2011 Table 1-Background - Agricultural or Other, Coarse Grained

MATRIX: SOIL

Select Guideline from list above for comparison.

Note: Window zoom values other than 75% may cause unstable performance. \*\* See Note #5 at bottom of sheet for more information about Guideline Flagging.

Sample ID	Guideline	REPORTING	Units	HUB-TH#1 - 0.4M BG	HUB-TH#5 - 0.5M BG	HUB-TH#1 - 1.0M BG	AMARAKS 7/8 - 0.6M BG	BOPLARS 17/18 - 0.6M BG	BIRCHES 13/14 - 0.6M BG	BHES 13/14 - 0.6M BG	Matrix Spike	SPIKED BLANK	Method Blank
Laboratory ID / Guideline ID	2011 Table 1-Background	LIMIT		FBW139	FBW140	FBW141	FBW142	FBW143	FBW144	FBW144 DUP 1	99995	99998	99999
Maxxam Job #	Agricultural or Other			B7J5101	B7J5101	B7J5101	B7J5101	B7J5101	B7J5101	B7J5101	B7J5101	B7J5101	B7J5101
Units	ug/g										%	%	
Sampling Date	Coarse Grained			05-September-2017	05-September-2017	05-September-2017	05-September-2017	05-September-2017	05-September-2017	05-September-2017			
Antimony	1	0.2	ug/g	<0.20	<0.20	-	-	-	-	-	99	95	<0.20
Arsenic	11	1	ug/g	4.5	5.3	-	-	-	-	-	99	102	<1.0
Barium	210	0.5	ug/g	33	35	-	-	-	-	-	99	93	<0.50
Beryllium	2.5	0.2	ug/g	0.45	0.54	-	-	-	-	-	99	101	<0.20
Boron (Hot Water Soluble)	NV	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	1	0.1	ug/g	<0.10	<0.10	-	-	-	-	-	97	100	<0.10
Chromium	67	1	ug/g	30	36	-	-	-	-	-	103	105	<1.0
Chromium VI	0.66	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	19	0.1	ug/g	<b>51</b>	9.8	-	-	-	-	-	103	103	<0.10
Copper	62	0.5	ug/g	30	16	-	-	-	-	-	103	103	<0.50
Lead	45	1	ug/g	9.2	10	-	-	-	-	-	102	99	<1.0
Mercury	0.16	-	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	2	0.5	ug/g	<0.50	0.53	-	-	-	-	-	101	101	<0.50
Nickel	37	0.5	ug/g	27	24	-	-	-	-	-	103	105	<0.50
Selenium	1.2	0.5	ug/g	<0.50	<0.50	-	-	-	-	-	102	101	<0.50
Silver	0.5	0.2	ug/g	<0.20	<0.20	-	-	-	-	-	100	97	<0.20
Thallium	1	0.05	ug/g	0.13	0.14	-	-	-	-	-	100	100	<0.050
Vanadium	86	5	ug/g	35	37	-	-	-	-	-	104	102	<5.0
Zinc	290	5	ug/g	29	30	-	-	-	-	-	102	101	<5.0
pH (pH Units)	NV	-	%	-	-	7.67	7.52	7.53	7.6	-	-	99	-
Conductivity (ms/cm)	0.47	0.002	mS/cm	-	-	0.132	0.174	0.165	0.136	0.139	-	100	<0.002
Sodium Adsorption Ratio	1	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide, Free	0.051	-	-	-	-	-	-	-	-	-	-	-	-
Chloride	NV	20	ug/g	-	-	<20	<20	<20	<20	<20	108	101	<20
Boron (Total)	36	5	ug/g	8.2	7	-	-	-	-	-	95	98	<5.0
Uranium	1.9	0.05	ug/g	0.39	0.4	-	-	-	-	-	99	98	<0.050

Criteria exceedences will turn BOLD with Yellow Background.

BOLD with Blue Background indicates non-detected but RDL > Guideline criteria (due to dilution etc)

NOTES:

NV = No value

- Criteria refers to Ministry of Environment "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" March 9, 2004, amended as of July 1, 2011
- This table represents a summary of the data presented in the Laboratory Certificate of Analysis for convenience purposes only
- This summary is to be used in conjunction with, not as a replacement of the Laboratory Certificate of Analysis which contains all QA/QC information
- New parameters indicated in the July 1, 2011 amendment, will appear at the bottom of each criteria page.
- Guideline flagging accuracy only guaranteed when result units correspond with guideline units on spreadsheet.

Maxxam Job Number: B7J5101  
 Report Date: 2017/10/13

GM BluePlan Engineering Limited  
 Client Project #: 217291  
 Site Location: CYPRUS LAKE IMPROVEMENT

**SOIL CORROSIVITY PACKAGE (SOIL)**

Maxxam ID		FBW141	FBW141	FBW142	FBW143	FBW144	FBW144		
Sampling Date		2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00	2017/09/05 14:00		
COC Number		610131-18-01	610131-18-01	610131-18-01	610131-18-01	610131-18-01	610131-18-01		
	<b>UNITS</b>	<b>HUB-TH#1 - 1.0M BG</b>	<b>HUB-TH#1 - 1.0M BG Lab-Dup</b>	<b>TAMARAKS 7/8 - 0.6M BG</b>	<b>POPLARS 17/18 - 0.6M BG</b>	<b>BIRCHES 13/14 - 0.6M BG</b>	<b>BIRCHES 13/14 - 0.6M BG Lab-Dup</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Calculated Parameters</b>									
Resistivity	ohm-cm	7600		5700	6100	7300			5155146
<b>Inorganics</b>									
Soluble (20:1) Chloride (Cl)	ug/g	<20		<20	<20	<20	<20	20	5157838
Conductivity	mS/cm	0.132		0.174	0.165	0.136	0.139	0.002	5158423
Available (CaCl2) pH	pH	7.67		7.52	7.53	7.60			5157265
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	<20	<20	20		20	5157839

RDL = Reportable Detection Limit  
 QC Batch = Quality Control Batch  
 Lab-Dup = Laboratory Initiated Duplicate

**Results relate only to the items tested.**

Maxxam Job Number: B7J5101  
 Report Date: 2017/10/13

GM BluePlan Engineering Limited  
 Client Project #: 217291  
 Site Location: CYPRUS LAKE IMPROVEMENT

**O.REG 153 ICPMS METALS (SOIL)**

Maxxam ID		FBW139	FBW140		
Sampling Date		2017/09/05 14:00	2017/09/05 14:00		
COC Number		610131-18-01	610131-18-01		
	<b>UNITS</b>	<b>HUB-TH#1 - 0.4M BG</b>	<b>HUB-TH#5 - 0.5M BG</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Metals</b>					
Acid Extractable Antimony (Sb)	ug/g	<0.20	<0.20	0.20	5159368
Acid Extractable Arsenic (As)	ug/g	4.5	5.3	1.0	5159368
Acid Extractable Barium (Ba)	ug/g	33	35	0.50	5159368
Acid Extractable Beryllium (Be)	ug/g	0.45	0.54	0.20	5159368
Acid Extractable Boron (B)	ug/g	8.2	7.0	5.0	5159368
Acid Extractable Cadmium (Cd)	ug/g	<0.10	<0.10	0.10	5159368
Acid Extractable Chromium (Cr)	ug/g	30	36	1.0	5159368
Acid Extractable Cobalt (Co)	ug/g	51	9.8	0.10	5159368
Acid Extractable Copper (Cu)	ug/g	30	16	0.50	5159368
Acid Extractable Lead (Pb)	ug/g	9.2	10	1.0	5159368
Acid Extractable Molybdenum (Mo)	ug/g	<0.50	0.53	0.50	5159368
Acid Extractable Nickel (Ni)	ug/g	27	24	0.50	5159368
Acid Extractable Selenium (Se)	ug/g	<0.50	<0.50	0.50	5159368
Acid Extractable Silver (Ag)	ug/g	<0.20	<0.20	0.20	5159368
Acid Extractable Thallium (Tl)	ug/g	0.13	0.14	0.050	5159368
Acid Extractable Uranium (U)	ug/g	0.39	0.40	0.050	5159368
Acid Extractable Vanadium (V)	ug/g	35	37	5.0	5159368
Acid Extractable Zinc (Zn)	ug/g	29	30	5.0	5159368

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

**Results relate only to the items tested.**

**TEST SUMMARY**

<b>Maxxam ID</b>	FBW139		<b>Collected</b>	9/5/2017
<b>Sample ID</b>	HUB-TH#1 - 0.4M BG		<b>Shipped</b>	
<b>Matrix</b>	Soil		Received	2017/09/08

<b>Test Description</b>	<b>Instrumentation</b>	<b>Batch</b>	<b>Extracted</b>	<b>Date Analyzed</b>	<b>Analyst</b>
Strong Acid Leachable	ICP/MS	5159368	9/12/2017	9/12/2017	Viviana Canzonieri

<b>Maxxam ID</b>	FBW140		<b>Collected</b>	9/5/2017
<b>Sample ID</b>	HUB-TH#5 - 0.5M BG		<b>Shipped</b>	
<b>Matrix</b>	Soil		Received	2017/09/08

<b>Test Description</b>	<b>Instrumentation</b>	<b>Batch</b>	<b>Extracted</b>	<b>Date Analyzed</b>	<b>Analyst</b>
Strong Acid Leachable	ICP/MS	5159368	9/12/2017	9/12/2017	Viviana Canzonieri

<b>Maxxam ID</b>	FBW141		<b>Collected</b>	9/5/2017
<b>Sample ID</b>	HUB-TH#1 - 1.0M BG		<b>Shipped</b>	
<b>Matrix</b>	Soil		Received	2017/09/08

<b>Test Description</b>	<b>Instrumentation</b>	<b>Batch</b>	<b>Extracted</b>	<b>Date Analyzed</b>	<b>Analyst</b>
Chloride (20:1 extract)	KONE/EC	5157838	N/A	9/12/2017	Alina Dobreanu
Conductivity	AT	5158423	N/A	9/12/2017	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5157265	9/11/2017	9/11/2017	Tahir Anwar
Resistivity of Soil		5155146	9/12/2017	9/12/2017	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5157839	N/A	9/12/2017	Alina Dobreanu

<b>Maxxam ID</b>	FBW141 Dup		<b>Collected</b>	9/5/2017
<b>Sample ID</b>	HUB-TH#1 - 1.0M BG		<b>Shipped</b>	
<b>Matrix</b>	Soil		Received	2017/09/08

<b>Test Description</b>	<b>Instrumentation</b>	<b>Batch</b>	<b>Extracted</b>	<b>Date Analyzed</b>	<b>Analyst</b>
Sulphate (20:1 Extract)	KONE/EC	5157839	N/A	9/12/2017	Alina Dobreanu

<b>Maxxam ID</b>	FBW142		<b>Collected</b>	9/5/2017
<b>Sample ID</b>	TAMARAKS 7/8 - 0.6M BG		<b>Shipped</b>	
<b>Matrix</b>	Soil		Received	2017/09/08

<b>Test Description</b>	<b>Instrumentation</b>	<b>Batch</b>	<b>Extracted</b>	<b>Date Analyzed</b>	<b>Analyst</b>
Chloride (20:1 extract)	KONE/EC	5157838	N/A	9/12/2017	Alina Dobreanu
Conductivity	AT	5158423	N/A	9/12/2017	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5157265	9/11/2017	9/11/2017	Tahir Anwar
Resistivity of Soil		5155146	9/12/2017	9/12/2017	Automated Statchk

Sulphate (20:1 Extract	KONE/EC	5157839	N/A	9/12/2017	Alina Dobreanu
------------------------	---------	---------	-----	-----------	----------------

<b>Maxxam ID</b>	FBW143		<b>Collected</b>	9/5/2017	
<b>Sample ID</b>	POPLARS 17/18 - 0.6M BG		<b>Shipped</b>		
Matrix	Soil		Received	2017/09/08	

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract	KONE/EC	5157838	N/A	9/12/2017	Alina Dobreanu
Conductivity	AT	5158423	N/A	9/12/2017	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5157265	9/11/2017	9/11/2017	Tahir Anwar
Resistivity of Soil		5155146	9/12/2017	9/12/2017	Automated Statchk
Sulphate (20:1 Extract	KONE/EC	5157839	N/A	9/12/2017	Alina Dobreanu

<b>Maxxam ID</b>	FBW144		<b>Collected</b>	9/5/2017	
<b>Sample ID</b>	BIRCHES 13/14 - 0.6M BG		<b>Shipped</b>		
Matrix	Soil		Received	2017/09/08	

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract	KONE/EC	5157838	N/A	9/12/2017	Alina Dobreanu
Conductivity	AT	5158423	N/A	9/12/2017	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5157265	9/11/2017	9/11/2017	Tahir Anwar
Resistivity of Soil		5155146	9/12/2017	9/12/2017	Automated Statchk
Sulphate (20:1 Extract	KONE/EC	5157839	N/A	9/12/2017	Alina Dobreanu

<b>Maxxam ID</b>	FBW144 Dup		<b>Collected</b>	9/5/2017	
<b>Sample ID</b>	BIRCHES 13/14 - 0.6M BG		<b>Shipped</b>		
Matrix	Soil		Received	2017/09/08	

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract	KONE/EC	5157838	N/A	9/12/2017	Alina Dobreanu
Conductivity	AT	5158423	N/A	9/12/2017	Neil Dassanayake

Quality Assurance Report

Maxxam Job Number: B7J5101

QA/QC Bat Init	QC Type	Parameter	Date Analy Value	Recovery	UNITS	QC Limits
5157265	TA1	Spiked Blank	9/11/2017	99	%	97 - 103
5157265	TA1	RPD	9/11/2017	0.11	%	N/A
		Matrix Spike				
5157838	ADB	[FBW144-01]	9/12/2017	108	%	70 - 130
5157838	ADB	Spiked Blank	9/12/2017	101	%	70 - 130
5157838	ADB	Method Blank	9/12/2017	<20	ug/g	
5157838	ADB	RPD [FBW144-01]	9/12/2017	NC	%	35
		Matrix Spike				
5157839	ADB	[FBW141-01]	9/12/2017	112	%	70 - 130
5157839	ADB	Spiked Blank	9/12/2017	107	%	70 - 130
5157839	ADB	Method Blank	9/12/2017	<20	ug/g	
5157839	ADB	RPD [FBW141-01]	9/12/2017	NC	%	35
5158423	NYS	Spiked Blank	9/12/2017	100	%	90 - 110
5158423	NYS	Method Blank	9/12/2017	<0.002	mS/cm	
5158423	NYS	RPD [FBW144-01]	9/12/2017	2.2	%	10
		Matrix Spike				
5159368	VIV	Spiked Blank	9/12/2017	99	%	75 - 125
		Acid Extractable Antimony (Sb)	9/12/2017	99	%	75 - 125
		Acid Extractable Arsenic (As)	9/12/2017	99	%	75 - 125
		Acid Extractable Barium (Ba)	9/12/2017	99	%	75 - 125
		Acid Extractable Beryllium (Be)	9/12/2017	99	%	75 - 125
		Acid Extractable Boron (B)	9/12/2017	95	%	75 - 125
		Acid Extractable Cadmium (Cd)	9/12/2017	97	%	75 - 125
		Acid Extractable Chromium (Cr)	9/12/2017	103	%	75 - 125
		Acid Extractable Cobalt (Co)	9/12/2017	103	%	75 - 125
		Acid Extractable Copper (Cu)	9/12/2017	103	%	75 - 125
		Acid Extractable Lead (Pb)	9/12/2017	102	%	75 - 125
		Acid Extractable Molybdenum (Mo)	9/12/2017	101	%	75 - 125
		Acid Extractable Nickel (Ni)	9/12/2017	101	%	75 - 125
		Acid Extractable Silver (Ag)	9/12/2017	102	%	75 - 125
		Acid Extractable Thallium (Tl)	9/12/2017	100	%	75 - 125
		Acid Extractable Uranium (U)	9/12/2017	100	%	75 - 125
		Acid Extractable Vanadium (V)	9/12/2017	99	%	75 - 125
		Acid Extractable Zinc (Zn)	9/12/2017	104	%	75 - 125
5159368	VIV	Spiked Blank	9/12/2017	102	%	75 - 125
		Acid Extractable Antimony (Sb)	9/12/2017	95	%	80 - 120
		Acid Extractable Arsenic (As)	9/12/2017	93	%	80 - 120
		Acid Extractable Barium (Ba)	9/12/2017	101	%	80 - 120
		Acid Extractable Beryllium (Be)	9/12/2017	98	%	80 - 120
		Acid Extractable Boron (B)	9/12/2017	100	%	80 - 120
		Acid Extractable Cadmium (Cd)	9/12/2017	105	%	80 - 120
		Acid Extractable Chromium (Cr)	9/12/2017	103	%	80 - 120
		Acid Extractable Cobalt (Co)	9/12/2017	103	%	80 - 120
		Acid Extractable Copper (Cu)	9/12/2017	99	%	80 - 120
		Acid Extractable Lead (Pb)	9/12/2017	101	%	80 - 120
		Acid Extractable Molybdenum (Mo)	9/12/2017	105	%	80 - 120
		Acid Extractable Nickel (Ni)	9/12/2017	101	%	80 - 120
		Acid Extractable Silver (Ag)	9/12/2017	97	%	80 - 120
		Acid Extractable Thallium (Tl)	9/12/2017	100	%	80 - 120
		Acid Extractable Uranium (U)	9/12/2017	98	%	80 - 120
		Acid Extractable Vanadium (V)	9/12/2017	102	%	80 - 120
		Acid Extractable Zinc (Zn)	9/12/2017	101	%	80 - 120
5159368	VIV	Method Blank	9/12/2017	<0.20	ug/g	
		Acid Extractable Antimony (Sb)	9/12/2017	<1.0	ug/g	
		Acid Extractable Arsenic (As)	9/12/2017	<0.50	ug/g	
		Acid Extractable Barium (Ba)	9/12/2017	<0.20	ug/g	
		Acid Extractable Beryllium (Be)	9/12/2017	<5.0	ug/g	
		Acid Extractable Boron (B)	9/12/2017	<0.10	ug/g	
		Acid Extractable Cadmium (Cd)	9/12/2017	<1.0	ug/g	
		Acid Extractable Chromium (Cr)	9/12/2017	<0.10	ug/g	
		Acid Extractable Cobalt (Co)	9/12/2017	<0.50	ug/g	
		Acid Extractable Copper (Cu)	9/12/2017	<1.0	ug/g	
		Acid Extractable Lead (Pb)	9/12/2017	<0.50	ug/g	
		Acid Extractable Molybdenum (Mo)	9/12/2017	<0.50	ug/g	
		Acid Extractable Nickel (Ni)	9/12/2017	<0.50	ug/g	
		Acid Extractable Selenium (Se)	9/12/2017	<0.20	ug/g	
		Acid Extractable Silver (Ag)	9/12/2017	<0.050	ug/g	
		Acid Extractable Thallium (Tl)	9/12/2017	<0.050	ug/g	
		Acid Extractable Uranium (U)	9/12/2017	<5.0	ug/g	
		Acid Extractable Vanadium (V)	9/12/2017	<5.0	ug/g	
		Acid Extractable Zinc (Zn)	9/12/2017	NC	%	30
5159368	VIV	RPD	9/12/2017	NC	%	30
		Acid Extractable Antimony (Sb)	9/12/2017	NC	%	30
		Acid Extractable Cadmium (Cd)	9/12/2017	2.4	%	30
		Acid Extractable Chromium (Cr)	9/12/2017	12	%	30
		Acid Extractable Cobalt (Co)	9/12/2017	1.5	%	30
		Acid Extractable Copper (Cu)	9/12/2017	4.1	%	30
		Acid Extractable Lead (Pb)	9/12/2017	4.8	%	30
		Acid Extractable Nickel (Ni)	9/12/2017	2.5	%	30
		Acid Extractable Zinc (Zn)	9/12/2017	2.5	%	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDU).