# Public Works and Government Services Canada

Requisition No. EZ899-182549

DRAWINGS & SPECIFICATIONS
for

**Belmont Battery Rehabilitation**
**Fort Rodd Hill BC**

Project No.: R.075097.001

**APPROVED BY:**

A/ Regional Manager, AES — 2018-02-06 — Date

Construction Safety Coordinator — 2018-02-06 — Date

**TENDER:**

Project Manager — 2018-02-07 — Date

Real Property Services Branch, Professional and Technical Services, Pacific Region
Room 219 - 800 Burrard Street, Vancouver, B.C. V6Z 0B9

END OF SECTION 00 00 10

**CONSULTANTS – SEAL & SIGNATURE**

| **Discipline** | **Seal/Signature/Date** |
|---|---|
| Architectural<br>Chernoff Thompson Architects |  |
| Structural<br>CWMM Consulting Engineers Ltd. |  |
| Civil<br>ISL Engineering and Land Services Ltd. |  |

END OF SECTION 00 01 07

1.0 GENERAL

1.1 CODES

.1 Perform work in accordance with National Building Code for Canada 2015, BCBC 2012, Workers' Compensation Board of BC, and any other code of provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.

.2 Meet or exceed requirements of specified standards, codes and referenced documents.

1.2 DESCRIPTION OF WORK

.1 Work under this Contract comprises, but is not limited to, the provision of all labour, materials, services and equipment necessary for the rehabilitation of the Belmont Battery, central area and Lower Battery which generally include concrete repair, waterproofing, roofing, steel and brick repair work, seismic upgrade, painting, electrical and underground drainage work as fully described in the Tender Documents.

1.3 CONTRACT DOCUMENTS

.1 The Contract documents, drawings and specifications are intended to complement each other.

.2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.

1.4 TIME OF COMPLETION

.1 Complete the project in sixty (60) weeks upon award of contract.

1.5 HOURS OF WORK

.1 Hours of Work:

.1 Refer to Section 01 14 00 Work Restriction Paragraph 1.7.

.2 Phasing of Work :

.1 Refer to Section 01 14 00 Work Restriction Paragraph 1.8

1.6 WORK SCHEDULE

.1 Carry out work as follows:

.1 Within 10 working days after Contract award, submit Bar (GANTT) chart as per specification sections 01 32 16.07 Construction Progress Schedule Bar (GANTT) chart. Indicate the following:

.1 Submission of shop drawings, product data, MSDS sheets and samples.

.2 Commencement and completion of work of each section of the specifications or trades for each phase as outlined.

.3 Final completion date within the time period required by the Contract documents.

.2 Do not change approved Schedule without notifying Departmental Representative.

.3 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.

1.7 DIVISION OF SPECIFICATIONS

.1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.

.2 A division may consist of the work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the work rests solely with the Contractor.

.3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

1.8 CODE, BYLAWS, STANDARDS

.1 Perform work in accordance with the National Building Code of Canada (NBC) 2015, and other indicated Codes, Construction Standards and/or any other Code or Bylaw of local application.

.2 Comply with applicable local bylaws, rules and regulations enforced at the location concerned.

.3 Meet or exceed requirements of Contract documents, specified standards, codes and referenced documents.

.4 In any case of conflict or discrepancy, the most stringent requirements shall apply.

1.9 DOCUMENTS REQUIRED

.1 Maintain one copy each of the following at the job site:
- .1 Contract drawings.
- .2 Contract specifications.
- .3 Addenda to Contract documents.
- .4 Copy of work schedule.
- .5 Reviewed shop drawings.
- .6 Change orders.
- .7 Other modifications to Contract.
- .8 Field test reports.
- .9 Reviewed samples.
- .10 Manufacturer's installation and application instructions.
- .11 One set of record drawings and specifications for "as-built" purposes.
- .12 National Building Code of Canada 2015.
- .13 Current construction standards of workmanship listed in technical Sections.
- .14 Building Safety Plan.
- .15 Request for Information (RFI)
- .16 Contemplated Change Notices
- .17 WHMIS Documents
- .18 Site Instructions
- .19 Contractor's Health and Safety Plan, including map to nearest hospital.

1.10 REGULATORY REQUIREMENTS

.1 Building Permit

- .1 Building permit is not required for this project. Obtain other trades permits required by regulatory municipal and provincial authorities to complete the work.

.2 Provide inspection authorities with plans and information required for issue of acceptance certificates.

.3 Furnish inspection certificates in evidence that the work installed conforms to the requirements of the authority having jurisdiction.

.4 Comply with conditions as stated in Standard Acquisition Clauses and Conditions (SACC) Manual.

1.11 CONTRACTOR'S USE OF SITE

.1 Use of site:

.1 Exclusive and complete for execution of work.

.2 Assume responsibility for assigned premises for performance of this work.

.3 Be responsible for coordination of all work activities on site, including the work of other contractors engaged by the Departmental Representative.

.4 Provide security of Contractor's work site and all Contractors and Subcontractor's equipment and material. Secure Contractor's work site at the end of each work day.

.5 Perform work in accordance with the Contract documents. Ensure work is carried out in accordance with indicated phasing.

.6 Do not unreasonably encumber site with material or equipment

.7 Any area of the Fort Rodd Hill Historical Site property to which access is restricted by sign is a secured or restricted area and shall not be entered.

.8 Do not obstruct access to the property outside of the Contractor's work site. Maintain overhead clearances, keep roadways and walkways clear, and maintain routes for emergency response vehicles.

.2 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with approved schedules.

.3 Do not unreasonably encumber site with material or equipment.

.4 Coordinate with Departmental Representative for material storage on site which belongs to the project but waiting to be installed.

1.12 EXAMINATION

.1 Examine site and be familiar and conversant with existing conditions likely to affect work.

1.13 EXISTING SERVICES

.1 Where Work involves breaking into or connecting to existing services, carry out work as directed by Departmental Representative or the authority having jurisdiction.

.2 Record locations of maintained, re-routed and abandoned service lines.

.3 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.14 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space, and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Departmental Representative at least 48 hours prior to impending installation and obtain approval for actual location.

.4 Submit field drawings or shop drawings to indicate the relative position of various services and equipment when required by the Departmental Representative and/or as specified.

1.15 CUTTING AND PATCHING

.1 Cut existing surfaces as required to accommodate new work.

.2 Remove items so shown or specified.

.3 Do not cut, bore, or sleeve load-bearing members.

.4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.

.5 Fit work airtight to pipes, sleeves, ducts and conduits.

.6 Conceal pipes, ducts and wiring in raised floors, wall and ceiling construction of finished areas except where indicated otherwise.

.7 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.

.8 Making good is defined as matching construction and finishing materials and the adjacent surfaces such that there is no visible difference between existing and new surfaces when viewed from 1.5 metres in ambient light, and includes painting the whole surface to the next change in plane.

1.16 SETTING OUT OF WORK

1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.

.2 Provide devices needed to lay out and construct work.

.3 Supply such devices as templates required to facilitate Departmental Representative's inspection of work.

1.17 ACCEPTANCE OF SUBTRADES

1 Each trade shall examine surfaces prepared by others and job conditions which may affect his work, and shall report defects to the General Contractor. Commencement of work shall imply acceptance of prepared work or substrate surfaces.

1.18 QUALITY OF WORK

.1 Ensure that quality workmanship is performed through use of skilled tradesmen, under supervision of qualified journeyman.

.2 The workmanship, erection methods and procedures to meet minimum standards set out in the National Building Code of Canada 2015 and Construction Standards as specified herein.

.3 In cases of dispute, decisions as to standard or quality of work rest solely with the Departmental Representative, whose decision is final.

1.19 WORKS COORDINATION

.1 Coordinate work of sub-trades:

.1 Designate one person to be responsible for review of contract documents and shop drawings and managing coordination of Work.

.2 Convene meetings between subcontractors whose work interfaces and ensure awareness of areas and extent of interface required.

.1 Provide each subcontractor with complete plans and specifications for Contract, to assist them in planning and carrying out their respective work.

.2 Develop coordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.

.1 Pay particularly close attention to overhead work above ceilings and within or near to building structural elements.

.2 Identify on coordination drawings, building elements, services lines, rough-in points and indicate location services entrance to site.

.3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign off on drawings.

.4 Publish minutes of each meeting.

.5 Plan and coordinate work in such a way to minimize quantity of service line offsets.

.6 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.

.3 Submit shop drawings and order of prefabricated equipment or rebuilt components only after coordination meeting for such items has taken place.

.4 Work cooperation:

.1 Ensure cooperation between trades in order to facilitate general progress of Work and avoid situations of spatial interference.

.2 Ensure that each trade provides all other trades reasonable opportunity for completion of Work and in such a way as to prevent unnecessary delays, cutting, patching and removal or replacement of completed work.

.3 Ensure disputes between subcontractors are resolved.

.4 Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to coordinate Work.

.5 Maintain efficient and continuous supervision.

1.20 APPROVAL OF SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

.1 In accordance with Section 01 33 00, submit the requested shop drawings, product data, MSDS sheets and samples indicated in each of the technical Sections.

.2 Allow sufficient time for the following:

.1 Review of product data.

.2 Approval of shop drawings.

.3 Review of re-submission.

.4 Ordering of approved material and/or products. Refer to individual technical sections of specifications.

1.21 PROJECT MEETINGS

.1 Contractor will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.

1.22 TESTING AND INSPECTION

.1 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified in Sections 01 45 00.

.2 The Contractor will appoint and pay for all the services of testing agency or testing laboratory as specified, and where required for the following:

.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 Mill tests and certificates of compliance.
.4 Tests specified in the contract documents. Such test may be subjected to Departmental Representative's supervision.

.3 Within 15 working days after Contract award provide a list of proposed testing services or testing laboratories for Departmental Representative's approval.

.4 The Departmental Representative may require, and pay for, additional inspection and testing services not included in paragraph 1.22.2.

.5 Where tests or inspections by designated testing laboratory reveal work is not in accordance with the Contract requirements, Contractor shall pay costs for additional tests or inspections as the Departmental Representative may require to verify acceptability of corrected work.

.6 Contractor shall furnish labour and facilities to carry out specified testing and notify Departmental Representative in advance of planned testing.

.7 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.8 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.

.9 Provide Departmental Representative with 2 copies of testing laboratory reports as soon as they are available.

1.23 SURVEYING

.1 Not Applicable

1.24 AS-BUILT DOCUMENTS

.1 Contractor to provide 1 copy of mark-up contract drawings for "as-built" purposes to Departmental Representative at substantial completion of the project.

.2 Keep one set of current white prints of all contract drawings and all addenda, revisions, clarifications, change orders, and reviewed shop drawings in the site office; and have them available at all times for inspection by the Consultant.

.3 As the work progresses, maintain accurate records to show all deviations from the Contract documents. Note on as-built specifications, drawings and shop drawings as changes occur.

.4 At completion of the Work, transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings and change order, to a set of Issued for Construction drawings. Submit the 'red-marked' as-built set to the Departmental Representative in hard copy with contractor's review stamp and date confirming that the set submitted are a true record of "as-built" information.

.5 Refer to Section 01 78 00 – Close-out Submittals.

1.25 CLEANING

.1 Refer to Section 01 74 11 - Cleaning.

1.26 DUST CONTROL

.1 Provide temporary 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.

1.27 ENVIRONMENTAL PROTECTION

.1 Prevent extraneous materials from contaminating air beyond construction area, by providing temporary enclosures during work.

.2 Do not dispose of waste or volatile materials into water courses, storm or sanitary sewers.

.3 Ensure proper disposal procedures in accordance with all applicable territorial regulations.

.4 An Environmental consultant will be assigned by Departmental Representative to provide environmental monitoring during the ground disturbing activities, or other construction activities that may impose potential environmental impact. Contractor will be responsible for coordinating and facilitating all the monitoring work provided by the environmental consultant.

1.28 MAINTENANCE MATERIALS, SPECIAL TOOLS AND SPARE PARTS

.1 Specific requirements for maintenance materials, tools and spare parts are specified in individual technical sections of specifications.

1.29 ADDITIONAL DRAWINGS

.1 The Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with drawings referred to in the Contract Documents.

.2 Departmental Representative will furnish only pdf of Contract drawings and specification for use by the Contractor. Contractor to provide their own printing as needed for their construction work.

1.30 BUILDING SMOKING ENVIRONMENT

.1 Smoking within the building and within 7.5m of all air intakes is not permitted.

1.31 SYSTEM OF MEASUREMENT

.1 The metric system of measurement (SI) will be employed on this Contract.

1.32 FAMILIARIZATION WITH SITE

.1 Before submitting tender, visit site as indicated in tender documents and become familiar with all conditions likely to affect the cost of the work.

1.33 SUBMISSION OF TENDER

.1 Submission of a tender is deemed to be confirmation of the fact that the Tenderer has analyzed the Contract documents and inspected the site, and is fully conversant with all conditions.

1.34 COST BREAKDOWN

.1 Before submitting the first progress claim, submit a breakdown of the Contract price in detail as directed by the Departmental Representative and aggregating Contract price. After approval, the cost breakdown will form the basis of progress payments.

.2 Within 2 weeks after award of contract, provide a monthly cash flow projection for the whole contract period in detail as directed by Departmental Representative. Contractor should provide a

monthly update of the cash flow projection according to the actual work schedule.

1.35 RELICS & ANTIQUITIES

.1 Relics and antiquities and items of historical or scientific interest shall remain property of Department. Protect such articles and request directives from Departmental Representative.

.2 Give immediate notice to Departmental Representative if evidence of archaeological finds are encountered during excavation/construction, and await Departmental Representative's written instructions before proceeding with work in this area.

.3 An archaeologist will be assigned by Departmental Representative to monitor the site and provide daily archaeological report during ground disturbing activities. If artifacts or archaeological features (including historic structures or objects) are encountered during excavation work, excavation is to be stopped until further instruction be provided by Departmental Representative to proceed with work again. Contractor to be responsible for coordinating and facilitating all the monitoring work provided by the assigned archaeologist.

END OF SECTION 01 11 55

## 1.0 GENERAL

### 1.1 FACILITY OPERATIONS AND SECURITY PROCEDURES

.1 Departmental Representative enforces a zero tolerance policy for the following misbehavior:

- .1 Appear to be under the influence of alcohol, drugs or narcotics.
- .2 Behave in an unusual or disorderly manner.
- .3 In possession of contraband.

### 1.2 ACCESS AND EGRESS

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

.2 Provide hoarding, and scaffolding plan for Departmental Representative to review 5 business days prior to installation.

### 1.3 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to the neighbor.

.2 Maintain existing services to building and provide for personnel and vehicle access.

.3 Closures: protect work temporarily until permanent enclosures are completed.

.4 Coordinate with Departmental Representative in scheduling the construction of new egress into the existing right-of-way to minimize conflict and to facilitate use of the right-of-way by the adjoining Departmental Representative.

### 1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

.1 Execute work with least possible interference or disturbance to the neighbours.

### 1.5 EXISTING SERVICES SHUT DOWNS

.1 Notify, Departmental Representative and adjoining neighbour of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services that are shared by any adjoining property, give Departmental Representative and the adjoining Departmental Representative 6 weeks of notice for necessary interruption of civil, mechanical or electrical service throughout course of work. Keep duration of interruptions to a minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

- .1 Optimize and plan shut-downs so that services are restored in time for normal facility operation hours. Coordinate all shut-downs with utility providers and facility users.
  - .1 Departmental Representative will review the proposed schedule and may stipulate changes. Any such changes, modifications, or revisions shall not be the basis for any extra claim.
  - .2 After review of draft schedule, contractor to submit firm time and duration for each outage required. Include all input from the Departmental Representative as described above.

.3 Provide for personnel and vehicular traffic (if required) and barricades or walkway delineation for personal walkways.

.4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.6 NOISE CONTROL

.1 Comply with applicable provincial by-law for noise control.

1.7 WORK HOURS AND RESTRICTIONS

.1 Use of Site and Facilities.

- .1 Execute work with least possible interference or disturbance to the normal use of the site. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Do not disrupt existing services to Fort Rodd National Historic Site.
- .3 Maintain fire access.
- .4 Refer to drawing A103 for contractor's vehicular access path and lay down area.

.2 Special Scheduling Requirements.

- .1 Carry out work during "regular hours", Monday to Friday from 07:00 to 20:00 hours and from 08:00 to 18:00 hours on Saturdays, Sundays and statutory holidays.
- .2 Give the Departmental Representative 48 hours notice for work to be carried out during "off hours".
- .3 Delivery of materials to occur between 07:00 to 10:00 but is not permitted on Saturdays, Sundays and statutory holidays.
- .4 Delivery and removal of construction bins to occur between 08:00 and 10:00 but is not permitted on Saturdays, Sundays and statutory holidays.
- .5 Accommodate site staff's intermittent use of premises during the Work.
- .6 Special Events:
  - .1 Site has itinerary of special events throughout the summer. During special events, Noise must be kept to a minimum during hours open to public (10 am to 5:30 PM), for example, do jackhammering before 10:00 and reduce vehicular traffic on site as there will be an increase in other vehicles and pedestrians on site.
  - .2 Departmental Representative will provide notice to contractor ahead of the events.
  - .3 Allow for interruptions of the Work by special events. Refer to Appendix 6 for List of expected special events during the year 2018. List of events will be similar for 2019 and will be issued to the contractor by Departmental Representative when available.
- .7 Overnight Visitors:
  - .1 Be aware that Site has areas for overnight tent camping. From May 15 to September 30, there may be overnight visitors on the site in the evenings and early mornings, therefore no jackhammering or loud noise generating activities are allowed before 9 am and after 6 pm. There will be a requirement for a flagperson site during those times when visitors are on site.
    Please Note: there is a requirement for a flagperson down by the Casemate corner (where the maintenance road comes in), as long as there is any vehicle traffic coming through the site. It is a blind corner and carries a risk of pedestrians

1.8 CONSTRUCTION PHASING

.1 Construction work at the Lower Battery as described in drawing UM-A001 can only commence after September 04th, 2018 and be completed before March 31st, 2019.

.2 Provide 48 hours advance notice to Departmental Representative prior to closing off the Lower Battery to start construction work.

.3 After completion of work at Lower Battery, turn over the site to Departmental Representative for acceptance.

.4 There is no other construction phasing requirement for remaining of the work.

END OF SECTION 01 14 00

1.0 GENERAL

1.1 ADMINISTRATIVE

.1 Schedule and administer site meetings throughout the progress of the work on a regular basis or at the call of Departmental Representative.

.2 Site meeting will be in the form of field review on site with the general contractors, all sub-trades, departmental representative, representatives from Parks Canada, and other contractors/consultants appointed by PWGSC.

.3 Meeting will be at a minimum bi-weekly throughout the whole construction period.

.4 Meeting will be held at the job site location directly or at the Park's operation building at Fort Rodd Hill Historical Park. No separate site trailer is needed to be provided by the contractor for the purpose of site meeting.

.5 Preside at meetings.

.6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.

.7 Reproduce and distribute copies of minutes within five (5) days after meetings and transmit to meeting participants and affected parties not in attendance, Departmental Representative and Consultants.

.8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRE- CONSTRUCTION MEETING

.1 Within 15 days after award of Contract: Departmental Representative will request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Attendance will include, but is not limited to, the Departmental Representative, members of Parks Canada representatives, other contractors and consultants appointed by PWGSC.

.3 Departmental Representative to establish time and location of preconstruction meeting, Contractor to notify parties concerned a minimum of 4 working days before meeting.

.4 Departmental Representative will chair the meeting, record minutes and issue minutes.

.5 Agenda to include:

- .1 Introduction of official representative of participants in the Work.
- .2 Start date on site.
- .3 Communication Protocol for submission of shop drawings and samples. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 51 00 - Temporary Facilities.
- .5 Site safety in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .6 Communication Protocol for proposed changes, change orders, procedures, approvals required.
- .7 Departmental Representative's Work.
- .8 Record drawings in accordance with Section 01 78 00 - Closeout Submittals.
- .9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.

.10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
.11 Monthly progress claims, administrative procedures, photographs, hold backs.
.12 Inspection and testing agencies or firms by the contractor.

1.3 PROGRESS MEETINGS

.1 During course of Work and two weeks prior to Project Completion, schedule progress meetings bi-weekly.

.2 Attendance to include but is not limited to Departmental Representative, Parks Canada Representatives, Contractor, and major subcontractors.

.3 Contractor is responsible to record minutes of meetings and circulate to attending parties and affected parties not in attendance within five (5) days after meeting.

.4 Record next meeting dates in the meeting minutes or notify parties minimum of seven (7) days in advance for other ad-hoc meetings.

.5 Agenda to include, at a minimum, the following:
.1 Review, approval of minutes of previous meeting.
.2 Review of Health and Safety including any incidents, near misses, and WorkSafe BC visits.
.3 Review of Work progress since previous meeting.
.4 Coordination discussions with Parks Canada.
.5 Construction schedule review.
.6 Review of off-site fabrication delivery schedules.
.7 Corrective measures and procedures to regain projected schedule.
.8 Request for Information (RFI) log review.
.9 Engineering Disciplines Reviews.
.1 Architectural
.2 Structural
.3 Civil
.4 Geotechnical
.10 Change order log review.
.11 Review submittal schedule.
.12 Review updated as built.
.13 Review and resolve site issues.
.14 New business.

END OF SECTION 01 31 19

## 1.0 GENERAL

### 1.1 DEFINITIONS

.1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.

.3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

### 1.2 REQUIREMENTS

.1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

.5 Clearly show sequence and interdependence of construction activities and indicate:

- .1 Start and completion of all items of Work, their major components and interim milestones completion dates.
- .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
  - .1 Time for submittals, re-submittal and review.
  - .2 Time for fabrication and delivery of manufactured products for Work.

.3 Interdependence of procurement and construction activities.

.3 Include sufficient detail for project activities to assure adequate planning and execution of work. Activities should generally range in duration from 3 to 15 days each.

.4 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated to allow coordination and control of project activities. Show continuous flow from left to right.

.5 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being whenever possible, continuous series of activities throughout length of project to form critical path.

1.3 SUBMITTALS

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

.2 Submit to Departmental Representative within 28 working days after Award of Contract Project schedule in form of Bar (GANTT) Chart for planning, monitoring and reporting of project progress.

1.4 REVIEW OF THE SCHEDULE

.1 Allow 10 working days for Departmental Representative to review proposed schedule. Make necessary changes to proposed schedule within 5 days.

.2 Submit letter ensuring the schedule has been prepared in coordination with major subcontractors and suppliers.

.3 Promptly provide additional information to validate practicability of schedule as required by Departmental Representative.

.4 Submittal of Schedule indicates that it meets Contract Requirements and will be executed generally in sequence.

1.5 COMPLIANCE WITH SCHEDULE

.1 Comply with reviewed schedule.

.2 Proceed with significant changes and deviations from schedule sequence of activities which cause delay only after review by Departmental Representative.

.3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.

.1 Corrective measures may include:

.1 An increase of personnel on the site for effective activities or work packages.

.2 An increase in materials and equipment.

.3 Additional work shifts, longer hours.

1.6 PROJECT SCHEDULE

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule that shows milestone and activity types and expand from the following items:

.1 Award.

.2 Shop Drawings, Samples and Approvals.

.3 Permits.

.4 Mobilization.

.5 Mock-ups and Approvals.

.6 Procurement.
.7 Construction.
.8 Installation.
.9 Site Works.
.10 Training.

1.7 PROJECT SCHEDULE REPORTING

.1 On an ongoing basis, schedule on job site must show “progress to date”. Arrange participation on and off site of subcontractor and suppliers, as and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Departmental Representative at least once monthly to establish progress on each current activity shown on applicable networks.

.2 Maintain a daily log of progress of the work:
.1 Submit daily force report to Departmental Representative daily prior to noon the following day indicating:
.1 Total number of personnel on site.
.2 Major subcontractors on site listed by trade.
.3 Major equipment on site, i.e. excavators, cranes, drills.
.4 Concrete volumes.
.5 Visitors to site.
.6 Weather
.7 Documents required from Departmental Representative to Contractor to maintain.

.3 Perform schedule update monthly dated on last working day of the month. Update to reflect activities completed to date, activities in progress, logic and duration changes.

.4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.

.5 Requirements for monthly progress monitoring and reporting are basis for progress payment request.

.6 Submit monthly schedule updates with the progress payment request.

.7 Submit monthly written reports based on schedule, showing Work to Date performed, comparing work progress planned and presenting current forecasts. Report must summarize progress, defining problem areas and anticipated delays with respect to Work Schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate any potential delay. Include in report:
.1 Description of progress made.
.2 Pending items and status of: Permits, shop drawings, samples, mockups, deliveries, change orders, possible time extension.
.3 Status of Contract Completion Date and Milestones.
.4 Current and Anticipated problem areas, potential delays and corrective measures.

.8 Submit weekly 3 weeks look ahead schedule to Departmental Representative on each Friday of the Week indicating the planned tasks of the next three week period.

1.8 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

END OF SECTION 01 32 16.07

## 1.0 GENERAL

### 1.1 ADMINISTRATIVE

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, 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 Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

.10 Keep one reviewed copy of each submission on site.

.11 Do not proceed with work until relevant submissions are reviewed by Departmental Representative.

### 1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 When specified in the Contract document, submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia of Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 10 days for Departmental Representative's review of each submission, unless noted otherwise.

.5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in shop drawings as Departmental Representative may require consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, in duplicate, 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 include:
- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.

.9 After Departmental Representative's review, distribute copies.

.10 Submit electronic copy of shop drawings for each requirement requested in specification sections and as Departmental Representative may reasonably request.

.11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
- .2 Testing must conform to the most current requirement as of the date of contract award for project.

.13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
- .2 Certificates must be dated after award of project contract complete with project name.

.14 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.18 Delete information not applicable to project.

.19 Supplement standard information to provide details applicable to project.

.20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

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

.22 Shop drawings to be submitted in electronic format. Contractor to provide printed reviewed final copies for inclusion in maintenance manual. If the contractor choose to submit hardcopies, sufficient copies must be allowed for retention by the consultants and for inclusion in the maintenance manual.

.23 Electronic submissions will only be reviewed and returned electronically. No hardcopies will be returned to contractor.

.24 All electronic submissions to be uploaded to Document Control System FTP site hosted by PWGSC, if PWGSC decided to set up one for this project.

1.3 SAMPLES

.1 Submit for review samples in duplicate as required in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Departmental Representative's business address.

.3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.

.7 Reviewed and accepted samples will be kept onsite and will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

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

1.5 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of colour digital photography in jpg format, standard resolution monthly with progress statement and as directed by Departmental Representative.

.2 Project identification: name and number of project and date of exposure indicated.

.3 Viewpoints and their locations as reasonably determined by Departmental Representative.

.4 Provide photographic documentation of adjacent existing conditions prior to commencement of construction for determining and accidental damage as a result of contractor’s work.

.5 Frequency of photographic documentation: minimum bi-weekly unless otherwise directed by Departmental Representative.

.1 Upon completion of: demolition, framing and services before concealment of Work, and as directed by Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Submit electronic copies of test results and inspection reports required as noted in each section of specifications.

END OF SECTION 01 33 00

PSPC Update on Asbestos Use

Effective April 1, 2016, all Public Service and Procurement Canada (PSPC) contracts for new construction and major rehabilitation will prohibit the use of asbestos-containing materials. Further information can be found at http://www.tpsgc-pwgsc.gc.ca/comm/vedette-features/2016 04-19-00-eng.html

## 1.0 GENERAL

### 1.1 REFERENCES

.1 Government of Canada.
- .1 Canada Labour Code - Part II
- .2 Canada Occupational Health and Safety Regulations.

.2 National Building Code of Canada (NBC 2015):
- .1 Part 8, Safety Measures at Construction and Demolition Sites.

.3 Canadian Standards Association (CSA as amended):
- .1 CSA Z797-2009 Code of Practice for Access Scaffold
- .2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes
- .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures

.4 National Fire Code of Canada 2015 (as amended)
- .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.

.5 American National Standards Institute (ANSI):
- .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.6 Province of British Columbia:
- .1 Workers Compensation Act Part 3-Occupational Health and Safety.
- .2 Occupational Health and Safety Regulation

.7 Current B.C. Electrical Code

### 1.2 RELATED SECTIONS

| | | |
|---|---|---|
| .1 | Construction Progress Schedule Bar (GANTT) Chart | Section 01 32 16.07 |
| .2 | Submittal Procedures | Section 01 33 00 |
| .3 | Temporary Utilities | Section 01 51 00 |
| .4 | Temporary Barriers Enclosures | Section 01 56 00 |
| .5 | Structure Demolition | Section 02 41 16 |
| .6 | Demolition for Minor Works | Section 02 41 99 |
| .7 | Asbestos Abatement Intermediate Precautions | Section 02 82 00.02 |
| .8 | Lead Base Paint Intermediate Precautions | Section 02 83 11 |

1.3 WORKERS' COMPENSATION BOARD COVERAGE

.1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.

.2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.4 COMPLIANCE WITH REGULATIONS

.1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.

.2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.5 SUBMITTALS

.1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 33 00.

.2 Work effected by submittal shall not proceed until review is complete.

.3 Submit the following:

- .1 Health and Safety Plan.
- .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- .3 Copies of incident and accident reports.
- .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Material Information System (WHMIS) requirements.
- .5 Emergency Procedures.

.4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 2 days after Receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

.5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.

.6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:

- .1 Be construed to imply approval by the Departmental Representative.
- .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
- .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6 RESPONSIBILITY

.1 Assume responsibility as the Prime Contractor for work under this contract.

.2 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.

.3 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.

1.7 HEALTH AND SAFETY COORDINATOR

.1 The Health and Safety Coordinator must:
- .1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.
- .2 Be responsible for implementing, daily enforcing, and monitoring the site-specific Health and Safety Plan.
- .3 Be on site during execution of work.

1.8 GENERAL CONDITIONS

.1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.

.2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
- .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
- .2 Secure site at night time as deemed necessary to protect site against entry.

1.9 PROJECT/SITE CONDITIONS

.1 Other safety hazards or risks which may be encountered include, but are not limited to:
- .1 Contact with traveling and mobile cranes, forklifts, manlifts and other motorized vehicles.
- .2 Overhead hazards such as that created by material transported by cranes.
- .3 Fall hazards.
- .4 Drowning hazards.
- .5 Confined space hazards.
- .6 Electrical hazards.
- .7 Contact with operating mechanical, electrical, electronic, pneumatic, thermal, and hydraulic machinery and equipment.
- .8 Fire hazards.

1.10 REGULATORY REQUIREMENTS

.1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.

.2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

1.11 WORK PERMITS

.1 Obtain specialty trade permits related to project before start of work.

1.12 FILING OF NOTICE

.1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.

.2 Provide copies of all notices to the Departmental Representative.

1.13 HEALTH AND SAFETY PLAN

.1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.

.2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:

- .1 Primary requirements:
  - .1 Contractor's safety policy.
  - .2 Identification of applicable compliance obligations.
  - .3 Definition of responsibilities for project safety/organization chart for project.
  - .4 General safety rules for project.
  - .5 Job-specific safe work, procedures.
  - .6 Inspection policy and procedures.
  - .7 Incident reporting and investigation policy and procedures.
  - .8 Occupational Health and Safety Committee/Representative procedures.
  - .9 Occupational Health and Safety meetings.
  - .10 Occupational Health and Safety communications and record keeping procedures.
- .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
- .3 List hazardous materials to be brought on site as required by work.
- .4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
- .5 Identify personal protective equipment (PPE) to be used by workers.
- .6 Identify personnel and alternates responsible for site safety and health.
- .7 Identify personnel training requirements and training plan, including site orientation for new workers.

.3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.

.4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.

.5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.14 EMERGENCY PROCEDURES

.1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:

.1 Designated personnel from own company.
.2 Regulatory agencies applicable to work and as per legislated regulations.
.3 Local emergency resources.
.4 Departmental Representative and site staff.

.2 Include the following provisions in the emergency procedures:
.1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
.2 Evacuate all workers safely.
.3 Check and confirm the safe evacuation of all workers.
.4 Notify the fire department or other emergency responders.
.5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
.6 Notify Departmental Representative and site staff.

.3 Provide written rescue/evacuation procedures as required for, but not limited to:
.1 Work at high angles.
.2 Work in confined spaces or where there is a risk of entrapment.
.3 Work with hazardous substances.
.4 Underground work.
.5 Work on, over, under and adjacent to water.
.6 Workplaces where there are persons who require physical assistance to be moved.

.4 Design and mark emergency exit routes to provide quick and unimpeded exit.

.5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

1.15 HAZARDOUS PRODUCTS

.1 Comply with requirements of Workplace Hazardous Materials Information system (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

.2 Where use of hazardous and toxic products cannot be avoided:
.1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 33 00.
.2 Provide adequate means of ventilation in accordance with Section 01 51 00.

1.16 ELECTRICAL SAFETY REQUIREMENTS

.1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.
.1 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.
.2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

1.17 ELECTRICAL LOCKOUT

.1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.

.2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.

.3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

1.18 OVERLOADING

.1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

1.19 CONFINED SPACES

.1 Carry out work in confined spaces in compliance with Occupational Health and Safety Regulation, Part 9.

1.20 POWDER-ACTUATED DEVICES

.1 Use powder-actuated devices in accordance with ANSI A10.3 only after receipt of written permission from the Departmental Representative.

1.21 FIRE SAFETY AND HOT WORK

.1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.

.2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.

1.22 FIRE SAFETY REQUIREMENTS

.1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.25 FIRE PROTECTION AND ALARM SYSTEM

.1 Fire protection and alarm systems shall not be:

.1 Obstructed.

.2 Shut off.

.3 Left inactive at the end of a working day or shift.

.2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.

.3 Be responsible/liable for costs incurred from the fire department, the Departmental Representative and the tenants, resulting from false alarms.

1.23 UNFORESEEN HAZARDS

.1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and advise the Departmental Representative verbally and in writing.

1.24 POSTED DOCUMENTS

.1 Post legible versions of the following documents on site:

.1 Health and Safety Plan.

.2 Sequence of work.
.3 Emergency procedures.
.4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
.5 Notice of Project.
.6 Floor plans or site plans.
.7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
.8 Workplace Hazardous Materials Information System (WHMIS) documents.
.9 Material Safety Data Sheets (MSDS).
.10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.

.2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

.3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.25 MEETINGS

.1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

1.26 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.

.3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

END OF SECTION 01 35 33

## 1.0 GENERAL

### 1.1 DEFINITIONS

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

### 1.2 SUBMITTALS

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

.2 Prior to commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative. Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.

.3 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.4 Environmental protection plan to include:

- .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
- .2 Names and qualifications of persons responsible for manifesting contaminated soils and hazardous waste to be removed from site.
- .3 Names and qualifications of persons responsible for training site personnel.
- .4 Descriptions of environmental protection personnel training program.
- .5 Erosion and sediment control plan which identifies type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .6 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods of control runoff and to contain materials on site.
- .7 Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.
- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Ensure plan includes measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .9 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off project site.

.12 Contaminant prevention plan that: identifies potentially hazardous substances to be used on job site; identifies intended actions to prevent introduction of such materials into air, water, or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.13 Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

.14 Historical, archaeological, culture resources biological resources and wetlands plan that defines procedures for identifying and protecting historical archeological, cultural resources, biological resources and wetlands.

.15 Pesticide treatment plan to be included and updated, as required.

1.3 FIRES

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

1.4 DISPOSAL OF WASTES

.1 Do not bury rubbish and waste materials on site.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways.

1.5 DRAINAGE

.1 Provide Erosion and Sediment Control Plan identifying type and location of erosion and sediment controls provided. Ensure plan includes monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations, EPA 832/R-92-005, Chapter 3 requirements.

.2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.

.3 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.4 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.6 WORK ADJACENT TO WATERWAYS

.1 Construction equipment to be operated on land only.

.2 Do not use waterway beds for borrow material without Departmental Representative's approval.

.3 Waterways to be free of excavated fill, waste material and debris.

.4 Design and construct temporary crossings to minimize erosion to waterways.

.5 Do not skid logs or construction materials across waterways.

.6 Avoid indicated spawning beds when constructing temporary crossings of waterways.

1.7 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 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

.4 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area. Provide temporary enclosures for this construction activity.

1.8 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties as 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 2 m minimum.

.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 zone.

.4 Minimize stripping of topsoil and vegetation.

.5 Restrict tree removal to project areas.

1.9 SPECIES AT RISK

.1 There are a number of threatened species inhabiting the greater Fort Rodd Hill National Historic site, both floral and faunal. It will be necessary to consult the Species at Risk experts located at the PCA site administration office to determine which registered species may be at risk due to construction activities, as well as mitigation efforts or schedule modifications that may need to be undertaken.

.2 PSPC has identified the presence of nesting Barn Swallows (Hirundo rustica) in both the Lower and Upper Batteries at Fort Rodd Hill. In Canada, the Barn Swallow and its nests and eggs are protected under the *Migratory Birds Convention Act, 1994*. It is ranked as threatened under the SARA registry.

.3 Pursuant to sections 32 and 33 of the Federal Species at Risk Act (SARA) of 2003, it is an offense to kill, harm, harass, capture, or take an individual of a listed species; as well as to damage or destroy the residence of a listed species.

1.9 NOTIFICATION

.1 Departmental Representative will notify Contractor in writing of observed non-compliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

.2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.

.1 Do not take action until after receipt of written approval by Departmental Representative.

.3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.

.4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

END OF SECTION 01 35 43

1.0 GENERAL

1.1 RELATED
.1 General Instructions Section 01 11 55

1.2 REFERENCES AND CODES
.1 Perform Work in accordance with National Building Code of Canada (NBC) 2015 and B.C. Building Code 2012 including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:
.1 Contract Documents.
.2 Specified standards, codes and referenced documents.

1.3 BUILDING SMOKING ENVIRONMENT
.1 Comply with smoking restrictions and municipal by-laws.

1.4 NATIONAL PARKS ACT
.1 Perform Work in accordance with National Parks Act.

2.0 PRODUCTS

2.1 NOT USED
.1 Not Used.

3.0 EXECUTION

3.1 NOT USED
.1 Not used

END OF SECTION 01 41 00

## 1.0 GENERAL

### 1.1 INSPECTION

.1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental 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 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

### 1.2 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Contractor for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Contractor.

.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, contractor will be requested to provide additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and re-inspection.

### 1.3 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

### 1.4 PROCEDURES

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.5 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

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

1.6 REPORTS

.1 Submit electronic copy of inspection and test reports to Departmental Representative. Testing and Inspection companies engaged by the Contractor will furnish paper copies of reports on site to allow for work to proceed in a timely manner.

.2 Provide copies to subcontractor of work being, inspected or tested or manufacturer or fabricator of material being inspected or tested.

1.7 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested.

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

1.8 MOCK-UPS

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.

.2 Construct in locations acceptable to Departmental Representative as specified in specific Section.

.3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed.

1.9 MILL TESTS

.1 Submit mill test certificates as requested.

END OF SECTION 01 45 00

## 1.0 GENERAL

### 1.1 REFERENCES

.1 Canada Green Building Council (CaGBC)

.1 LEED Canada – latest version LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.

.2 U.S. Environmental Protection Agency (EPA) / Office of Water

.1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

### 1.2 ACTION AND INFORMATION SUBMITTALS

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

### 1.3 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

### 1.4 DEWATERING

.1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

### 1.5 WATER SUPPLY

.1 Water supply is available on site. There is no guarantee that the supply will meet construction demand and uninterrupted. Contractor will use this supply at their own risk.

### 1.6 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.

.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 degrees 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 or 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 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
.1 Conform with applicable codes and standard.
.2 Enforce safe practices.
.3 Prevent abuse of services.
.4 Prevent damages to finishes.
.5 Vent direct-fired combustion units to outside.

.7 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.7 TEMPORARY POWER AND LIGHT

.1 Department Representative will not provide power for lighting and operating of power tools during construction.

.2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.

.3 Provide and maintain temporary power and lighting throughout project.

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.

1.9 CONSTRUCTION PARKING

.1 Parking is allowed only in the designated parking stalls assigned for contractor's use in the parking lot. There is no guarantee that there will be sufficient parking allocated to meet all contractor's parking requirement. Location of parking is subjected to coordination with Parks' management staff on site.

2.0 PRODUCTS

NOT USED

3.0 EXECUTIION

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 sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.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 01 51 00

## 1.0 GENERAL

## 1.1 RELATED REQUIREMENTS

## 1.2 REFERENCES

.1 Canada Green Building Council (CAGBC)
- .1 LEED Canada – latest Version LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB 1. 189-00, Exterior Alkyd Primer for Wood.
- .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.3 Canadian Standards Association (CSA International)
- .1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA-0121-M1978 (R2003), Douglas Fir Plywood.
- .3 CAN/CSA-S269.2 – M1987 (R2001), Access Scaffolding for Construction Purpose.
- .4 CAN/CSA-Z321-96 (R2001), Signs and Symbols for the Occupational Environment.

.4 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC) – ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.

.5 U.S. Environmental Protection Agency (EPA) / Office of Water
- .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

## 1.4 INSTALLATION AND REMOVAL

.1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.

.2 Identify areas which have to be gravelled to prevent tracking of mud.

.3 Indicate use of supplemental or other staging area.

.4 Provide construction facilities in order to execute work expeditiously.

.5 Remove from site all such work after use.

## 1.5 SCAFFOLDING

.1 Scaffolding in accordance with CAN/CSA-S269.2.

## 1.6 HOISTING

.1 Provide, operate and maintain hoists (cranes) required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.

.2 Hoists cranes to be operated by qualified operator.

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 weight or force that will endanger Work.

1.8 CONSTRUCTION PARKING

.1 Parking will be permitted on site and subject to coordination with Departmental Representatives.

.2 Provide and maintain adequate access to project site.

.3 Clean driveways where used by Contractor's equipment.

1.9 SECURITY

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

1.10 OFFICES

.1 Contractor to provide their own offices as necessary. Location of temporary office to be coordinated with Departmental Representative.

1.11 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

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

1.12 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.13 CONSTRUCTION SIGNAGE

.1 No other signs or advertisements, other than warning signs, are permitted on site.

.2 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 Departmental Representative.

1.14 PROTECTION AND MAINTENANCE OF TRAFFIC

.1 Provide access and temporary relocated roads as necessary to maintain traffic.

.2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.

.3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger and direction signs.

.4 Protect travelling public from damage to person and property.

.5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.

.6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: 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 operations at all times.

.11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Departmental Representative.

.12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.

.13 Provide snow removal during period of Work.

.14 Remove, upon completion of work, haul roads designated by Departmental Representative.

1.15 CLEAN-UP

.1 Remove construction debris, waste materials, packaging material from work site daily.

.2 Clean dirt or mud tracked onto paved or surfaced roadways.

.3 Store materials resulting from demolition activities that are salvageable.

.4 Stack stored new or salvaged material not in construction facilities.

2.0 PRODUCTS

2.1 NOT USED

.1 Not used.

3.0 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 sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.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 01 52 00

## 1.0 GENERAL

### 1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)
- .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 Canadian Standards Association (CSA International)
- .1 CSA-O121-M1978(R2003, Douglas Fir Plywood.

.3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

### 1.2 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

### 1.3 HOARDING

.1 Erect temporary site enclosure using module lock fence with visual screening of minimum 1.8 m high. Provide lockable truck gate or man gate as applicable. Maintain fence in good repair.

.2 Provide barriers around trees and plants to remain within the project area. Protect from damage by equipment and constriction procedures.

### 1.4 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, and open edges of floors and roofs,

.2 Provide as required by governing authorities.

### 1.5 WEATHER ENCLOSURES

.1 Provide weather tight closures 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.

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 public.

1.9 FIRE ROUTES

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

.2 Maintain clearance for all egress routes.

1.10 PROTECTION 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 EXISTING PROPERTY

.1 Provide protection for finished and partially finished property and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.12 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.13 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management And Disposal.

END OF SECTION 01 56 00

## 1.0 GENERAL

### 1.1 PRODUCTS/MATERIAL AND EQUIPMENT

.1 Use NEW products/material and equipment unless otherwise specified. The term "products" is referred to throughout the specifications.

.2 Use products of 1 manufacturer for material and equipment of the same type or classification unless otherwise specified.

.3 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.4 Notify Departmental Representative in writing of any conflict between these specifications and manufacturer's instructions. Departmental Representative will designate which document is to be followed.

.5 Provide metal fastenings and accessories in the same texture, colour and finish as base metal in which they occur.

- .1 Prevent electrolytic action between dissimilar metals.
- .2 Use non-corrosive fasteners, anchors and spacers for securing exterior work.
- .3 Fastenings which cause spalling or cracking are not acceptable.
- .4 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .5 Use heavy hexagon heads, semi-finished unless otherwise specified.
- .6 Bolts may not project more than 1 diameter beyond nuts.
- .7 Types of washers as follows:
  - .1 Plain type washers: use on equipment and sheet metal.
  - .2 Soft gasket lock type washers: use where vibrations occur.
  - .3 Resilient washers: use with stainless steel.
- .8 Deliver, store and maintain packaged material and equipment with manufacturer's seals and labels intact.
- .9 Prevent damage, adulteration and soiling of products during delivery, handling and storage. Immediately remove rejected products from site.
- .10 Store products in accordance with suppliers' instructions.
- .11 Touch up damaged factory finished surfaces to Departmental Representative's satisfaction.
  - .1 Use primer or enamel to match original.
  - .2 Do not paint over nameplates.

### 1.2 QUALITY OF PRODUCTS

.1 Products, materials and equipment (referred to as products) incorporated into work shall be new, not damaged or defective, and of the best quality (compatible with the specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of the products provided.

.2 Defective products will be rejected regardless of previous inspections.

- .1 Inspection does not relieve responsibility, but is precaution against oversight or error.
- .2 Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Retain purchase orders, invoices and other documents to prove that all products utilized in this Contract meet the requirements of the specifications. Produce documents when requested by the Departmental Representative.

.4 Should any dispute arise as to quality or fitness of products, the decision rests strictly with the Departmental Representative based upon the requirements of the Contract documents.

.5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.

.6 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 OF PRODUCTS

.1 Immediately upon signing the Contract, review product delivery requirements and anticipate foreseeable supply delays for any items.

.2 If delays in supply of products are foreseeable, notify Departmental Representative of such in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of the work.

.3 In event of failure to notify Departmental Representative at the start of work and should it subsequently appear that the work may be delayed for such reason, the Departmental Representative reserves the right to substitute more readily available products of similar character, at no increase in either the Contract price or the Contract time.

1.4 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the specifications, install or erect products in accordance with the manufacturer's instructions.
  .1 Do not rely on labels or enclosures provided with products.
  .2 Obtain written instructions directly from the manufacturer.

.2 Notify Departmental Representative in writing of conflicts between the specifications and the manufacturer's instructions so that the Departmental Representative may establish the course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and reinstallation at no increase in either the Contract price or the Contract time.

1.5 CONTRACTOR'S OPTIONS FOR SELECTION OF PRODUCTS FOR TENDERING

.1 Products are specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.

.2 Products specified under "Acceptable Products": select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.

.3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.

.4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided that full technical data is received in writing by Departmental Representative in accordance with "Special Instructions to Tenderers".

.5 When products are specified by a referenced standard or by or Performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent laboratory report showing that the product meets or exceeds the specified requirements.

1.6 SUBSTITUTION AFTER CONTRACT AWARD

.1 No substitutions are permitted without prior written approval of the Departmental Representative.

.2 Proposals for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and the proposed substitution.

.3 Proposals will be considered by the Departmental Representative if:

.1 Products selected by tenderer from those specified are not available;

.2 Delivery date of products selected from those specified would unduly delay completion of Contract, or

.3 Alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.

.4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.

.5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative and the Contract price will be reduced accordingly.

END OF SECTION 01 61 00

## 1.0 GENERAL

### 1.1 REFERENCES

.1 A set of construction drawings of existing washrooms in pdf format is available for reference only. The set of drawings may not be full completed set and do not necessarily represent as-built conditions. All existing conditions measurements need to be verified on site.

### 1.2 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, licensed to practice in the province of British Columbia, acceptable to Departmental Representative.

### 1.3 EXISTING SERVICES

.1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.

.2 Contractor is responsible to provide GPR Survey of existing services as required to verify existing underground condition prior to excavation.

### 1.4 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Departmental Representative of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

### 1.5 RECORDS

.1 Maintain a complete, accurate log of control and survey work of the drainage work as it progresses.

.2 Record locations of maintained, re-routed and abandoned service lines.

### 1.6 SUBMITTALS

.1 On request of Departmental Representative, submit documentation to verify accuracy of field engineering work, noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

### 1.7 SUBSURFACE CONDITIONS

.1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

.2 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

END OF SECTION 01 71 00

## 1.0 GENERAL

### 1.1 SUBMITTALS

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

.2 Submit written request in advance of cutting or alteration which affects:
- .1 Structural integrity of elements of project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Departmental Representative or separate contractor.

.3 Include in request:
- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Departmental Representative or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

### 1.2 MATERIALS

.1 Required for original installation.

.2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

### 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 assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.5 Provide protection from elements for areas which are to 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 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

.12 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management And Disposal.

END OF SECTION 01 73 00

## 1.0 GENERAL

### 1.1 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Departmental Representative or other Contractors.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.

.3 Clear snow and ice from access to building, bank/pile snow in designated areas only.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 - Waste Management and Disposal.

.7 Dispose of waste materials and debris off site.

.8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

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

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

### 1.2 FINAL CLEANING

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris including that caused by Departmental Representative or other Contractors.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.

.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, millwork floors and ceilings.

.9 Clean lighting reflectors, lenses, and other lighting surfaces.

.10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.14 Remove dirt and other disfiguration from exterior surfaces.

.15 Sweep and wash clean paved areas.

.16 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

.17 Remove snow and ice from access to buildings.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management And Disposal.

END OF SECTION 01 74 11

## 1.0 GENERAL

### 1.1 WASTE MANAGEMENT GOALS

.1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss PWGSC's Waste Management Plan and Goals.

.2 Accomplish maximum control of solid construction waste.

.3 Preserve environment and prevent pollution and environment damage.

### 1.2 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. WRW is based on information acquired from WA (Schedule A).

1.3 DOCUMENTS

.1 Maintain at job site, one copy of following documents:
- .1 Waste Audit.
- .2 Waste Reduction Workplan.
- .3 Material Source Separation Plan.
- .4 Schedules A, B, C, D, E completed for project.

1.4 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 completed Waste Reduction Workplan (WRW): Schedule B.
- .2 Submit 2 copies of completed Demolition Waste Audit (DWA): Schedule C.
- .3 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 using deconstruction/disassembly material audit form.
- .1 Failure to submit could result in hold back of final payment.
- .2 Provide receipts, scale tickets, 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 quantities by number, type and size of items and the destination.
- .4 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

1.5 WASTE AUDIT (WA)

.1 Conduct WA prior to project start-up.

.2 Prepare WA: Schedule A.

.3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

1.6 WASTE REDUCTION WORKPLAN (WRW)

.1 Prepare WRW prior to project start-up.

.2 WRW should include but not limited to:
- .1 Destination of materials listed.
- .2 Deconstruction/disassembly techniques and sequencing.
- .3 Schedule for deconstruction/disassembly.
- .4 Location.
- .5 Security.
- .6 Protection.
- .7 Clear labelling of storage areas.
- .8 Details on materials handling and removal procedures.
- .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.

.3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.

.4 Describe management of waste.

.5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.

.6 Post WRW or summary where workers at site are able to review content.

.7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.

.8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

1.7 DEMOLITION WASTE AUDIT (DWA)

.1 Prepare DWA prior to project start-up.

.2 Complete DWA: Schedule C.

.3 Provide inventory of quantities of materials to be salvaged for reuse, recycling, or disposal.

1.8 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 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.

1.9 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.

.2 Unless specified otherwise, materials for removal become Contractor's property.

.3 Protect surface drainage, mechanical and electrical from damage and blockage.

.4 Separate and store materials produced during dismantling of structures in designated areas.

.5 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.

1.10 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner, 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 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.11 USE OF SITE AND FACILITIES

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

.2 Provide temporary security measures approved by Departmental Representative.

1.12 SCHEDULING

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

2.0 PRODUCTS

2.1 NOT USED

.1 Not Used.

3.0 EXECUTION

3.1 APPLICATION

.1 Do Work in compliance with WRW.

.2 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 From following list, separate materials from general waste stream and stockpile in separate piles or

containers, as reviewed by 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 and/or recyclable materials is not permitted.

.3 Demolition Waste:

| Material Type | Recommended Diversion % | Actual Diversion % |
|---|---|---|
| Rubbles (Stone / Brick / Concrete) | 100 | |
| Structural Steel | 100 | |
| Electrical Conduits | 80 | |
| Metals (miscellaneous metal & pipings) | 100 | |
| Masonry | 100 | |
| Wood (uncontaminated) | 100 | |
| Other (Stucco / Roofing / waterproofing material) | 100 | |

.4 Construction Waste:

| Material Type | Recommended Diversion % | Actual Diversion % |
|---|---|---|
| Cardboard | 100 | |
| Plastic Packaging | 100 | |
| Masonry | 100 | |
| Structural Steel | 100 | |
| Metal ((miscellaneous metal & pipings) | 100 | |
| Wood (uncontaminated) | 100 | |
| Other (Stucco / Roofing / waterproofing material) | 100 | |

3.4 WASTE AUDIT (WA)

The following pertains to Schedule A - Waste Audit (WA). Column-1 refers to the category of waste, and a physical description of the material (e.g. off-cuts, clean drywall, etc.). Column-2 refers to the total quantity of materials received by the Contractor. Measurement units must be specified. Column-3 refers to the estimated percentage of material that is waste. Column-4 refers to the total quantity of waste (column-2 x column-3). Column-5 refers to the areas(s) in which the waste was generated. Column-6 refers to the total percentage of recycled material from the specified total quantity of waste (column-4). Column-7 refers to

the total percentage of reused material from the specified total quantity of waste (column-4).

.1 Schedule A - Waste Audit (WA):

| (1) Material Category | (2) Material Quantity Unit % | (3) Estimated Waste | (4) Total Quantity of Waste (unit) | (5) Generation Point | (6) % Recycled | (7) % Reused |
|---|---|---|---|---|---|---|
| Wood | | | | | | |
| Off-Cuts | | | | | | |
| Warped | | | | | | |
| Plastic | | | | | | |
| Cardboard | | | | | | |
| Other | | | | | | |
| Metals | | | | | | |
| Brick | | | | | | |

3.6 WASTE REDUCTION WORKPLAN (WRW)

The following pertains to Schedule B - Waste Reduction Workplan (WRW). Column-1 refers to the category and type of waste materials. Column-2 refers to the persons responsible for completing the WRW. Column-3 refers to Column-4 of Schedule A. Column-4 refers to the amount of reused waste predicted and realized. Column-5 refers to the amount of recycled waste predicted and realized. Column-6 refers to the approved recycling facility.

.1 Schedule B:

| (1) Material Quantity Category | (2) Person Amount Responsible Waste | (3) Total of Project (unit) | (4) Reused Actual (units) | (5) Recycle Actual (s) Amount | (6) Material Destination (s) |
|---|---|---|---|---|---|
| Wood | | | | | |
| Warped | | | | | |
| Plastic | | | | | |
| Cardboard Packaging | | | | | |
| Other | | | | | |
| Doors & Windows | | | | | |
| Metal | | | | | |
| Brick | | | | | |

3.7 DEMOLITION WASTE AUDIT (DWA)

The following pertains to Schedule C - Demolition Waste Audit (DWA). Column-1 refers to the type of material salvaged. Column-2 refers to the material quantity shown in column-1. Several columns may be required to identify specific demolition areas. Column-3 refers to the unit of measurement used to describe Column-2. Column-4 refers to the total quantity of salvaged material. Column-5 refers to the cumulative volume of salvaged material. Column-6 refers to the total weight in kilograms. Column-7 refers to remarks and assumptions made about the specified material.

.1 Schedule C - Demolition Waste Audit (DWA):

| (1) Material Description Assumptions | (2) Quantity | (3) Unity | (4) Total | (5) Volume (cum) | (6) Weight (cum) | (7) Remarks & Assumptions |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Wood | | | | | | |
| Brick | | | | | | |
| Concrete | | | | | | |
| Steel | | | | | | |
| Roofing / Waterproofing | | | | | | |
| Stucco | | | | | | |
| Metals | | | | | | |
| Wood | | | | | | |
| Electrical Conduits | | | | | | |

3.8 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

.1 Schedule E - Government Chief Responsibility for the Environment:

.1 Ministry of Environment Lands and Parks
810 Blanshard Street, 4th Floor
Victoria, BC V8V 1X4
604-387-1161 / 604-356-6464

.2 Waste Reduction Commission Soils and Hazardous Waste
770 South Pacific Blvd, Suite 303
Vancouver BC, V6B 5E7
604-660-9550 / 604-660-9596

END OF SECTION 01 74 19

## 1.0 GENERAL

### 1.1 SECTION INCLUDES

.1 Administrative procedures preceding preliminary and final inspections of Work.

### 1.2 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.

### 1.3 INSPECTION AND DECLARATION

.1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

- .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
- .2 Request Departmental Representative's Inspection.
- .3 Departmental Representative's Review: Departmental Representative and Contractor will perform review of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- .4 Completion: submit written certificate that following have been performed:
  - .1 Work has been completed and inspected for compliance with Contract Documents.
  - .2 Defects have been corrected and deficiencies have been completed.
  - .3 Equipment and systems have been tested, adjusted, and balanced and are fully operational.
  - .4 Certificates required by authorities having jurisdiction.
  - .5 Work is complete and ready for Final Inspection.

.2 Submit required forms as described in General Conditions and Standard Acquisition Contract Clause (SACC) manual.

END OF SECTION 01 77 00

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

| | | |
|---|---|---|
| .1 | Quality Control | Section 01 45 00 |
| .2 | Examination & Preparation | Section 01 71 00 |
| .3 | Closeout Procedures | Section 01 77 00 |
| .4 | Demonstration and Training | Section 01 79 00 |
| .5 | Building Management Manual (BMM) | Section 01 91 51 |

### 1.2 SUBMISSION

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.2 Copy will be returned after final inspection, with Departmental Representative's comments.

.3 Revise content of documents as required prior to final submittal.

.4 Two weeks prior to Completion of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English.

.5 An electronic copy Interactive Operating and Maintenance Manual System is required as specified under clause 1.3. Provide 4 sets of the Electronic Interactive Operating and Maintenance Manual System to the Departmental Representative.

.6 Hard copies of the Operating and Maintenance Manual System is required as specified under clause 1.4. Provide 4 sets of the Hard Copy Interactive Operating and Maintenance Manual System to the Departmental Representative.

.7 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.

.8 If requested, furnish evidence as to type, source and quality of products provided.

.9 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.10 Pay costs of transportation.

### 1.3 INTERACTIVE OPERATING AND MAINTENANCE MANUAL SYSTEM

.1 In addition to the printed copies, submit provide an Interactive Operating and Maintenance Manual System as specified herein.

.2 System Description and Requirements

.1 All as constructed drawings and operation and maintenance (O&M) manuals listed under the Scope of Work shall be converted, where necessary, into Portable Data File (PDF) format for viewing using the Adobe Acrobat Reader.

.2 Documentation storage and retrieval system shall be structured based on a database framework with direct links to the appropriate PDF files. Documents retrieval and viewing shall be executed through a menu driven approach.

.3 Program shall be capable of storing separately and independently data of multiple buildings and shall be expandable for addition of new buildings and systems.

.4 Data of each building shall be accessible by the input of either the building name or building number as defined by the Departmental Representative.

.5 O&M data and as constructed drawings shall be classified by their corresponding disciplines, including:

.1 Architectural
.2 Electrical
.3 Civil
.4 Under each discipline, data shall be grouped into the following four major categories:

.1 Basic Documents

.1 'Basic Documents' shall, according to the type of services or disciplines, include the full contents of each hard copy of the O&M manuals with the addition of Miscellaneous Maintenance Reports and Records, or as defined by the user. In general the following shall be included unless specifically excluded by the Departmental Representative:

.1 Introduction
.2 Consultant/Contractor/Suppliers List
.3 System Description
.4 Maintenance Schedules
.5 Specifications
.6 Others as stipulated by the Departmental Representative

.2 All Basic Documents PDF files shall be enhanced with appropriate bookmarks to facilitate searching of information within the document or linking to other relevant documents for references.

.2 'As-Constructed' Drawings

.1 'As-Constructed' hardcopy drawings shall be scanned and saved in PDF format. PDF files of the 'As-Constructed' drawings shall be enhanced with the following bookmarks to zoom into legible views on the computer screen as a minimum:

.1 Drawing Number and Title
.2 Drawing Notes
.3 Cross-links to other related drawings
.4 Revisions

1.4 FORMAT HARD COPY MANUALS

.1 Organize data in the form of an instructional 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.

.7 Text: Manufacturer's printed data.

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

1.5 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;
- .1 date of submission;
- .2 names, addresses, and telephone and fax numbers of Contractor, Subcontractors, Suppliers with name of responsible parties;
- .3 schedule of products and systems, indexed to content of volume.
- .4 copy of paint schedules, complete with the actual manufacturer, supplier and identification names and numbers.
- .5 all extended guarantees, warranties, maintenance bonds, certificates, letters of guarantees, registration cards, as called for in the various sections of the specification.
- .6 complete set of all final reviewed shop drawings.
- .7 test reports and certificates as applicable.
- .8 complete set of as constructed drawings.

.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, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.6 'AS CONSTRUCTED' DRAWINGS AND SAMPLES

.1 In addition to requirements in General Conditions, maintain at the site 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 Departmental Representative.

.6 Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring. Transfer information weekly to hardcopies to show work as actually installed.

.7 Provide a hardcopy of as constructed drawings for each discipline.

1.7 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, provided by Departmental Representative.

.2 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.

.4 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.

.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.

1.8 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.

1.9 MAINTENANCE MATERIALS

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in the Operating and Maintenance Manuals.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.10 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 Departmental 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 Departmental Representative's permission; leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Retain warranties and bonds until time specified for submittal.

END OF SECTION 01 78 00

1.1 RELATED REQUIREMENTS

.1 Hazardous Building Material Assessments (Appendix 1)

1.2 REFERENCES

.1 Definitions:

.1 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, include but not limited to: poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or materials that endanger human health or environment if handled improperly.

.2 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as co-ordinating related, required submittal and reporting requirements.

.3 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.

.4 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. WRW is based on information acquired from WA.

.2 Reference Standards:

.1 CSA International

.1 CSA S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

1.3 ADMINISTRATIVE REQUIRMENTS

.1 Pre-Demolition Meetings:

.1 Convene pre-demolition meeting 1 week prior to beginning work of this Section with Contractor's Representative and Departmental Representative in accordance with Section 01 31 19 - Project Meetings to:

.1 Verify project requirements.

.2 Verify existing site conditions adjacent to demolition work.

.3 Co-ordination with other construction subtrades.

.2 Ensure key personnel site supervisor, project manager and subcontractor representatives WMC attend.

.3 WMC must provide written report on status of waste diversion activity at each meeting.

.4 Departmental Representative will provide written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

.2 Scheduling:

.1 Employ necessary means to meet project time lines without compromising specified minimum rates of material diversion.

.1 In event of unforeseen delay notify Consultant in writing.

1.4 ACTION & INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures and Section 01 74 19 - Waste Management Disposal.

.2 WMC is responsible for fulfilment of reporting requirements.

.3 Prior to beginning of Work on site submit detailed Waste Management Plan in accordance with Section 01 74 19 - Waste Management And Disposal and indicate:

.1 Descriptions of and anticipated quantities in percentages of materials to be salvaged reused, recycled and landfilled.

.2 Schedule of selective demolition.
.3 Number and location of dumpsters.
.4 Anticipated frequency of tippage.
.5 Name and address of waste receiving organizations.

.4 Submit PDF copies of receipts from authorized disposal sites and reuse and recycling facilities for material removed from site on a bi-weekly basis upon request of Consultant.
.1 Written authorization from Departmental Representative is required to deviate from receiving organizations listed in Waste Reduction Workplan.

.5 Construction Waste Management:
.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: Ensure Work is performed in compliance with applicable Provincial and Municipal regulations.

1.6 SITE CONDITIONS

.1 Environmental protection:
.1 Ensure Work is done in accordance with Section 01 35 43 - Environmental Procedures.

.2 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.

.3 Fires and burning of waste or materials is not permitted on site.

.4 Do not bury rubbish waste materials.

.5 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into storm or sanitary sewers.
.1 Ensure proper disposal procedures are maintained throughout project.

.6 Do not pump water containing suspended materials into storm or sanitary sewers, or onto adjacent properties.

.7 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction.

.8 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.

.9 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all interior and exterior public areas.

.2 Review "Pre-Construction Hazmat Survey" and take precautions to protect environment.

.3 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous is encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
.1 Proceed only after receipt of written instructions have been received from Consultant.

.4 Notify Departmental Representative before disrupting building access or services.

.5 Extent of Demolition - refer to drawings.

1.7 EXISTING CONDITIONS

.1 If material resembling spray or trowel applied asbestos or other designated substance listed as hazardous be encountered in course of demolition, stop work, take preventative measures, and notify Departmental Representative immediately. Proceed only after receipt of written instructions has been received from Consultant.

.2 Structures to be demolished are based on their condition at time of examination prior to tendering.

2.0 PRODUCTS

2.1 EQUIPMENT

.1 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

3.0 EXECUTION

3.1 EXAMINATION

.1 Inspect building with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing utilities within the building where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Departmental Representative in case of damage to any utility or service designated to remain in place.

.2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

.1 Protection of in-place conditions:

.1 Work in accordance with Section 01 35 43 - Environmental Procedures.

.2 Prevent movement, settlement or damage of adjacent structures, services and parts of existing building to remain.

.1 Provide bracing, shoring and underpinning as required.

.2 Repair damage caused by demolition as directed by Departmental Representative

.3 Support affected structures and, if safety of structure being demolished or adjacent structures or services appears to be endangered, take preventative measures, stop Work and immediately notify Departmental Representative

.4 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.

.1 Disconnect and cap mechanical services.

.2 Natural gas supply lines: remove in accordance with gas company requirements.

.3 Sewer and water lines: remove or provide temporary support if they are to remain as indicated on drawings.
.4 Other underground services: remove and dispose of as indicated on drawings.

3.3 DEMOLITION

.1 Do demolition work in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
.2 Blasting operations not permitted during demolition.

.3 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.

.4 Prior to start of Work, remove contaminated or hazardous materials as indicated in Hazardous Material Report from site and dispose of at designated disposal facilities in safe manner and in accordance with recommendation in report.

.5 Demolish structural work as indicated on drawings.

.6 Crush concrete generated due to demolition of concrete structure to size suitable for recycling
.1 Where possible identify markets which will accept crushed material as aggregate.

.7 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.

.8 At end of each day's work, leave Work in safe and stable condition.

.9 Demolish to minimize dusting. Keep materials wetted as directed by Departmental Representative.

.10 Use natural lighting to do Work where possible.
.1 Shut off lighting except those required for security purposes at end of each day.

3.4 CLEANING

.1 Develop Waste Management Plan related to Work of this Section.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.3 Divert excess materials from landfill to site approved, by Departmental Representative.

.4 Designate appropriate security resources / measures to prevent vandalism, damage and theft.

END OF SECTION 02 41 16

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 02 41 16 Structure Demolition

.2 Section 02 82 00.02 Asbestos Abatement Intermediate Precautions

.3 Section 02 83 11 Lead Base Paint Intermediate Precautions

1.2 REFERENCES

.1 Canada Green Building Council (CaGBC)

.1 LEED Canada-CI Version 1.0- 2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

.2 CSA International

.1 CSA S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

1.3 ACTION & INFORMATIONS SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 21 - Construction/Demolition Waste Management Disposal.

.2 Submit hoarding layout plan for approval by Departmental Representative at each stage of work.

.3 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.4 SITE CONDITIONS

.1 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous is encountered, stop work, take preventative measures, and notify Departmental Representative immediately.

.1 Proceed only after receipt of written instructions have been received from Consultant.

.2 Notify Departmental Representative before disrupting building access or services.

.3 Extent of Demolition - refer to drawing.

3.0 EXECUTION

3.1 EXAMINATION

.1 Inspect building with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing utilities within the building where they interfere with the execution of the work, in conformity with the requirements of the authorities having

jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Departmental Representative in case of damage to any utility or service designated to remain in place.

.2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

.1 Protection of In-Place Conditions:

.1 Prevent movement, settlement, or damage to adjacent structures, and utilities.

.2 Keep noise, dust, and inconvenience to occupants to minimum.

.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.5 Do Work in accordance with Section 01 35 33 - Health and Safety Requirements.

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 in accordance with Section 01 74 19 - Waste Management and Disposal.

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

END OF SECTION 02 41 99

1.0 GENERAL

1.1 SUMMARY

.1 Comply with requirements of this Section when performing following Work:

.1 Removal of asbestos containing material from building material within the project area at the existing welding shop, machine shop and pumphouse, as indicated in the Pre-Construction Hazardous Building Material and Survey in Appendix A.

1.2 RELATED REQUIREMENTS

| | | |
|---|---|---|
| .1 | Structure Demolition | Section 02 41 16 |
| .2 | Demolition for Minor Works | Section 02 41 99 |
| .3 | Lead Base Paint Intermediate Precautions | Section 02 83 11 |

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.205- 94, Sealer for Application of Asbestos Fibre Releasing Materials.

.2 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.5 Underwriters' Laboratories of Canada (ULC)

.6 BC Occupational Health and Safety Act, WorkSafe BC.

1.4 DEFINITIONS

.1 Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.

.2 Asbestos Containing Materials (ACMs): materials that contain 0.1 provincial regulated amount per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.3 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.

.4 Authorized Visitors: Departmental Representative, Engineers, or designated representatives, and representatives of regulatory agencies.

.5 Competent worker person : in relation to specific work, means a worker who:

.1 Is qualified because of knowledge, training and experience to perform the work.

.2 Is familiar with the provincial federal laws and with the provisions of the regulations that apply to the work.

.3 Has knowledge of all potential or actual danger to health or safety in the work.

.6 Friable Materials: material that when dry can be crumbled pulverized or powdered by hand

pressure and includes such material that is crumbled, pulverized or powdered.

.7 Glove Bag: prefabricated glove bag as follows:
- .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
- .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
- .3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.
- .4 Straps for sealing ends around pipe.

.8 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.

.9 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.10 Occupied Area: any area of building or work site that is outside Asbestos Work Area.

.11 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.12 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.5 ACTION & INFORMATIONAL SUBMITTALS

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

.2 Submit proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of asbestos containing waste in accordance with requirements of authority having jurisdiction.

.3 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.

.4 Submit proof of Contractor's Asbestos Liability Insurance.

.5 Submit to Departmental Representative necessary permits for transportation and disposal of asbestos containing waste and proof that asbestos containing waste has been received and properly disposed.

.6 Submit proof satisfactory to Departmental Representative that all asbestos workers have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.

.7 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by Departmental Representative. Minimum of one supervisor for every ten workers.

.8 Submit Worker's Compensation Board status and transcription of insurance.

.9 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:
- .1 Encapsulants;
- .2 Amended water;
- .3 Slow drying sealer.

.10 Submit proof satisfactory to Departmental Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

11. Submit Exposure Control Plan as per requirement in WorkSafe BC Part 6.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at the time work is performed.

.2 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements and WorkSafe BC.
- .2 Safety Requirements: worker and visitor protection.
  - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
    - .1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.
    - .2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and it to be repaired or replaced if torn.
- .3 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
- .4 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective

clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

.5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing are located as indicated on drawings.

.6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

.7 Visitor Protection:

.1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.

.2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.

.3 Instruct Authorized Visitors in proper procedures to be followed in entering into - and exiting from Asbestos Work Area.

1.7 WASTE MANAGEMENT & DISPOSAL

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers steel metal plastic waste in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal banding, flatten and place in designated area for recycling.

.8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial/Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.

.9 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.8 EXISTING CONDITIONS

.1 Reports and information pertaining to ACMS to be handled, removed, or otherwise disturbed and disposed of during this Project is appended in appendix A of this specifications.

.2 Notify Departmental Representative of friable material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.9 SCHEDULING

.1 Hours of Work: perform work in accordance with Section 01 11 55 General Instructions

1.10 QUALIFICATIONS

.1 Asbestos Abatement Contractor must have at least 10 years of experience in similar scope and nature of work. Qualifications and resume of personnel involved must be submitted and approved by Departmental Representative.

2.0 PRODUCTS

2.1 MATERIALS

.1 Drop and Enclosure Sheets:

.1 Polyethylene: 0.15 mm thick.

.2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos containing material.

.3 Waste Containers: contain waste in two separate containers.

.1 Inner container: 0.15 mm thick sealable polyethylene bag or where glove bag method is used, glove bag itself.

.2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.

.3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.

.4 Glove bag:

.1 Acceptable materials: safe-T-Strip products in configuration suitable for Work, or Alternative material approved by addendum during tendering period in accordance with Instructions to Tenderers.

.2 The glove bag to be equipped with:

.1 Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period.

.2 Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure.

.3 A tool pouch with a drain.

.4 A seamless bottom and a means of sealing off the lower portion of the bag.

.5 A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.

.5 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.

.6 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.1 Sealer: flame spread and smoke developed rating less than 50 and be compatible with new fireproofing.

.7 Encapsulant: surface film forming / penetrating type conforming to CAN/CGSB-1.205.

3.0 EXECUTION

3.1 SUPERVISION

.1 Minimum of one Supervisor for every ten workers is required.

.2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

.2 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)'.

.3 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.

.1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.

.2 Do not use compressed air to clean up or remove dust from any surface.

.4 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.

.1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained.

.2 When removing suspended ceilings and walls themselves do not enclose work area and when removing asbestos containing material from piping or equipment and "glove bag" method is not used erect enclosure of polyethylene sheeting around work area, shut off mechanical ventilation system serving work area and seal ventilation ducts to and from work area.

.5 Before removing suspended ceilings, remove friable material on upper surfaces using HEPA vacuum equipment.

.1 Remove and clean surfaces of ceiling panels using HEPA vacuum, wrap clean panels in 0.10 mm thick polyethylene, and store in building as directed by Departmental Representative.

.2 Clean "T" grid suspension system, disconnect, wrap in 0.10 mm thick polyethylene, and store in building as directed by Engineer.

.6 Remove loose material by HEPA vacuum; thoroughly wet friable material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.

.1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.

.2 Perform Work in a manner to reduce dust creation to lowest levels practicable.

.7 Pipe Insulation Removal Using Glove Bag:

.1 A glove bag not to be used to remove insulation from a pipe, duct or similar structure if:

.1 It may not be possible to maintain a proper seal for any reason including, without limitation:
.1 The condition of the insulation.
.2 The temperature of the pipe, duct or similar structure.
.2 The bag could become damaged for any reason including, without limitation.
.1 The type of jacketing.
.2 The temperature of the pipe, duct or similar structure.

.2 Upon installation of the glove bag, inspect bag for any damage or defects. If any damage or defects are found, the glove bag is to be repaired or replaced. The glove bag to be inspected at regular intervals for damage and defects, and repair or replaced, as appropriately. The asbestos containing contents of the damaged or defective glove bag found during removal are to be wetted and the glove bag and its contents are to be removed and disposed of in an appropriate waste disposal container. Any damaged or defective glove bags are not be reused.

.3 Place tools necessary to remove insulation in tool pouch. Wrap bag around pipe and close zippers. Seal bag to pipe with cloth straps.

.4 Place hands in gloves and use necessary tools to remove insulation. Arrange insulation in bag to obtain full capacity of bag.

.5 Insert nozzle of garden reservoir type sprayer into bag through valve and wash down pipe and interior of bag thoroughly. Wet surface of insulation in lower section of bag.

.6 To remove bag after completion of stripping, wash top section and tools thoroughly. Remove air from top section through elasticized valve using a HEPA vacuum. Pull polyethylene waste container over glove bag before removing from pipe. Release one strap and remove freshly washed tools. Place tools in water. Remove second strap and zipper. Fold over into waste container and seal.

.7 After removal of bag ensure that pipe is free of residue. Remove residue using HEPA vacuum or wet cloths. Ensure that surfaces are free of sludge which after drying could release asbestos dust into atmosphere. Seal exposed surfaces of pipe and ends of insulation with slow drying sealer to seal in any residual fibres.

.8 Upon completion of Work shift, cover exposed ends of remaining pipe insulation with polyethylene taped in place.

.8 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.

.9 Cleanup:

.1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.

.2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.

.3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.

.4 Seal and remove double bagged waste from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.

.5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.3 AIR MONITORING

.1 From beginning of Work until completion of cleaning operations, Departmental Representative to take air samples on daily basis outside of Asbestos Work Area enclosures in accordance with Provincial/Territorial Occupational Health and Safety Regulations PWGSC requirements.

.1 Contractor will be responsible for monitoring inside enclosure in accordance with applicable Provincial/Territorial Occupational Health and Safety Regulations.

.2 If air monitoring shows that areas outside Asbestos Work Area enclosures are contaminated, enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area.

.3 Ensure that respiratory safety factors are not exceeded.

.4 During the course of Work, Departmental Representative to measure fibre content of air outside Work areas by means of air samples analyzed by Phase Contrast Microscopy (PCM).

.1 Stop Work when PCM measurements exceed 0.05 f/cc and correct procedures.

END OF SECTION 02 82 00.02

1.0 GENERAL

1.1 SUMMARY

.1 Comply with requirements of this Section when performing following Work:
- .1 Removal of lead based paint from walls and ceilings within the project area.
- .2 Manual demolition of lead-painted plaster walls or building components.

1.2 RELATED REQUIREMENTS

| | | |
|---|---|---|
| .1 | Structure Demolition | Section 02 41 16 |
| .2 | Demolition for Minor Works | Section 02 41 99 |
| .3 | Asbestos Abatement Intermediate Precautions | Section 02 82 00.02 |

1.3 REFERENCES

.1 Department of Justice Canada
- .1 Canadian Environmental Protection Act, 1999 (CEPA).

.2 Health Canada
- .1 Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).

.3 Human Resources and Social Development Canada (HRSDC)
- .1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.

.4 Transport Canada (TC)
- .1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.5 U.S. Environmental Protection Agency (EPA)
- .1 EPA 747-R-95-007- 1995, Sampling House Dust for Lead.

.6 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (NIOSH)
- .1 NIOSH 94-113 - NIOSH Manual of Analytical Methods (NMAM), 4th Edition (1994).

.7 U.S. Department of Labour - Occupational Safety and Health Administration (OSHA) - Toxic and Hazardous Substances
- .1 Lead in Construction Regulation - 29 CFR 1926.62- 1993.

.8 BC Occupational Health and Safety Act, WorkSafe BC.

1.4 DEFINITIONS

.1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.2 Authorized Visitors: Departmental Representative or designated representatives and representatives of regulatory agencies.

.3 Occupied Area: areas of building or work site that is outside Work Area.

.4 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.

.5 Airlock: ingress or egress system, without permitting air movement between contaminated area and uncontaminated area. Consisting of two curtained doorways at least 2 m apart.

.6 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another. Typically constructed as follows:

.1 Place two overlapping polyethylene sheets over existing or temporarily framed doorway, securing each along top of doorway, securing vertical edge of one sheet along one vertical side of doorway, and secure other sheet along opposite vertical side of doorway.

.2 Reinforce free edges of polyethylene with duct tape and add weight to bottom edge to ensure proper closing.

.3 Overlap each polyethylene sheet at openings 1.5 m on each side.

.7 Action level: employee exposure, without regard to usage of respirators, to an airborne concentration of lead of 50 micrograms per cubic meter of air calculated as 8 hour time-weighted average (TWA). Intermediate precautions for lead abatement are based on airborne lead concentrations greater than 0.05 milligrams per cubic meter of air within Work Area.

.8 Competent person: Professionals capable of identifying existing lead hazards in workplace and taking corrective measures to eliminate them.

.9 Lead in Dust: wipe sampling on vertical and/or horizontal surfaces, dust and debris is considered to be lead contaminated if it contains more than 40 micrograms of lead in dust per square foot.

## 1.5 ACTION & INFORMAL SUBMITTALS

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

.2 Provide proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of lead based paint waste in accordance with requirements of authority having jurisdiction.

.3 Provide: Provincial Territorial and local requirements for Notice of Project Form.

.4 Provide proof of Contractor's General and Environmental Liability Insurance.

.5 Quality Control:

.1 Provide Departmental Representative necessary permits for transportation and disposal of lead based paint waste and proof that it has been received and properly disposed.

.2 Provide proof satisfactory to Departmental Representative that employees have had instruction on hazards of lead exposure, respirator use, dress, entry and exit from Work Area, and aspects of work procedures and protective measures.

.3 Provide proof that supervisory personnel have attended lead abatement course, of not less than two days duration, approved by Departmental Representative. Minimum of one supervisor for every ten workers.

.6 Product data:

.1 Provide documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:

.1 Encapsulants.

.2 Amended water.

.3 Slow drying sealer.

.7 Submit Exposure Control Plan as per requirement in Worksafe BC Part 6.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to lead paint, in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

.2 Safety Requirements: worker and visitor protection.

.1 Protective equipment and clothing to be worn by workers and visitors in Work Area includes:

.1 Respirator NIOSH approved and equipped with filter cartridges with assigned protection factor of 50, acceptable to Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure in Lead Work Area. Provide sufficient filters so workers can install new filters following disposal of used filters and before re-entering contaminated areas.

.2 Disposable type protective clothing that does not readily retain or permit skin contamination, consisting of full body covering including head covering with snug fitting cuffs at wrists, ankles, and neck.

.2 Requirements for workers:

.1 Remove street clothes in clean change room and put on respirator with new filters or reusable filters, clean coveralls and head covers before entering Equipment and Access Rooms or Work Area. Store street clothes, uncontaminated footwear, towels, and similar uncontaminated articles in clean change room.

.2 Remove gross contamination from clothing before leaving work area. Place contaminated work suits in receptacles for disposal with other lead - contaminated materials. Leave reusable items except respirator in Equipment and Access Room. When not in use in Work Area, store work footwear in Equipment and Access Room. Upon completion of lead abatement, dispose of footwear as contaminated waste or clean thoroughly inside and out using soap and water before removing from Work Area or from Equipment and Access Room.

.3 Enter unloading room from outside dressed in clean coveralls to remove waste containers and equipment from Holding Room of Container and Equipment Decontamination Enclosure system. Workers not to use this system as means to leave or enter work area.

.3 Eating, drinking, chewing, and smoking are not permitted in Work Area.

.4 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual lead abatement.

.5 Ensure workers wash hands and face when leaving Work Area. Facilities for washing are located as indicated on drawings.

.6 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.

.7 Ensure no person required to enter Work Area has facial hair that affects seal between respirator and face.

.8 Visitor Protection:

.1 Provide protective clothing and approved respirators to Authorized Visitors to Work Areas.

.2 Instruct Authorized Visitors in use of protective clothing, respirators and procedures.

.3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Work Area.

1.7 WASTE MANAGEMENT & DISPOSAL

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

.2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.3 Disposal of lead waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of lead waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.

.4 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 EXISTING CONDITIONS

.1 Reports and information pertaining to lead based paint to be handled, removed, or otherwise disturbed and disposed of during this Project is appended in Appendix A of this specifications.

.2 Notify Departmental Representative of lead based paint discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.9 SCHEDULING

.1 Not later than two days before beginning Work on this Project notify the following in writing, where appropriate:
- .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
- .2 Provincial Ministry of Labour.
- .3 Disposal Authority.

.2 Inform sub trades of presence of lead-containing materials identified in Existing Conditions.

.3 Provide Departmental Representative copy of notifications prior to start of Work.

.4 Hours of Work: perform work in accordance with Section 01 11 55 General Instructions. Include in Contract Sum additional costs due to this requirement.

1.10 QUALIFICATIONS

.1 Abatement Contractor must have at least 10 years of experience in similar scope and nature of work. Qualifications and resume of personnel involved must be submitted to Departmental Representative for approval.

2.0 PRODUCTS

2.1 MATERIALS

.1 Polyethylene: 0.15 mm unless otherwise specified; in sheet size to minimize joints.

.2 FR polyethylene: 0.15 mm reinforced fabric bonded both sides with polyethylene.

.3 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.

.4 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for trapping residual lead paint residue.

.5 Lead waste containers: metal fibre type acceptable to dump operator with tightly fitting covers and 0.15 mm sealable polyethylene liners.
- .1 Label containers with pre-printed bilingual cautionary Warning Lead clearly visible when ready for removal to disposal site.

## 3.0 EXECUTION

### 3.1 SUPERVISION
.1 Approved Supervisor must remain within Lead Work Area during disturbance, removal, or other handling of lead based paints.

### 3.2 PREPARATION
.1 Remove and wrap items to be salvaged or reused, and transport and store in area specified by Departmental Representative.

.2 Work Area:
- .1 Shut off and isolate HVAC system to prevent dust dispersal into other building areas. Conduct smoke tests to ensure duct work is airtight.
- .2 Pre-clean fixed casework, and equipment within work areas, using HEPA vacuum and cover with polyethylene sheeting sealed with tape.
- .3 Clean work areas using HEPA vacuum. If not practicable, use wet cleaning method. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA vacuum.
- .4 Seal off openings, corridors, doorways, windows, skylights, ducts, grilles, and diffusers, with polyethylene sheeting sealed with tape.
- .5 Cover floor surfaces in work area from wall to wall with FR polyethylene drop sheets to protect existing floor during removal.
- .6 Build airlocks at entrances and exits from work areas to ensure work areas are always closed off by one curtained doorway when workers enter or exit.
- .7 At point of access to work areas install warning signs in both official languages in upper case "Helvetica Medium" letters reading as follows where number in parentheses indicates font size to be used:
  - .1 CAUTION LEAD HAZARD AREA (25 mm).
  - .2 NO UNAUTHORIZED ENTRY (19 mm).
  - .3 WEAR ASSIGNED PROTECTIVE EQUIPMENT AND RESPIRATOR (19 mm).
  - .4 BREATHING LEAD CONTAMINATED DUST CAUSES SERIOUS BODILY HARM (7 mm).
- .8 Maintain emergency and fire exits from work areas, or establish alternative exits satisfactory to Authority having jurisdiction.
- .9 Where water application is required for wetting lead containing materials, provide temporary water supply by use of appropriately sized hoses for application of water as required.
- .10 Provide electrical power and shut off for operation of powered tools and equipment. Provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical lines and equipment.

.3 Worker Decontamination Enclosure System:
- .1 Worker Decontamination Enclosure System includes Equipment and Access Room and Clean Room, as follows:
  - .1 Equipment and Access Room: construct between exit and work areas, with two curtained doorways, one to the rest of suite, and one to work area. Install waste receptor and storage facilities for workers' shoes and protective clothing to be re-worn in work areas. Build large enough to accommodate specified facilities, equipment needed, and at least one worker allowing sufficient space to change comfortably.
  - .2 Clean Room: construct with curtained doorway to outside of enclosures. Provide lockers or hangers and hooks for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install mirror to permit workers to fit respiratory equipment properly.

.4 Construction of Decontamination Enclosures:
- .1 Construct framing for enclosures or use existing rooms. Line enclosure with polyethylene sheeting and seal with tape, apply two layers of FR polyethylene on floor.
- .2 Construct curtain doorways between enclosures so when people move through or waste containers and equipment are moved through doorway, one of two closures comprising doorway always remains closed.

.5 Separation of Work Areas from Occupied Areas
- .1 Barriers between Work Area and occupied area to be constructed as follows:
  - .1 Construct floor to ceiling lumber metal stud framing, cover with polyethylene sheeting and seal with duct tape. Apply 9 plywood over polyethylene sheeting. Seal plywood joints and between adjacent materials with surface film forming sealer, to create airtight barrier.
  - .2 Cover plywood with polyethylene sheeting and sealed with duct tape.

.6 Maintenance of Enclosures:
- .1 Maintain enclosures in clean condition.
- .2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately.
- .3 Visually inspect enclosures at beginning of each work day.
- .4 Use smoke test method to test effectiveness of barriers as directed by Departmental Representative.

## 3.3 LEAD-BASE PAINT ABATEMENT

.1 Removal of lead based paint to be performed by scraping or sanding using non-powered hand tools, or manual demolition of lead-painted plaster walls or building components by striking a wall with sledgehammer or similar tool.

.2 Remove lead based paint in small sections and pack as it is being removed in sealable 0.15 mm plastic bags and place in labelled containers for transport.

.3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.

.4 After completion of stripping work, wire brush and wet sponge surface from which lead based paint has been removed to remove visible material. During this work keep surfaces wet.

.5 After wire brushing and wet sponging to remove visible lead based paint, and after encapsulating lead containing material impossible to remove, wet clean work area including equipment and access room, and equipment used in process. After inspection by Departmental Representative, apply continuous coat of slow drying sealer to surfaces. Do not disturb work for 8 hours with no entry, activity, ventilation or disturbance during this period.

.6 After enclosing lead painted surfaces, wet clean work area and equipment and access room. During settling period no entry, activity, or ventilation will be permitted.

3.4 INSPECTION

.1 Perform inspection to confirm compliance with specification and governing authority requirements. Deviations from these requirements not approved in writing by Departmental Representative will result in work stoppage, at no cost to Departmental Representative.

.2 Departmental Representative will inspect work for:
- .1 Adherence to specific procedures and materials.
- .2 Final cleanliness and completion.
- .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

.3 When lead dust leakage from Work Area occurs Departmental Representative may order Work shutdown.
- .1 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

3.5 LEAD SURFACE SAMPLING-WORK AREAS

.1 Final lead surface sampling to be conducted as follows:
- .1 After Work Area has passed a visual inspection for cleanliness approved by Departmental Representative and acceptable coat of lock-down agent has been applied to surfaces within enclosure, and appropriate setting period of 8 hours has passed. Departmental Representative will perform lead wipe sampling in Work Area.
  - .1 Final lead wipe sampling results from horizontal and vertical surfaces where lead based paints have been removed must show lead levels of less than 40 micrograms of lead in dust per square foot. Samples must be collected and analyzed in accordance with EPA 747-R-95-007.
  - .2 If wipe sampling results show levels of lead in excess of 40 micrograms per square foot, re-clean work area at contractor's expense and apply another acceptable coat of lock-down agent to surfaces.
  - .3 Repeat as necessary until fibre levels are less than 40 micrograms per square foot.

3.6 FINAL CLEAN-UP

.1 Following specified cleaning procedures, and when lead wipe sampling is below acceptable concentrations proceed with final cleanup.

.2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum equipment.

.3 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in plastic bags and sealed labeled waste containers for transport.

.4 Clean-up Work Areas, Equipment and Access Room, and other contaminated enclosures.

.5 Clean-up sealed waste containers and equipment used in Work and remove from work areas, via Container and Equipment Decontamination Enclosure System, at appropriate time in cleaning sequence.

.6 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

3.7 RE-ESTABLISHMENT OF OBJECTS & SYSTEMS

.1 Repair or replace objects damaged in course of work to their original state or better, as directed by Departmental Representative.

END OF SECTION 02 83 11

## 1.0 GENERAL

### 1.1 RELATED REQUIREMENTS

| | | |
|---|---|---|
| .1 | Period Concrete Roof-Wall Sections Repair/Replacement | Section 03 03 31 |
| .2 | Period Concrete Roof Slab Reinforcement | Section 03 03 32 |
| .3 | Period Embedded Steel Beam Repair | Section 05 03 14 |
| .4 | Cold Fluid-Applied Waterproofing Roofing | Section 07 14 16 |
| .5 | Joint Sealant | Section 07 92 00 |
| .6 | Portland Cement Plaster Stucco Wall Assemblies | Section 09 24 00 |

### 1.2 MEASUREMENT AND PAYMENT PROCEDURES

.1 Repairs: price as Fixed Price Items.

Estimated quantities of repairs: quantities of concrete repairs as described on the Drawings. All to be priced as part of Fixed Price bid submission.

### 1.3 REFERENCES

.1 Reference Standards:

ASTM International

.1 ASTM C207-06(2011), Standard Specification for Hydrated Lime for Masonry Purposes.

.2 ASTM C979/C979M-10, Standard Specification for Pigments for Integrally Colored Concrete.

.3 ASTM C10/C10M -14, Standard Specification for Natural Cement

CSA International

.4 CSA A23.1/A23.2-09(R2014), Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.5 CSA A283-06(R2011), Qualification Code for Concrete Testing Laboratories.

.6 CSA S-807-10, Specification for fibre-reinforced polymers.

.7 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data.

Technical Data Sheets: submit minimum one (1) week prior to beginning Work.

.3 Samples.

Samples of materials proposed for use: submit minimum one (1) week prior to beginning Work, as follows:

.1 One (1) kilogram each of fine and coarse aggregates.

.4 Site Quality Control Submittals.

Submit three (3) samples of each prepared combination of aggregate blends and pigment. Match appearance and texture of existing concrete as closely as possible.

.1 Crack Repair and Parging Mix: Two (2) sets of 100 x 100 x 25 samples for each of three (3) blends of aggregate and colouring agent, one set with Cement-Lime – aggregate blend and one set with Natural Cement – aggregate blend.
Spalling Repair Mix: Two (2) sets of 100 x 100 x 25 samples for each of three (3) blends of aggregate and colouring agent, one set with Cement-Lime – aggregate blend and one set with Natural Cement – aggregate blend.

.2 Fine Aggregate for Caulking Surface Application: Three (3) 100 gram samples.

Prepare and submit additional samples as required by Departmental Representative, at no additional cost to Departmental Representative.
Submit plan for removal of debris and natural growth that may encumber the Work.
Record Photographs:

.3 As work progresses, maintain accurate photo record including daily photographs of preparatory work and stages of repairs.
.1 Submit electronic copies of photographs weekly.

.4 Mock-ups:
.1 Submit photographic record of each step of mock-up procedures.

.5 Certificates.
Submit valid and recognized certificate from plant delivering concrete: minimum four (4) weeks prior to starting concrete work.

.6 Special Procedure Submittals.
Curing Procedures: submit minimum one (1) week prior to implementation in field:

.1 Submit description of procedures for curing repair material in accordance with this specification. As a minimum, indicate:
.1 Method for protecting fresh concrete from evaporation of surface moisture;
.2 Type of curing material;
.3 Method for keeping surface moist, and quality control requirements for keeping surface moist;
.4 Time of initiation and duration of curing;
.5 Risk management provisions to address potential problems including high winds and hot and cold weather; and
.6 Limitations of access to surfaces being cured.

Concrete Quality Control Procedures: Submit minimum two (2) weeks prior to start of concrete work quality control procedures for:

.2 Hot weather concrete.
.3 Cold weather concrete.
.4 Curing.
.5 Finishes.
.6 Ensuring quality and consistency of each of the concrete mix types for the duration of the work. Indicate how the mixes will be monitored and identified as distinct from each other.

.7 Provide copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements.

.8 Provide Engineered Drawings for Shoring system signed and sealed by a professional engineer licensed in British Columbia where shoring is specified.

1.5 CLOSEOUT SUBMITTALS

.1 Maintain accurate records in accordance with Section 01 77 00 – Closeout Procedures.

.2 As-Built Drawings.

Mark on supplied sets of drawings:

.1 Locations of areas repaired.

.2 Dimensions for each repaired area.

.3 Records: Maintain accurate written records of poured concrete items.

Indicate date, location of pour, quality, air temperature and test samples taken.

1.6 QUALITY ASSURANCE

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

.2 Certifications.

Valid and recognized certificate from concrete delivery plant.

.3 Site Quality Control Samples.

Samples reviewed for colour and texture match with existing concrete, including appearance, size and colour of aggregate.

Samples for each mix type for quality control reference for the duration of the work.

.4 Mock-ups:

Propose locations and construct one (1) mock-up of each concrete repair type.

Obtain approval of locations from Departmental Representative.

Contractor must demonstrate experience and skills in historic concrete repairs, on-site manual customized mixes and application, finishing and curing.

Provide minimum three (3) working days notice to Departmental Representative prior to beginning mock-up.

Create photographic record of each step of mock-up procedure.

Undertake each initial step, from labelling, disassembly and surface preparation through repair under direct review of Departmental Representative.

.1 Adjust techniques as directed by Departmental Representative until desired results are achieved.

.2 Techniques approved by Departmental Representative serve as standard for this work.

Allow 48 hours for inspection of mock-up by Departmental Representative before proceeding with work.

Obtain Departmental Representative's approval of mock-up before proceeding with the Work.

When accepted, mock-up demonstrates minimum standard for this work.

Mock-up may remain as part of finished work.

Concrete Repair Mix Testing: As per Article 3.17.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Advise Departmental Representative 24 hours in advance of material deliveries to site.

.2 Store materials in location approved by Departmental Representative.

.3 Provide secure enclosure for material storage.

.4 Packaging Waste Management: remove for reuse or recycle in accordance with Section 01 74 19 – Waste Management Disposal.

1.8 AMBIENT CONDITIONS

.1 Hot Weather Concreting

When rate of moisture evaporation exceeds 1.0 kg/m² per hour, employ the following measures in addition to requirements of CSA A23.1.

.1 Ready Mix Concrete:

.1 Lower temperature of concrete: Use ice as mixing water.

.2 Keep mixing time to a minimum: Dispatch ready-mix trucks and organize work to minimize mixing time.

.3 Minimize exposure of waiting mixing trucks to hot sun.

.4 Keep placing time to a minimum: Provide adequate personnel and organize work.

.5 Place concrete in layers thin enough and areas small enough to reduce time interval between lifts.

.6 Compact the concrete. Ensure union of adjacent portions.

.7 Spray formwork with water. Keep formwork tight and free from cracking.

.2 Pre-bagged Concrete and Patching Material:

.1 Proceed as recommended by manufacturer's written instructions.

.2 Cold Weather Concreting

When temperatures are below 5 °C.:

.1 Provide equipment necessary for cold weather protection and curing before starting concrete placement.

.2 Obtain approval of product and add antifreezing admixture to concrete.

.3 When fresh concrete is cast against existing concrete: Prevent heat loss.

.1 Extend protection covering fresh concrete to minimum 600mm over existing concrete.

.4 Insulate and enclose within protective housing: tie rods, reinforcement and metal projecting from concrete being protected.

.5 Maintain housing, enclosures and supplementary heat in place for required protection period, with following exceptions:

.1 Sections may be temporarily removed to permit placing of additional forms and placing of additional concrete only when uncovered concrete is not permitted to freeze.

.1 Make up time lost from the required period of protection at the required temperature before protection is discontinued and removed.

.6 Locate heaters to:

.1 Avoid heating concrete locally.

.2 Avoid drying concrete excessively.

.3 Avoid high temperature and dry heating within enclosures.

.7 Concrete elements vulnerable to freezing:

.1 Maintain edges and corners of concrete at required temperature.

1.9 EXISTING CONDITIONS

.1 The existing concrete is anticipated to be extremely hard due to the existing hard rock aggregate used is up to 50 mm in size.

1.10 EXTENDED WARRANTY

.1 For breathable sealing compound, provide two (2) year manufacturer's warranty on products and installation against fading and delamination of finished surfaces.

2.0 PRODUCTS

2.1 DESIGN CRITERIA

.1 Concrete repair products: to CSA A23.1/A23.2, and as described in Mixes of PART 2 – PRODUCTS:

Formulated for localized repairs.
Compatible with existing concrete structure.

2.2 PERFORMANCE CRITERIA

.1 For duration of warranty periods the following performance criteria apply to the concrete repairs:

Repair does not debond from existing substrate.
Repair does not develop shrinkage cracking within the repair patch.
Caulking and sealer do not debond from substrate.

2.3 MATERIALS

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

.2 Lime: Hydrated Lime Type SA to ASTM C207.

.3 Natural Cement: ASTM C10/C10M -14; Rosendale Natural Cement or approved equivalent

.4 Water: potable, to CSA A23.1.

Free of oil, alkali, acidic, organic materials or deleterious substances.
Do not use water from shallow, stagnant or marshy or marine sources.

.5 Coarse aggregate: to CSA A23.1, Table 11, Group I.

Sizes for mix designs: maximum 12.5 mm and 19 mm nominal sizes in accordance with mix designs.
Meet grading requirements of CSA A23.1, Table 11, Group I.
.1 Maximum 1% to pass a 75um sieve.
.2 Uniformly graded.
Consisting of crushed stone or gravel or combination of both.
Hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter and other injurious substances.
Clean and free from alkali, organic and other deleterious matter.
Fracture faces: minimum two (2).
Absorption: maximum 3%.
Aggregate retained on 5 mm sieve: clean, hard, tough, durable, angular particles with rough surface texture, free from organic material, adherent coats of clay, clay balls, excess of thin particles and other extraneous material.
Crushed and washed selected aggregate from concrete removals as approved by the Departmental Representative.

.6 Fine aggregate for Concrete Spall Repair Mixes: to CSA A23.1, Table 10 and Table 12.

Meet grading requirements of CSA A23.1, Table 10.
.1 Maximum 1% to pass a 75um sieve.
.2 Uniformly graded.
Include a mixture of sharp and rounded grains.
Consisting of sand, stone, screenings and other inert materials with similar characteristics or combinations of these.
Clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam and other deleterious substances.

Tests not to exceed limits for standard requirements in accordance with CSA A23.1, Table 12.

.7 Fine Aggregate for Crack Repair and Parging Mix, and Sand Aggregate applied over sealant:

Washed beach sand to suit. See mock-up samples. Fine Aggregate to match Beach Sand colour and existing aggregate as closely as possible, washed and graded to meet the following:

.1 4% No. 18 sieve.
.2 16% No. 25 sieve.
.3 32% No. 30 sieve.
.4 18% No. 35 sieve.
.5 30 % under No. 35 sieve.
.6 Discard material coarser than No. 18 sieve.

.8 Concrete Mix Colouring Agent: Mineral Oxide Pigment to ASTM C979 maximum 10% mass of cement, or crushed granite aggregate.

.9 Curing compounds: compatible with applied finish on concrete.

.10 Sealant and Backer Rod: in accordance with Section 07 92 00 – Joint Sealant.

.11 Sand Aggregate for Sealant Finish: Beach sand or Crushed granite aggregate, dark colour to closely match adjacent concrete.

.12 Pinning repair dowels: 600 mm long, Glass Fiber Reinforced Polymer (GFRP) threaded rods to CSA S-807, bar size 20 mm.

.13 Epoxy Adhesive: high strength two-part epoxy adhesive suitable for wet application. Approved by ICC-ES (International Code Council) for cracked concrete and seismic service. Tested in accordance to ICC-ES confirming bond can develop the yield strength of the anchors/rebars with the indicated anchor length as shown on the drawings.

.14 Cement Slurry bonding agent. 1 part Cement to 1 part water mix.

.15 Breathable Sealing Compound: Breathable Clear Surface Sealer: to CAN/CGSB-25.20. Acceptable Product : Fabrishield PS-500 by Fabrikem Manufacturing Ltd. or approved equivalent.

.16 Not permitted: Pre-mix high strength concrete repair mortar products.

2.4 MIXES

.1 Crack Repair Mix: 1 part Portland cement, ½ part SA lime, 4.5 parts fine aggregate, pigment to suit maximum 10% mass of cement.

.2 Parging Mix: 1 part Portland cement, ½ part SA lime, 4.5 parts fine aggregate, pigment to suit maximum 10% mass of cement.

.3 Shallow Spall Repair Mix: 1 part Portland cement, ½ part SA lime, 1.5 parts fine aggregate, 3 parts coarse aggregate 12.5 mm max

.4 Deep Spall Repair Mix: 1 part Portland cement, ½ part SA lime, 1.5 parts fine aggregate, 3 parts coarse aggregate (50% 12.5mm max, 50% 19mm max).

3.0 EXECUTION

3.1 VERIFICATION OF CONDITIONS

.1 Verify existing conditions are as indicated on Contract Drawings.

.2 Notify Departmental Representative of conditions not indicated on Contract Drawings.

3.2 PROTECTION OF IN-PLACE CONDITIONS

.1 Provide protection measures to existing structures suitable for the scope of the Work.

.2 Protect exposed concrete, exposed masonry and exposed members from staining and from becoming coated with concrete leakage from concreting operations.

.3 Protect wood flooring from physical damage and water damage at all times. As a minimum, protection must include complete protective cover over entire floor.

3.3 EXAMINATION

.1 Examine areas where concrete repairs are indicated on Contract Drawings.
Visually inspect and hammer tap areas.
Confirm areas of deteriorated and delaminated concrete.
Mark these areas on drawings and on concrete surface with suitable marking crayon.

.2 Confirm areas for removal and repair.

.3 Obtain approval from Departmental Representative confirming areas of repair.

.4 Mark areas of repair on as-built/record drawings.

3.4 PREPARATION

.1 Confirm areas for removal and repair.

.2 Obtain approval from Departmental Representative confirming areas of repairs.

.3 Mark areas of repair in as-built drawings.

3.5 EFFLORESCENCE, DEPOSIT CLEANING

.1 At beginning of project, use dry cleaning method over all exposed wall surfaces, wall caps and roof slab surfaces for all buildings/structures shown in the contract drawings with efflorescence, debris, bio-growth, loose paint through scraping with hand tools and dry brushing with hard bristle brush.

.2 Repeat with mild detergent and water.

.3 After surface is dry, repeat dry cleaning.

.4 After concrete repairs and roofing membrane work are complete, repeat 3.5.1-2 above.

3.6 SURFACE PREPARATION – ALL CONCRETE REPAIR TYPES

.1 Debris and natural growth.
Obtain approval to remove debris and natural growth identified in submitted removal plan.

.2 Clean concrete surfaces.
Remove dirt, debris, loose concrete, existing coatings and stains.
Use gentlest means of cleaning first: soap and water, wire brush, hand tools, pressure wash, mechanical tools.
Avoid damaging adjacent surfaces.
Chemical cleaning is not permitted.

.3 Sound all concrete surfaces, interior and exterior, walls, ceilings by hammer sounding.

.4 Remove existing areas of spalling, cracked, delaminated and debonded concrete down to sound material.

.5 Surface Preparation for Re-Roofing:
Remove and dispose of all existing roofing material from roof slab and roof fascia down to bare concrete surface. Entire surface of concrete to be grinded to remove rough uneven surfaces to suit new roofing application.

3.7 PREPARATION WORK – ALL CONCRETE REPAIR TYPES

.1 Sawcut perimeter of repair areas and cracks where specified under the specific repair type.

.2 Roughen adjacent concrete surfaces where smooth cuts have been made by bush hammer or other suitable methods to enhance bond of new concrete to existing.

.3 Where steel exposed during concrete removal:
Clean corrosion in-situ to bare metal. Use gentlest means of cleaning first.
Review condition with Departmental Representative.
Refer to Specification Section 05 03 14 – Period Embedded Steel Beam Repair for Steel Treatment and application of corrosion-inhibiting agent over exposed steel prior to applying repair mix.

.4 At completion of concrete removal:
Perform a final check of areas adjacent to repair patch.
Determine if additional delamination has occurred.
Mark out delaminated areas and notify Departmental Representative for review.

.5 Remove loosened concrete debris and bond-inhibiting materials.

.6 Wash down exposed surfaces with pressurized water jet and air hose. Control the pressure to properly clean the surface but avoid damaging adjacent surfaces.

.7 Provide formwork as required to suit repair, matching existing form and profile. Match adjacent surfaces.

.8 Wet repair patch areas. Maintain concrete surface saturated surface dry for a minimum of 24 hours prior to placing concrete.

.9 Keep work areas clean and protect exposed concrete and steel from water.

3.8 APPLICATION OF CONCRETE REPAIR MATERIAL FOR ALL CONCRETE REPAIR TYPES

.1 Provide Departmental Representative with minimum 48 hours notice prior to placing of concrete.

.2 Bond coat on concrete repair area: Brush cement slurry bonding agent onto cleaned concrete surface. Completely cover surfaces of exposed reinforcing.

.3 Mix patching material with selected blend of aggregates.

.4 While cement slurry bonding agent is still tacky:
Fill repair area with concrete repair mix to the appropriate surface depth for the repair type.
Fill area in individual lifts to suit depth of repair area.
.1 Note: Leave sufficient depth back from surface for repairs that are to receive a subsequent parging coat.
Do not float with steel trowels.
Apply brush texture finish.

.5 Wet Cure for repair areas.
Wet cure period: minimum four (4) days.
Cover repaired surfaces of concrete with single layer of clean, pre-soaked burlap.
Cover only as soon as surface will not be marred by covering.
Keep fabric wet with soaker hoses.
Keep curing system in place for specified time period.

3.9 CRACK REPAIR TYPES

.1 SLAB CRACK REPAIR TYPES

.1 RSC-1 & RSC-1S – General Cracks, Cracks with Spalling and Cracks line up with Existing Steel Beam for Slabs. Allow for spalling repairs at all cracks repairs.

.1 Perform concrete repairs to concrete cracks and to spalling concrete along length of cracks as indicated on Contract Drawings.

.1 Prepare repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.

.2 General Cracks.

.1 Sawcut, rout out, clean out crack.

.2 Remove loose concrete within crack.

.3 Form 12-20mm wide slot for filling crack with crack repair mix material.

.4 Apply Crack Repair Mix in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.5 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.6 Sealant joint slot.

.1 Rout out 12-20 mm wide slot in repaired crack. Form sealant joint slot at 2:1 width to depth ratio.

.2 Install backer rod and bond breaker.

.3 Apply joint sealant.

.4 Camouflage joint: Add sand aggregate neatly over caulked joint to match other caulked joints.

.3 Cracks with Adjacent Spalling.

.1 Mark lines for making sawcut.

.2 Include spalled areas within the 2 sawcuts on each side of crack.

.3 Sawcut to minimum 12 mm depth along each side of crack and around spalled areas adjacent to crack.

.4 Repair areas of spalling adjacent to cracking in accordance with Paragraph 3.10.2, RLS - Local Spall Repair below.

.1 Use Shallow Spall Repair Mix and Deep Spall Repair Mix to suit depth of spall repair in conjunction with crack repair.

.5 Apply Crack Repair Mix in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.1 Fill and square off area between sawcuts and narrow the crack to a consistent 12-20 mm width along length of crack as indicated on Contract Drawings.

.6 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.7 Rout out 12-20 mm wide slot in repaired crack. Form sealant joint slot at 2:1 width to depth ratio.

.8 Install backer rod and bond breaker.

.9 Apply joint sealant.

.10 Camouflage joint: Add sand aggregate neatly over caulked joint to match other caulked joints.

.4 Crack Repair without caulking: Where indicated on Drawings, crack repair is to be finished off with crack repair mix.

WALL CRACK REPAIR TYPES

.2 RWC-1 & RWC-1S – General Cracks and Cracks with Spalling for Walls. Allow for spalling repairs at all cracks repairs.

.1 Perform concrete repairs to concrete cracks and to spalling concrete along length of cracks as indicated on Contract Drawings.

.1 Prepare repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.

.2 General Cracks.

.1 Sawcut, rout out, clean out crack.

.2 Remove loose concrete within crack.

.3 Form 12-20mm wide slot for filling crack with crack repair mix material.

.4 Apply Crack Repair Mix in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.5 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.6 Sealant joint slot.

.1 Rout out 12-20 mm wide slot in repaired crack. Form sealant joint slot at 2:1 width to depth ratio.

.2 Install backer rod and bond breaker.

.3 Apply joint sealant.

.4 Camouflage joint: Add sand aggregate neatly over caulked joint to match other caulked joints.

.3 Cracks with Adjacent Spalling.

.1 Mark lines for making sawcut.

.2 Include spalled areas within the 2 sawcuts on each side of crack.

.3 Sawcut to minimum 12 mm depth along each side of crack and around spalled areas adjacent to crack.

.4 Repair areas of spalling adjacent to cracking in accordance with Paragraph 3.10.2, RLS – Local Spall Repair below.
.1 Use Shallow Spall Repair Mix and Deep Spall Repair Mix to suit depth of spall repair in conjunction with crack repair.
.5 Apply Crack Repair Mix in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.
.1 Fill and square off area between sawcuts and narrow the crack to a consistent 12-20 mm width along length of crack as indicated on Contract Drawings.
.6 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.
.7 Rout out 12-20 mm wide slot in repaired crack. Form sealant joint slot at 2:1 width to depth ratio.
.8 Install backer rod and bond breaker.
.9 Apply joint sealant.
.10 Camouflage joint: Add sand aggregate neatly over caulked joint to match other caulked joints.

.4 Crack Repair without caulking: Where indicated on Drawings, crack repair is to be finished off with crack repair mix.

.3 RWC-2 – Wall Crack Repair where Crack at Existing Wall/slab Joints

.1 Perform concrete repairs to horizontal cracking at top of walls, between roof slab and wall as indicated on Contract Drawings and confirmed by Departmental Representative, interior and exterior side of walls, and both sides of interior walls where applicable.
.1 Prepare roof-wall junction crack repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.
.2 Clean out crack. Remove loose concrete within crack. Form 12-20 mm wide slot for filling crack with crack repair mix material.
.3 Apply Crack Repair Mix in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above. Use hand tools to ensure crack repair mix fills crack as deep as possible.
.4 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.4 RJC-1 – Roof-Wall Junction Crack from Corrosion Jacking

.1 Perform concrete repairs to horizontal cracking at top of walls, between roof slab and wall as indicated on Contract Drawings and confirmed by Departmental Representative, interior and exterior side of walls, and both sides of interior walls where applicable. Refer to Section 05 03 14 – Period Embedded Steel Beam Repair for corroded steel beam repairs.
.1 Prepare roof-wall junction crack repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.
.2 Clean out crack. Remove loose concrete within crack. Form 12-20 mm wide slot for filling crack with crack repair mix material.
.3 Apply Crack Repair Mix in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above. Use hand tools to ensure crack repair mix fills crack as deep as possible.

.4 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.5 RWC-3– Wall Crack Repair Where Cracks Along Existing Construction Joints

.1 Prepare repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.
Clean the cracks in accordance with Articles 3.5 & 3.6.
Apply compatible breathable sealer along the joints so that the sealer does not show visually.

.6 RWC – 4 - Wall Cap/Coping Crack Repair

.1 Repair Wall Cap and Coping Cracks as indicated on Contract Drawings.
Prepare wall cap and coping crack repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.
Wall Cap and Coping Cracks that align with wall cracks below:
.1 Repair in accordance with Paragraph 3.9.3, RWC-1S – General Cracks and Cracks with Spalling above.
.2 Form a continuous crack repair from wall coping down through wall.
Intermittent cracks in cap and coping:
.3 Fill with crack repair mix in accordance with Paragraph 3.9.3, RWC-1S – General Cracks and Cracks with Spalling above.
Match original cap and coping profile, including drip edge.

.7 RWC – 5 – Wall Crack Repair For Existing Building Joint Crack

.1 Repair Building or Wall Joint Crack/Junctions, as indicated on Contract Drawings.
Prepare repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.
Use proper tool to clean out, rout out joint crack. Remove loose concrete within joint.
At areas of Adjacent Spalling along joint:
.1 Mark lines for making sawcut.
.2 Include spalled areas within the 2 sawcuts on each side of joint.
.3 Sawcut to minimum 12 mm depth along each side of crack and around spalled areas adjacent to joint or cracking.
.4 Repair areas of spalling adjacent to building joint in accordance with Paragraph 3.9.2, RLS - Local Spall Repair. Use Shallow Spall Repair Mix and Deep Spall Repair Mix to suit depth of spall repair in conjunction with crack repair
Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.
Rout out 12-20 mm wide slot in repaired building joint. Form sealant joint slot at 2:1 width to depth ratio.
Install backer rod and bond breaker in joint.
Apply sealant.
Add sand aggregate neatly over caulked joint to camouflage joint, in a similar fashion to other caulked joints on site.

.8 RWI-1 – Typical Detail to Repair Wall Integrity.

.1 Refer to contract drawings for wall integrity bar details. Contractor shall submit shop drawings showing the GFRP bars layout, grout information including cement type, strength, addictive & mix design, proposed drilling

method and sequence of drilling and installation. Only one coring is allowed at each time for each wall section.
Core holes through wall centre down to minimum 1200mm below grade at the location where core hole applied. Core holes shall be drilled within plus or minus 1% of the theoretical centerline. Thoroughly clean core hole prior to the installation of GFRP bars.
The grout shall be Portland Cement grout with a minimum design compressive strength of 35 MPa at 28days. The mixing water shall be free of any deleterious material. No detrimental quickest addictive such as calcium chloride are permitted.
Use equipment capable of continuous mechanical mixing and pumping to produce a grout free of lumps and undispersed cement.
Inject the grout at the lowest point of core hole. The grout shall be pumped into the core hole through a grout tube from the bottom until neat grout exits from the top of the core hole. Select appropriate injection pressure to ensure solid grout to core holes while avoid damage adjacent existing walls.

.9 Wall Vertical Control Joint

- .1 Prepare repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.
- .2 Use proper tool to clean out, rout out joint crack. Remove loose concrete within joint.
- .3 At areas of Adjacent Spalling along joint, to be confirmed on site:
  - .1 Mark lines for making sawcut.
  - .2 Include spalled areas within the 2 sawcuts on each side of joint if it is deemed appropriate.
  - .3 Sawcut to 25 mm depth for 12mm wide.
  - .4 Repair areas of spalling if spalling within sawcut lines in accordance with Paragraph 3.10.2, RLS - Local Spall Repair. Use Shallow Spall Repair Mix and Deep Spall Repair Mix to suit depth of spall repair in conjunction with crack repair
- .4 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.
- .5 Apply breathable sealer in joint. Sealer should be flexible type to allow movement.
- .6 Add sand aggregate neatly over caulked joint to camouflage joint, in a similar fashion to other caulked joints on site.

.10 RSF- 1 – Crack Repair around Window or Door Steel Frame

- .1 Prepare window head concrete crack repair area in accordance with Article 3.7, Preparation Work for Concrete Maintenance Repair Types above.
- .2 Provide temporary shoring support for roof slab above opening as required.
- .3 Record Concrete Profile as required to match existing concrete form with new concrete.
- .4 Carefully remove concrete and completely expose steel frame around the opening including its connection plates/anchors to concrete wall. Do not damage existing steel frame and its connection plates/anchors.
- .5 Sandblast to remove corrosion and paint from all exposed steel frame including its connection plates and anchors to bare metal. Start with minimal pressure and slowly adjust pressure as required to completely remove existing rust but avoid damage to adjacent surfaces. Apply corrosion protection coating to entire exposed steel surface. Also refer to Section 05 03 14 – Period Embedded Steel Beam Repair for coating and painting to steel frames.

.6 Prepare adjacent concrete.
- .1 Form, mix and place concrete using Deep Spalling Repair Mix.
- .2 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.
- .3 After curing period, finish area with coat of Parging Mix.

.11 RSB- 1 – Concrete Repair at Steel Beam End Support

.1 Prepare window head concrete crack repair area in accordance with Article 3.7, Preparation Work for Concrete Maintenance Repair Types above.
Provide temporary shoring support for roof slab above opening as required.
Record Concrete Profile as required to match existing concrete form with new concrete.
Carefully remove concrete and completely expose steel beam end. Refer to contract drawings for concrete removal extent. Do not damage existing steel beams.
Sandblast to remove corrosion and paint from all exposed steel beam to bare metal. Start with minimal pressure and slowly adjust pressure as required to completely remove existing rust but avoid damage to adjacent surfaces. Apply corrosion protection coating to entire exposed steel surface. Also refer to Section 05 03 14 – Period Embedded Steel Beam Repair for coating and painting to steel beams.
Refer to Section 05 03 14 - Period Embedded Steel Beam Repair for beam pocket repair.
Repair adjacent concrete.
- .1 Form, mix and place concrete using Deep Spalling Repair Mix.
- .2 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.
- .3 After curing period, finish area with coat of Parging Mix.

.12 RSB- 2 – Concrete Repair to Cracks adjacent to Steel Lintels

.1 Prepare window head concrete crack repair area in accordance with Article 3.7, Preparation Work for Concrete Maintenance Repair Types above.
Provide temporary shoring support for roof slab above opening.
Record Concrete Profile as required to match existing concrete form with new concrete.
Carefully remove concrete and completely expose steel lintel, both sides of opening.
Remove steel lintel, and prepare adjacent concrete to receive new steel lintel. New hot dipped galvanized steel lintel as per Specification Section 05 03 14 – Period Embedded Steel Beam Repair.
- .1 Form, mix and place concrete using Deep Spalling Repair Mix.
- .2 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.
- .3 After curing period, finish area with coat of Parging Mix.

.13 RSB- 3 – Repair to Existing Rusted Steel Beam Inside Concrete Slab

- .1 Prepare concrete crack repair area in accordance with Article 3.7, Preparation Work for Concrete Maintenance Repair Types above.
- .2 Provide temporary shoring support for roof slab at both sides of opening as required.
- .3 Record Concrete Profile as required to match existing concrete form with new concrete.

.4 Carefully remove concrete and completely expose steel beam bottom flange and portion of web. Refer to contract drawings for concrete removal extent. Do not damage existing steel beams.

.5 Sandblast to remove corrosion and paint from all exposed steel beam to bare metal. Start with minimal pressure and slowly adjust pressure as required to completely remove existing rust but avoid damage to adjacent surfaces. Apply corrosion protection coating to entire exposed steel surface. Also refer to Section 05 03 14 – Period Embedded Steel Beam Repair for coating and painting to steel beams.

.2 Refer to Section 05 03 14 - Period Embedded Steel Beam Repair for beam pocket repair.

.3 Repair concrete adjacent to steel beam.

.1 Form, mix and place concrete using Deep Spalling Repair Mix.

.2 Cure concrete repair work in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.3 After curing period, finish area with coat of Parging Mix.

3.10 SPALLING AND EROSION REPAIR TYPES

.1 Perform Spalling and Erosion Repairs as indicated on Contract Drawings.

.2 RLS - Local Spall Repair

.1 Prepare local spall repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.

.2 Mark lines for making sawcut.

.3 Sawcut to minimum 12 mm depth around perimeter of spall repair area.

.4 Based on size and depth of concrete spalling, prepare Parging Mix, Shallow Spall Repair Mix and Deep Spall Repair Mix as follows:

.1 Parging Mix: Depth of Spall less than approximately 25 mm.

.2 Shallow Spall Repair Mix: Depth of Spall approximately 25 to 75 mm in depth.

.3 Deep Spall Repair Mix: Depth of Spall greater than approximately 75 mm in depth.

.5 Apply Repair Mix in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.6 Cure in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.3 RES – General Erosion Spalling Repair

.1 Prepare general erosion spalling repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.

.2 Refer to Contract Drawings for locations of horizontal surface repairs and of vertical surface repairs.

.1 Install temporary formwork as required.

.3 Deeper spalling within eroded area:

.1 Perform repair in accordance with Paragraph 3.10.2, RLS - Local Spall Repair above.

.4 Apply Parging Repair Mix to restore eroded surfaces in accordance with Article 3.8 Application of Concrete Repair Material for All Concrete Repair Types above.

.5 Cure in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.4 RP -1 - General Parging Repair

.1 Prepare general parging repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.

.1 Make saw cut to suit at junction of existing concrete and new concrete.

.2 Apply Parging Repair Mix in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above. Do not float with steel trowels. Use tools, brushes, to achieve close match to existing surface textures.

.3 Cure in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

.5 RF-1 – Fascia Repair

.1 Prepare fascia repair area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.

.2 Deeper spalling within eroded area:

.1 Perform in accordance with Paragraph 3.10.2, RLS - Local Spall Repair above.

.2 Provide stainless steel dowels and wire reinforcement where indicated on drawings.

.3 Allow for drip edge in construction of formwork.

.4 After formwork removal:

.1 Provide saw-cut at underside of fascia to match adjacent drip edge

.5 Apply Parging Repair Mix in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above. Do not float with steel trowels. Use tools, brushes, to achieve close match to existing surface textures.

.6 Cure fascia repair in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

3.11 TOP SURFACE REPAIR (RTS)

.1 Prepare top surface area in accordance with Article 3.7, Preparation Work – All Concrete Repair Types above.

.2 Refer to Contract Drawings for Locations.

.3 Spalling within surface area:

.1 Perform repairs in accordance with Paragraph 3.10.2 RLS - Local Spall Repair, RP Parging Repair and Crack Repairs.

.2 Apply Parging Repair Mix to restore eroded surfaces in accordance with Article 3.8 Application of Concrete Repair Material for All Concrete Repair Types above.

.4 Cure in accordance with Article 3.8, Application of Concrete Repair Material for All Concrete Repair Types above.

3.12 DRAIN REPAIR

.1 Confirm locations of all surface drains with Departmental Representative and restore functionality of drains:

.1 Carefully remove vegetation and debris to completely expose drain & surrounding concrete.

.2 Carefully remove drain cap fixture and all debris from inside top of drain.

.3 Using appropriate equipment such as mechanical snake/auger, clean out and unclog each drain. Test to ensure proper function and repeat as required.
.4 Carry out RLS – local spall repair around drain as required.
.5 Reinstate drain cap fixture.

3.13 CLEAN TRACK REPAIR

.1 Remove vegetation and debris to completely expose track & surrounding concrete.

.2 Perform RLS – local spall repairs as required all along both sides of track.

3.14 MISCELLANEOUS REPAIRS

.1 CMAR - Corroded Metal Attachment Repair:
.1 Perform Corroded Metal Attachment Repairs where indicated on Contract Drawings
.2 Prepare repair area in accordance with Article 3.7 , Preparation Work for Concrete Repair Types above.
.3 Corrosion Treatment.
.1 Review condition of metal attachment with Departmental Representative.
.2 Determine with Departmental Representative treatment method for corroded metal: treat in-situ or remove for complete corrosion treatment.
.3 Execute corrosion treatment as determined with Departmental Representative.
.4 Repair Concrete in accordance with Article 3.10.2, RLS – Local Spall Repair, and Article 3.10.3, RES – General Erosion Spalling Repair above.

3.15 SITE QUALITY CONTROL

.1 Engage testing laboratory firm to carry out testing of each of the concrete mixes for mixing procedures and material proportions and consistency of repair mix properties. Test to include the following at mock-up stages and for major concrete pour of the Work:
.1 For all Mixes, allow for 3 tests during concrete repair work for each mix type:
.1 Mix proportions.
.2 Aggregate grading.
.3 Wet air content.
.2 For Crack Repair and Parging Mix:
.1 Compressive Strength of mortar cubes at seven (7) days, minimum 3 Mpa, and 28 days, minimum 9 Mpa. Allow for 2 sets of three (3) cubes of each mix throughout the work, for each of 7 day and 28 day tests.
.3 For Shallow and Deep Spall Mix:
.1 Compressive Strength of cylinders at seven (7) days, minimum 6 Mpa, and 28 days, minimum 20 Mpa. Allow for three (3) cylinders each of each mix throughout the work, 3 for 7 day and 3 for 28 day tests.

.2 Ensure testing laboratory is certified to CSA A283.

.3 Excess and unnecessary concrete removal and associated repair:
.1 No cost to Departmental Representative.

3.16 BREATHABLE SEALING COMPOUND APPLICATION

.1 Test each surface to ensure compatibility, to confirm product selection, to establish a typical coverage rate and to confirm degree of water repellency. The surfaces to receive

sealing compound should be clean, free of stains, vegetative growth, and efflorescence, thoroughly sound and in good repair. Any deficiencies should be corrected prior to the application of compound.

3.17 CLEANING

.1 Clean in accordance with Section 01 11 55 – General Instructions.

.2 Construction Waste Management.

.1 Separate construction waste materials for reuse and recycling.

.2 Divert unused concrete materials from landfill to local facility after receipt of written approval from Departmental Representative.

.3 Provide appropriate area on job site where concrete trucks can be safely washed.

.4 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.

.5 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

.6 Prevent admixtures and additive materials from entering drinking water supplies or streams.

.7 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.

.8 Dispose of waste in accordance with applicable local, Provincial and National regulations.

END OF SECTION 03 03 30

## 1.0 GENERAL

### 1.1 RELATED REQUIREMENTS

.1 Section 03 03 30 – Period Concrete Repairs.

.2 Section 03 03 32 – Period Concrete Roof Slab Reinforcement.

.3 Section 05 03 14 – Period Embedded Steel Beam Repair.

.4 Section 07 14 16 – Cold Fluid-Applied Waterproofing Roofing.

.5 Section 07 92 00 – Joint Sealant.

### 1.2 REFERENCES

.1 Abbreviations and Acronyms:

.1 Cement: hydraulic cement or blended hydraulic cement (XXb - where b denotes blended).

.1 Type GU or GUb - General use cement.

.2 Reference Standards:

.1 ASTM International

.1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86 (R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 CSA International

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283-06(R2011), Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.4 CSA S806-12, Design and construction of building structures with fibre-reinforced polymers.

.5 CSA S807-10, Specification for fibre-reinforced polymers.

### 1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Ensure collaboration between shoring designer and concrete contractor to facilitate work.

.2 Window Rehabilitation: by others.

.1 Coordinate work with window contractor.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 55 – General Instructions.

.2 Product Data: provide product technical data sheets minimum two (2) weeks prior to beginning the Work.

.1 Submit written declaration that curing compounds are compatible with applied finish on concrete.

.3 Shop drawings.
- .1 Reinforcement work:
  - .1 Submit shop drawings indicating placement of reinforcement and:
    - .1 Lists.
    - .2 Quantities of reinforcement.
    - .3 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
    - .4 Indicate sizes, spacings and locations of chairs, spacers and hangers.
- .2 Temporary shoring to support roof slab/wall section:
  - .1 Submit shop drawings stamped and signed by professional engineer licensed in the province of British Columbia, Canada, indicating:
    - .1 Sequence of demolition work and supporting structures.
    - .2 Material specifications, details and information required for assembly and erection of temporary shoring, including anchorage to existing building.
    - .3 Superimposed service dead, live and lateral loads.
  - .2 The shoring design engineer should review and certify the shoring installation.
  - .3 The contractor is responsible for the design of all formwork and shoring and for complying with all Work Safe BC regulations pertaining to formwork construction, design and inspection.
  - .4 The formwork design engineer should review and certify the formwork installation

.4 Samples: provide samples of proposed materials minimum two (2) weeks prior to beginning the Work:
- .1 One (1) kg each of fine and coarse aggregate for use in concrete repair and parging mix.

.5 Test and Evaluation Reports.
- .1 Provide test data and certification by qualified independent inspection and testing laboratory that confirm materials and mix designs used in concrete mixture meet requirements of this Section.

.6 Source quality control submittals.
- .1 Submit valid certificate for concrete delivery plant.
- .2 Submit concrete delivery slips in accordance with CSA A23.1.

.7 Site quality control submittals: submit minimum two (2) weeks prior to starting concrete work.
- .1 Provide quality control procedures for following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
  - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.
  - .6 Formwork removal.

.7 Joints.

.2 Submit proof of review and approval of shoring erection by professional engineer licensed in the province of British Columbia, Canada.

.3 Submit Concrete Mix Design for new roof-wall sections.

.4 Concrete pours.

.1 Submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in Article 3.12 Site Quality Control.

.5 Submit documentation of deviations exceeding maximum allowable time for delivery of concrete to site of Work and discharged after batching.

.8 Submit two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 CLOSEOUT SUBMITTALS

.1 As-Built Drawings:

.1 Submit two (2) sets of as-built drawings. Indicate:

.1 Location and dimensions of roof-wall section replacements, showing clear delineation between original concrete and new concrete.

.2 Materials and mixes used.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time:

.1 Deliver concrete to site of Work and discharge within maximum allowable hauling time after batching.

.1 Maximum allowable concrete hauling time: 120 minutes.

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

.3 Document deviations from this procedure.

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

.2 Provide secure enclosure as required for material storage.

.3 Packaging Waste Management.

.1 Remove packaging materials for reuse by manufacturer in accordance with Section 01 11 55 – General Instructions.

1.7 AMBIENT CONDITIONS

.1 Hot Weather Concreting.

.1 When ambient temperature is above 32°C:

.2 When rate of moisture evaporation exceeds 1.0 kg/m² per hour, employ following measures in addition to requirements of A23.1.

.1 Ready Mix Concrete:

.1 Lower the concrete temperature: use ice as mixing water.

.2 Dispatch ready-mix trucks and organize work to keep mixing time to a minimum. Minimize exposure of mixing trucks to hot sun while waiting.

.3 Keep placing time to a minimum: provide adequate personnel and efficiently organize work.

.4 Reduce time interval for placing: place concrete in thin layers and in small areas. Compact layers. Ensure complete union of adjacent portions.

.2 Formed concrete:
.1 In addition to formwork providing curing: Spray formwork with water to keep it tight and free from cracking.

.2 Cold Weather Concreting.
.1 When ambient temperature is below 5°C:
.1 Before start of concrete placement:
.1 Provide equipment, materials and plant necessary for cold weather protection for duration of concrete work.
.2 Add approved anti-freeze admixture to concrete mix.
.3 Fresh concrete cast against existing concrete: prevent loss of heat.
.1 Extend protection for fresh concrete minimum 600 mm over existing concrete.
.4 Insulate or provide heated enclosure for tie rods, reinforcement and metal which projects from concrete being protected.
.5 Maintain housing, enclosures and supplementary heat in place for required period of protection.
.1 Exception: sections may be temporarily removed as required to permit placing additional forms or concrete.
.1 Protect uncovered concrete from freezing.
.2 Await completion of curing period before protection is discontinued and removed.
.6 Placement of heating units:
.1 Avoid heating concrete locally.
.2 Avoid drying concrete excessively.
.3 Avoid high temperature and dry heating within enclosures.
.7 Maintain edges and corners of concrete at required temperature.

1.8 EXISTING CONDITIONS

.1 The existing concrete extremely hard due to the hard rock aggregate that is up to and the rock aggregate is up to 50 mm in size.

2.0 PRODUCTS

2.1 MATERIALS

.1 Cement: to CSA A3001, Type GU, low heat of hydration hydraulic cement.

.2 Water: potable, to CSA A23.1.
.1 Free of oil, alkali, acidic, organic materials or deleterious substances.
.2 Do not use water from shallow, stagnant or marshy or marine sources.

.3 Coarse aggregate: to CSA A23.1, Table 11, Group I.
.1 Sizes for mix designs: maximum 12.5 mm and 19 mm nominal sizes in accordance with mix designs.
.2 Meet grading requirements of CSA A23.1, Table 11, Group I.
.3 Uniformly graded.
.4 Maximum 1% to pass a 75um sieve.
.5 Consisting of crushed stone or gravel or combination of both.
.6 Hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter and other injurious substances.
.7 Clean and free from alkali, organic and other deleterious matter.
.8 Fracture faces: minimum two (2).
.9 Absorption: maximum 3 percent.

.10 Aggregate retained on 5 mm sieve: clean, hard, tough, durable, angular particles with rough surface texture, free from organic material, adherent coats of clay, clay balls, excess of thin particles and other extraneous material.
.11 Crushed and washed selected aggregate from concrete removals as approved by Departmental Representative.

.4 Fine aggregate: to CSA A23.1, Table 10 and Table 12.
.1 Meet grading requirements of CSA A23.1, Table 10.
.2 Uniformly graded.
.3 Include a mixture of sharp and rounded grains.
.4 Maximum 1 % to pass a 75um sieve.
.5 Consisting of sand, stone, screenings and other inert materials with similar characteristics or combinations of these.
.6 Clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam and other deleterious substances.
.7 Tests not to exceed limits for standard requirements in accordance with CSA A23.1, Table 12.

.5 Curing compounds: compatible with applied finish on concrete.

.6 Reinforcing bars, dowels.
.1 Glass Fiber Reinforced Polymer (GFRP) threaded rods to CSA S-807, Grade II, bar size per Contract Drawings.
.2 Stainless Steel threaded bars – Grade 316 to ASTM A276

.7 Non-ferrous chairs, bolsters, bar supports, spacers: in accordance with CSA A23.1/A23.2.

.8 Tie wire: plastic coated.

.9 Bar clips: plastic.

.10 Formwork ties: non-metallic.

.11 Waterproofing membrane: self-adhesive SBS rubberized asphalt compound.

.12 Polyethylene film: 0.25 mm thick polyethylene sheet to CAN/CGSB-51.34.

.13 Epoxy Adhesive: high strength two-part epoxy adhesive suitable for wet application.
.1 Acceptable Materials:
.1 Hilti RE-500 V3,
.2 DeWALT adhesive,
.3 Simpson SET-XP High Strength Epoxy Adhesive,
.4 Alternative materials: Approved by addendum in accordance with General Instructions to Bidders.
.14 Cement Slurry bonding agent. 1 part Cement to 1 part water mix.

.15 Not permitted: Pre-mix high strength concrete repair mortar products.

2.2 MIXES
.1 Concrete mix in accordance with CSA A23.1.

.2 Admixtures.
.1 Obtain approval of admixtures by Departmental Representative.

.2 Air entrainment: to ASTM C260.
.3 Chemical admixtures: to ASTM C494.
.4 Water-reducing agent: to ASTM C494.
.5 Super-plasticizer: to ASTM C494.

2.3 PERFORMANCE CRITERIA – CONCRETE MIX

.1 Structural concrete for new roof - wall sections as shown on Contract Drawings:
.1 Compressive strength: 35 MPa at 28 days.
.2 Class of exposure: C-2, air category 1.

3.0 EXECUTION

3.1 VERIFICATION OF CONDITIONS

.1 Verify existing conditions are as indicated on Contract Drawings.

.2 Notify Departmental Representative of conditions not noted on Contract Drawings.

.3 Determine depth of embedment of steel beams into concrete walls through inspection openings and/or Ground Penetrating Radar.

.4 Verify presence of mechanical connections to underside of beam.

.5 Examine areas where concrete repairs are indicated on Contract Drawings.
.1 Visually inspect and hammer tap areas.
.2 Confirm areas of deteriorated and delaminated concrete.
.3 Mark these areas on drawings and on concrete surface with suitable marking crayon.

.6 Precisely record arched concrete profile at each window opening.

3.2 PROTECTION OF IN-PLACE CONDITIONS

.1 Install shoring for roof slab from interior of structure. Ensure Engineering certification of installations.

.2 Supply and Install plywood protection at interior of structure.

.3 Install plywood protection around exterior of structure as required.

.4 Provide other protection measures to existing structures suitable for the scope of work.

3.3 REMOVALS AND DEMOLITION

.1 Remove debris and natural growth from surfaces of the Work.

.2 Elements attached to structure.
.1 Remove elements, store and reinstall at completion of the Work.

.3 Remove all remnants of existing roofing membrane system removed by others.

.4 Remove loose delaminated concrete.

.5 Embedded steel components.
.1 Verify locations of steel components.
.2 Review process for removal and protection with Departmental Representative.

.3 Proceed with removal upon approval of Departmental Representative.
.4 Commence removals from exterior from window head up and into roof slab as indicated on Contract Drawings.
.5 Remove existing areas of spalling, cracked, delaminated and debonded concrete down to sound material.
.6 Remove concrete at areas of steel lintel replacement.
.7 Expose ends of steel beams at areas of corrosion treatment.

.6 Remove concrete as required: provide appropriate transition of new concrete to existing concrete to remain at terminations at intermediate walls and end wall sections to remain.

.7 Use caution to cut out and dismantle sections of roof slab/wall sections indicated on Contract Drawings. Cut into chunks of concrete for removal.

.8 Collect demolished sections of concrete and review suitability of coarse aggregate for use in new concrete mix and other concrete repairs on site.

.9 Protect from damage during concrete removal work: existing top of walls and roof slab to remain.

3.4 INSTALLATION – FORMWORK

.1 Install formwork as required for concrete work Contract Drawings.

.2 Window openings.
.1 Formwork to precisely match recorded profile dimensions.

.3 Form drip edge: depth x length and location to match existing.

.4 Junctions with Interior Walls, Existing Concrete to remain: Form to maintain existing profiles, form.

3.5 INSTALLATION – NEW REINFORCEMENT

.1 Confirm reinforcement type and placement with Departmental Representative.

.2 Where GFRP is specified on Drawings, install new GFRP reinforcement in accordance with CSA S-806. Minimum lap length of 40 bar diameters is required.

.3 Place new GFRP reinforcement where indicated on Contract Drawings.

.4 Ensure reinforcement is clean and free from oil and deleterious matter.

.5 Secure GFRP reinforcement in formwork.

.6 Field cutting: do not shear GFRP bars.
.1 Cut bars with fine blade saw or grinder, with carborundum or diamond blade.

.7 Field bending is not possible.

.8 Where Stainless steel bars are specified, install as per Contract Drawings.

3.6 INSTALLATION – STEEL BEAMS, LINTELS

.1 Where original steel beams or lintels, steel construction supporting roof slab have been removed, and designated for repair, carry out steel treatment in accordance with Section 05 03 14 – Period Embedded Steel Beam Repair.

.2 Where designated for replacement, supply new steel per Section 05 03 14 – Period Embedded Steel Beam Repair.

.3 Install steel in accordance with Section 05 03 14 – Period Embedded Steel Beam Repair to match original location, position.

3.7 INSTALLATION – NEW CONCRETE WALL/ROOF SECTION

.1 Ensure formwork is ready to receive new concrete.

.2 Obtain Departmental Representative's written approval before placing concrete.
- .1 Provide 24 hours minimum notice prior to placing of concrete.

.3 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.

3.8 CONCRETE – FORMED SURFACE

.1 After removal of formwork:
- .1 Apply hand-patching material in gaps. Finish to match adjacent concrete.
- .2 Concrete bleed from formwork: grind to match adjacent concrete.

3.9 CONCRETE FINISHING

.1 Finish concrete in accordance with CSA A23.1/A23.2.

.2 Remove excess bleed water in accordance with procedures in CSA A23.1/A23.2. Ensure surface is not damaged.

.3 Applied finish on concrete:
- .1 Upon formwork removal, perform following:
  - .1 Exterior exposed surfaces: etch concrete surface with pressure wash to expose surface aggregate for subsequent parging application.
  - .2 Interior surfaces: prepare surfaces to level of “ready to paint” finish to match adjacent surfaces.
- .2 Rub exposed sharp edges of concrete with carborundum: produce minimum 3 mm radius edges unless otherwise indicated.

3.10 CONCRETE CURING

.1 Cover concrete surface with single layer of clean, wet white polyester fabric
- .1 Pre-soak fabric in water prior to placing.

.2 When surface conditions permit: cover fabric with polyethylene sheet.

.3 Maintain fabric saturated throughout curing period.

.4 Wet cure for minimum 7 days at minimum temperature of 15°C.

.5 Cure concrete for minimum 28 days prior to roofing membrane work.

.6 Obtain Departmental Representative’s approval to remove curing cover.

3.11 PARGING

.1 After completion of curing period, prepare new concrete surfaces, except those to be covered by roofing membrane to receive new parging in accordance with Section 03 03 30 – Period Concrete Repairs.

.2 Apply new parging finish in accordance with Section 03 03 30 – Period Concrete Repairs.

.3 Finish and cure parging in accordance with Section 03 03 30 – Period Concrete Repairs.

3.12 SITE QUALITY CONTROL

.1 Temporary shoring to support roof slab:
- .1 Ensure review and approval of shoring erection by professional engineer licensed in the province of British Columbia, Canada.

.2 Site tests: conduct tests as follows in accordance with Section 01 11 55 – General Instructions and submit report as described in Section 01 33 00 – Submittal.
- .1 Concrete pours.
- .2 Slump.
- .3 Air content.
- .4 Compressive strength at 7 days and 28 days.
- .5 Air and concrete temperature.

.3 Inspection and testing of concrete and concrete materials:
- .1 Departmental Representative to designate testing laboratory for reviews to CSA A23.1/A23.2.
- .2 Ensure testing laboratory is certified to CSA A283.
- .3 Engage and pay for concrete tests

.4 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.

3.13 CLEANING

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

.2 Dispose Construction Waste Management in accordance with Section 01 74 19 – Waste Management Disposal.

END OF SECTION 03 03 31

## 1.0 GENERAL

### 1.1 RELATED REQUIREMENTS

.1 Period Concrete Repairs — Section 03 03 30

.2 Period Concrete Roof-Wall Sections Repair/Replacement — Section 03 03 31

.3 Period Embedded Steel Beam Repair — Section 05 03 14

.4 Cold Fluid-Applied Waterproofing Roofing — Section 07 14 16

.5 Joint Sealant — Section 07 92 00

### 1.2 REFERENCES

.1 Abbreviations and Acronyms:
- .1 Cement: hydraulic cement or blended hydraulic cement (XXb – where b denotes blended).
  - .1 Type GU or GUb – General use cement.

.2 Reference Standards:
- .1 ASTM International
  - .1 ASTM A276 – Stainless Steel Bars and Shapes
- .2 CSA International
  - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - .3 CSA S136-12, North American specification for the design of cold-formed steel structural members

### 1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:
- .1 Ensure collaboration between shoring designer and concrete contractor to facilitate work.

.2 Window Rehabilitation: by others.
- .1 Coordinate work with window contractor.

.3 Convene start-up meeting minimum two (2) weeks prior to beginning concrete works with key personnel, site supervisor, Departmental Representative.
- .1 Verify project requirements.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedure.

.2 Product Data: submit product technical data sheets minimum 2 weeks prior to beginning the Work.
- .1 Submit written declaration that curing compounds are compatible with applied finish on concrete.

.3 Samples: provide samples of proposed materials minimum two (2) weeks prior to beginning the Work.
- .1 One (1) kg each of fine and coarse aggregate for use in concrete repair and parging mix.

.4 Site quality control submittals: submit two (2) weeks prior to starting concrete work.
.1 Provide quality control procedures for the following items:
.1 Hot weather concrete.
.2 Cold weather concrete.
.3 Curing.

.5 Submit two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements.

.6 Design the GFRP composite system to achieve the structural performance shown on the structural drawings and specifications (E x A) and shall be submitted for approval by the Departmental Representative, and shall be performed by a Professional Engineer registered in the British Columbia

1.5 CLOSEOUT SUBMITTALS
.1 As-Built Record Drawings
.1 Submit one (1) set of as-built drawings. Indicate:
.1 Location and dimensions of each roof replacement slab, showing clear delineation between original concrete of top of wall and new concrete roof slab.
.2 Concrete Repairs carried out on existing walls.
.3 Materials and mixes used.

1.6 DELIVERY, STORAGE AND HANDLING
.1 Delivery and Acceptance Requirements:
.1 Concrete hauling time:
.1 Deliver concrete to site of Work and discharge within maximum allowable hauling time after batching
.1 Maximum allowable concrete hauling time: 120 minutes.
.2 Packaging Waste Management.
.1 Remove packaging materials for reuse by manufacturer in accordance with Section 01 74 19 – Waste Management Disposal.

1.7 AMBIENT CONDITIONS
.1 Hot Weather Concreting.
.1 When ambient temperature is above 32°C:
.2 When rate of moisture evaporation exceeds 1.0 kg/m² per hour, employ following measures in addition to requirements of A23.1.
.1 Ready Mix Concrete:
.1 Lower the concrete temperature: use ice as mixing water.
.2 Dispatch ready-mix trucks and organize work to keep mixing time to a minimum. Minimize exposure of mixing trucks to hot sun while waiting.
.3 Keep placing time to a minimum: provide adequate personnel and efficiently organize work.
.4 Reduce time interval for placing: place concrete in thin layers and in small areas. Compact layers. Ensure complete union of adjacent portions.
.2 Formed concrete:
.1 In addition to formwork providing curing: Spray formwork with water to keep it tight and free from cracking.
.3 Concrete Repair Material:
.1 Do hot weather concreting in accordance with manufacturer’s written

instructions.

.2 During the work: protect exposed concrete, exposed masonry and other exposed members from staining and from becoming coated with concrete leakage due to concreting operations.

.1 Members that become coated: classed as defective by Departmental Representative.

.2 Cold Weather Concreting.

.1 When ambient temperature is below 5°C:

.1 Before start of concrete placement:

.1 Provide equipment, materials and plant necessary for cold weather protection for duration of concrete work.

.2 Add approved anti-freeze admixture to concrete mix.

.3 Fresh concrete cast against existing concrete: prevent loss of heat.

.1 Extend protection for fresh concrete minimum 600 mm over existing concrete.

.4 Insulate or provide heated enclosure for tie rods, reinforcement and metal which projects from concrete being protected.

.5 Maintain housing, enclosures and supplementary heat in place for required period of protection.

.1 Exception: sections may be temporarily removed as required to permit placing additional forms or concrete.

.1 Protect uncovered concrete from freezing.

.2 Await completion of curing period before protection is discontinued and removed.

.6 Placement of heating units:

.1 Avoid heating concrete locally.

.2 Avoid drying concrete excessively.

.3 Avoid high temperature and dry heating within enclosures.

.7 Maintain edges and corners of concrete at required temperature.

1.8 EXISTING CONDITIONS

.1 The existing concrete extremely hard due to the hard rock aggregate that is up to and the rock aggregate is up to 50 mm in size.

## 2.0 PRODUCTS

### 2.1 MATERIALS

.1 Cement: to CSA A3001, Type GU.

.2 Lime: Hydrated Lime Type SA to ASTM C207

.3 Water: potable, to CSA A23.1.

.1 Free of oil, alkali, acidic, organic materials or deleterious substances.

.2 Do not use water from shallow, stagnant or marshy or marine sources.

.4 Coarse aggregate: to CSA A23.1, Table 11, Group I.

.1 Sizes for mix designs: maximum 12.5 mm and 19 mm nominal sizes in accordance with mix designs.

.2 Meet grading requirements of CSA A23.1, Table 11, Group I.

.3 Uniformly graded.
.4 Maximum 1% to pass a 75um sieve.
.5 Consisting of crushed stone or gravel or combination of both.
.6 Hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter and other injurious substances.
.7 Clean and free from alkali, organic and other deleterious matter.
.8 Fracture faces: minimum two (2).
.9 Absorption: maximum 3%.
.10 Aggregate retained on 5 mm sieve: clean, hard, tough, durable, angular particles with rough surface texture, free from organic material, adherent coats of clay, clay balls, excess of thin particles and other extraneous material.

.5 Fine aggregate for Concrete Spall Repair Mixes: to CSA A23.1, Table 10 and Table 12.
.1 Meet grading requirements of CSA A23.1, Table 10.
.2 Uniformly graded.
.3 Include a mixture of sharp and rounded grains.
.4 Maximum 1% to pass a 75um sieve.
.5 Consisting of sand, stone, screenings and other inert materials with similar characteristics or combinations of these.
.6 Clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam and other deleterious substances.
.7 Tests not to exceed limits for standard requirements in accordance with CSA A23.1, Table 12.

.6 Concrete Mix Colouring Agent: Mineral Oxide Pigment to ASTM C979 maximum 10% mass of cement, or crushed granite aggregate.

.7 Curing compounds: compatible with applied finish on concrete.

.8 Sealant and Backer Rod: in accordance with Section 07 92 00 – Joint Sealing.

.9 Sand Aggregate for Sealant Finish: Beach sand or Crushed granite aggregate, dark colour to closely match adjacent concrete.

.10 Paint: corrosion protection.
.1 Primer: oil base, rust inhibitive.
.2 Top Coat: oil base, rust inhibitive.

.11 Water repellent sealer.
.1 Acceptable materials:
.1 Protectosil BHN water repellent.
.2 Alternate materials: approved by addendum in accordance with General Instructions to Bidders.

.12 Reinforcing bars.
.1 Horizontal slab reinforcement: 20 mm diameter stainless steel threaded rods to ASTM A276 Grage 316, with stainless steel couplers as required, length to suit application.
.2 Vertical dowel reinforcement: 155 mm long, stainless steel threaded rods to ASTM A276 Grade 316.

.13 Non-ferrous chairs, bolsters, bar supports, spacers: in accordance with CSA A23.1/A23.2.

.14 Tie wire: plastic coated.

.15 Bar clips: plastic.

.16 Bonding Adhesive.

.17 Glass Fiber Reinforced Polymer (GFRP) sheet to CSA S-807. Minimum one layer in each orthogonal direction. Minimum stiffness (ExA) of 53000 kN/m width & minimum 40kN per meter width.

2.2 MIXES

.1 Concrete for Filling New Roof Slab Reinforcement Slots.

.1 Shallow Deterioration/Spall Repair Mix: 1 part cement, ½ part SA lime, 1.5 parts fine aggregate, 3 parts maximum 12.5 mm diameter coarse aggregate.

.2 Pre-mixed Concrete Repair Mixes: compatible with original concrete.

.1 Obtain review and approval of Departmental Representative for use.

3.0 EXECUTION

3.1 VERIFICATION OF CONDITIONS

.1 Verify existing conditions are as indicated on Contract Drawings.

.2 Notify Departmental Representative of conditions not noted on Contract Drawings.

.3 Determine depth of embedment of steel beams into concrete walls through inspection openings.

3.2 PREPARATION

.1 Record arched concrete profile at each window opening.

3.3 PROTECTION OF IN-PLACE CONDITIONS

.1 Maintain shoring for roof slab from interior of structure.

.2 Provide protection measures to existing structures suitable for the scope of work.

3.4 REMOVALS AND DEMOLITION

.1 Remove debris and natural growth from surfaces of the Work.

.2 Elements attached to structure.

.1 Remove elements, store and reinstall at completion of the Work.

.3 Remove loose delaminated concrete.

.4 Identify steel components and review process for removal and protection with Departmental Representative. Proceed with removal upon approval of Departmental Representative.

.5 Take care to protect top of walls to remain from damage during roof slab removal work.

3.5 REPAIR OF ROOF SLAB CRACKS OVER STEEL BEAMS

.1 Perform repair of roof slab cracks over steel beams in accordance with Section 03 03 30 – Period Concrete Repair, Crack Repairs without caulking, and RLS – Local Spall repairs as indicated on Contract Drawings.

3.6 PREPARATION OF SLOTS IN EXISTING CONCRETE

.1 Confirm completion of repair of existing cracks over steel beams. Obtain Departmental Representative's approval before starting saw-cutting slots into roof slab.

.2 Lay out locations of slots in roof slab in accordance with slot spacing, width, length and setbacks from roof edge indicated on Contract Drawings.

3.7 INSTALLATION – SLOTS IN CONCRETE SLAB

.1 Sawcut slots in concrete slab to minimum 100 mm deep ± 3 mm.

.2 Drill holes at 5° to 10° angle from vertical for stainless steel dowels at locations indicated on Contract Drawings.

.3 Roughen saw-cut surfaces of concrete by bush hammering or other suitable methods to enhance bond to concrete.

3.8 INSTALLATION – NEW REINFORCEMENT

.1 Place stainless steel threaded reinforcing rods, stainless steel couplers and non-ferrous supports as indicated on Contract Drawings and in accordance with CSA-A23.1/A23.2.

.2 Ensure reinforcement is clean and free from oil and deleterious matter.

.3 Secure stainless-steel reinforcement in slots.

3.9 INSTALLATION – NEW CONCRETE IN REINFORCING SLOTS

.1 Obtain Departmental Representative's written approval to proceed before placing concrete.
.1 Provide 48 hours minimum notice prior to placing of concrete.

.2 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.

.3 Ensure cover to reinforcement is maintained during concrete pour.

3.10 CONCRETE FINISHING

.1 Finish concrete in accordance with CSA A23.1/A23.2.

.2 Remove excess bleed water in accordance with procedures in CSA A23.1/A23.2 as reviewed by departmental Representative. Ensure surface is not damaged.

.3 Apply trowelled finish.

3.11 CONCRETE CURING

.1 Cover concrete surface with single layer of clean, wet white polyester fabric.
.1 Pre-soak fabric in water prior to placing.

.2 When surface conditions permit: cover fabric with polyethylene sheet.

.3 Maintain fabric saturated throughout curing period.

.4 Wet cure for minimum 7 days at minimum temperature of 15°C.

.5 Cure concrete for minimum 14 days.

.6 Obtain Departmental Representative's approval to remove curing cover.

3.12 CLEANING

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

.2 Dispose Construction Waste Management in accordance with Section 01 74 19 – Waste Management Disposal.

END OF SECTION 03 03 32

## 1.0 GENERAL

### 1.1 RELATED REQUIREMENTS

.1 Period Concrete Repairs — Section 03 03 30

.2 Period Concrete Roof Slab Reinforcement — Section 03 03 32

.3 Period Concrete Slab Wall Section Replacement — Section 03 03 31

### 1.2 REFERENCES

.1 Canada Green Building Council (CaGBC)
- .1 LEED Canada-NC 2009, LEED (Leadership in Energy and Environmental Design): LEED Canada Reference Guide for Green Building Design and Construction 2009.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
- .2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 CSA International
- .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
- .1 SCAQMD Rule 1168-A2005, Adhesive & Sealants Applications.

### 1.3 QUALITY ASSURANCE

.1 Standards: Conform to CAN/CSA-A23.1, for concrete finishes.

.2 Installer Qualifications:
- .1 Work shall be carried out by personnel who must have a minimum of 5 years related experience in similar floor treatment. The installer to provide a list of a minimum of 3 projects performed within 3 years of equivalent complexity and scope as this contract.

.3 Pre-installation Meeting:
- .1 Prior to commencement of Work on site, convene a pre-installation conference to be attended by the Contractor, Coating Subcontractor, Manufacturer's Technical Representative and Departmental Representative to review:
  - .1 Convey to Contractor requirements for protection of concrete slabs and coping to receive concrete sealer.

### 1.4 SUBMITTALS

.1 Submittals to be in accordance with 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 in accordance with Section 01 35 33- Health & Safety Requirements. 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.

.3 Submit maintenance instructions for insertion in operations and maintenance manuals. Instructions shall give specific warning of maintenance or cleaning practices or materials, which may damage installed work.

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 and storage requirements:

.1 Deliver materials to site in manufacturer's original factory packaging, labelled with manufacturer's name and address.

.2 Store materials in a clean dry area in accordance with manufacturer's instructions.

.3 Keep product from freezing.

.4 Avoid direct contact with this product as it may cause mild to moderate irritation of the eyes and/or skin.

.5 Protect materials during handling and application to prevent damage or contamination.

.3 Dispense special concrete finish material from sealed containers.

.4 Packaging Waste Management: Comply with requirements of Section 01 74 19 Waste Management and Disposal.

.5 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 Labour Canada.

1.6 ENVIRONMENTAL REQUIREMENTS / PROJECT CONDITIONS

1. Do not apply product when air, surface, or material temperature is below 35°F (2°C) or above135°F (57°C).

2. Do not apply to frozen concrete.

3. Do not use on highly dense or non-porous surfaces.

4. Ensure substrate acceptable by product manufacturer before commencement of work.

5. Limit and control dust generated by grinding and polishing procedures in order to prevent potential damage to adjacent surfaces and equipment.

.6 Control the use of water. Remove standing water from completed floor surfaces.

.7 Ensure that penetrating sealers are not applied to concrete floors that are to be polished.

1.7 EXTENDED WARRANTY

1. Provide two (2) year manufacturer's warranty on products and installation against fading and delamination of finished surfaces.

## 2.0 PRODUCTS

### 2.1 MATERIALS

.1 Concrete materials shall conform to requirements of Section 03 03 30 Period Concrete Repairs and CAN/CSA-A23.1.

.2 Breathable Sealing Compound: Breathable Clear Surface Sealer: to CAN/CGSB-25.20. Acceptable Products:
- .1 Fabrishield PS-500 by Fabrikem Manufacturing Ltd.
- .2 Or approved alternative

## 3.0 EXECUTION

### 3.1 FINISHING-GENERAL

.1 Do concrete finishing work in accordance with CAN/CSA-A23.1-M01, unless otherwise indicated.

.2 Tops of Walls and Columns to be level and true. Allowable tolerance 6 mm in 3,000 mm.

### 3.2 FORMED SURFACES

.1 Remove or cut back to a depth of 3/4" (19 mm) from the surface of the concrete all bolts, ties, nails, or other metal that is not required and repair immediately. Patch all cone and sleeve holes flush with concrete surface in strict accordance with manufacture's printed instructions. Grout all steel inserts in strict conformance with grout manufacturer's printed instructions.

.2 Remove imperfections such as bulges, fins, lips, and stains to permanently exposed surfaces as directed by Departmental Representative by chipping or grinding and patch to match adjacent surfaces. Do not proceed with grinding until the concrete has sufficiently hardened to prevent dislodgment of coarse aggregate particles. Allowable limits of grinding to be 1/16" so as to not expose aggregate.

.3 Repair to exposed surfaces or surfaces to receive paint type finishes: Repairs to be carried out under the direction of the Departmental Representative. Blend cement and aggregate so that, when dry, patching mortar will match colour of surrounding. Provide test areas at inconspicuous location to verify mixture and colour match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface. Patch and fill all concrete imperfections such as "blow holes", "honeycomb" and voids as directed.

.4 Strike off smooth and finish tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces with a texture matching the adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

### 3.3 HORIZONTAL SURFACES

.1 Coping and roof slab shall have positive slopes to provide complete water drainage with no ponding.

.2 Finish horizontal concrete surfaces as follows:
- .1 Exposed horizontal surfaces not intended to receive additional concrete: as per approved mock-ups.

3.4 DEFECTIVE WORK

.1 Repair honeycombing, rock packets, chips, spalls and other voids in exposed concrete surfaces, using patching materials as specified to provide a smooth surface. Remove fins and other protrusions in concrete surfaces. Maximum allowable depth of grinding to be 1/16".

.2 Consult with Departmental Representative on the repair of defective concrete surfaces prior to execution of the work.

.3 Patch form tie holes in all exposed concrete surfaces and surfaces designated to receive waterproofing unless otherwise directed.

.4 Where in the opinion of Departmental Representative, material or workmanship fails to meet the requirements of the specification, such work may be rejected. Work rejected shall be replaced or repaired to the approval of the consultant at no additional cost to the Departmental Representative.

3.5 PROTECTION

.1 Take every precaution to protect finished surfaces from stains and abrasions. Surfaces and edges likely to be damaged during the construction period shall be especially protected.

.2 Protect work of other sections from damage resulting from work of this Section.

.3 Erect barricades to prevent traffic on newly finished surfaces.

.4 Suggested protection in high traffic areas after the sealer has been applied is as follows:

.1 Place cheap colourfast carpet that is breathable (not rubber backed), fuzzy side down or Protect CP board.

.2 Masonite or plywood may then be applied over the carpet/cardboard for further protection.

3.6 ADJUSTING & CLEANING

.1 Progress Cleaning: Clean during progress of the Work in accordance with Section 01 74 11-Cleaning.

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

.3 Repair, remove and clean all drips or smears resulting from the work of this section on exposed, finished surfaces or surfaces to be subsequently finished.

.4 Engage a concrete finish manufacturer's authorized representative to train Departmental Representative's maintenance personnel on proper maintenance procedures

END OF SECTION 03 35 00

1.0 GENERAL

1.1 RELATED SECTIONS

.1 Section 07 62 00 – Sheet Metal Flashing and Trim.

1.2 ALTERNATES

.1 Obtain Departmental Representative's approval before changing manufacturer's brands or sources of supply of mortar materials during entire contract or other methods of mixing mortar specified elsewhere in this specification.

1.3 REFERENCES

.1 Definitions:

.1 Raking: removal of loose/deteriorated mortar to a depth suitable for repointing until sound mortar, and/or 4x joint thickness and/or a specified mm depth mm is reached.

.2 Repointing: filling and finishing of masonry joints from which mortar is missing has been raked out or has been omitted.

.3 Tooling: finishing of masonry joints using tool to provide final contour.

.4 Low-pressure water cleaning: water soaking of masonry using less than 350 kPa water pressure, measured at nozzle tip of hose.

.2 Reference Standards:

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

.1 ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.

.2 ASTM C207 06(2011), Standard Specification for Hydrated Lime for Masonry Purposes.

.3 ASTM C10/C10M -14, Standard Specification for Natural Cement.

.2 CSA International

.1 CAN/CSA A23.1/A23.2 14, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 CSA A82-14, Fired masonry brick made from clay or shale.

.3 CAN/CSA A179-14, Mortar and Grout for Unit Masonry.

.4 CAN/CSA A3000 13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.4 ACTION AND INFORMATION SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 15 – General Instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:

.1 Submit labelled samples of materials used on project for approval before work commences.

.2 New clay brick: submit 3 samples.

.4 Test Reports:

.1 Submit certified test reports showing compliance of mortar with specified performance characteristics and physical properties.

1.5 QUALITY ASSURANCE

.1 Masonry Contractor:

.1 Use single Masonry Contractor for masonry work.

.2 Masons:

.1 Mason to have minimum of 5 years of experience in historic brick masonry work.

.3 Testing Agency:

.1 Engage and pay for Testing Laboratory to provide certified test reports for compliance of mortar.

.2 Allowable Tolerances:

.1 If mortar fails to meet the 7 day compressive strength requirements, but meets the 28 day compressive strength requirement, it is acceptable. If mortar fails to meet the 7 day compressive strength requirement, but its strength at 7 days exceeds two thirds of the value required for the 7 day strength, contractor may elect to continue work at his own risk while awaiting the results of the 28 day tests, or to take down the work affected.

.4 Mock ups:

.1 Propose locations and construct one (1) mock-up of the following :

.1 masonry brick and stone replacement and resetting,

.2 mortar mixing and cured samples for brick and stone masonry

.3 brick and stone repointing, backpointing

.4 mortar cap over stone masonry walls

Obtain approval of locations from Departmental Representative."

.2 Contractor must demonstrate experience and skills in period masonry brick repairs and re-pointing.

.3 Provide minimum three (3) working days' notice to Departmental Representative prior to beginning mock-up.

.4 Create photographic record of each step of mock-up procedure.

.5 Undertake each initial step, from labelling, disassembly and surface preparation through repair under direct review of Departmental Representative.

.1 Adjust techniques as directed by Departmental Representative until desired results are achieved.

.2 Techniques approved by Departmental Representative serve as standard for this work.

.6 Allow 48 hours for inspection of mock up by Departmental Representative before proceeding with work.

.7 Obtain Departmental Representative's approval of mock-up before proceeding with the Work.

.8 When accepted, mock-up demonstrates minimum standard for this work.

.9 Mock-up may remain as part of finished work.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 11 15 – General Instructions and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements.

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Store cementitious materials and aggregates in accordance with CAN/CSA A23.1.

.3 Keep material dry. Protect from weather, freezing and contamination.

.4 Ensure that manufacturer's labels and seals are intact upon delivery.

.5 Remove rejected or contaminated material from site.

.3 Packaging Waste Management.

.1 Remove for reuse and recycling the pallets, crates, padding, and packaging materials in accordance with Section 01 11 55 – General Instructions.

1.7 AMBIENT CONDITIONS

.1 Maintain masonry temperature between 10 °C and 25 °C for duration of work.

.2 When ambient temperature is below 10 °C:

.1 Allow mortar materials to reach minimum temperature of 10 °C before use.

.2 Ensure only sand, aggregate and water are heated before use:

.1 Heat and maintain sand and aggregate temperature to minimum 10 °C and maximum 30 °C.

.3 Provide hot water to a maximum 30 °C on site during cold weather.

.3 Maintain sand and aggregate temperature between 10 °C and 30 °C.

.4 Do not mix cement with water or with aggregate or with water aggregate mixtures having higher temperature than 30 °C.

.5 Maintain mortar mix temperature between 10 °C and 30 °C.

1.8 EXISTING CONDITIONS

.1 Designated Substances Report.

.1 Pacific EHS Designated Substances/Hazardous Materials Survey – Project No.: V3800, Fort Rodd Hill National Historic Site, Victoria, BC.

.1 Typical for structures at Fort Rodd Hill NHS.

2.0 PRODUCTS

2.1 PERFORMANCE CRITERIA

.1 Mortar compression strength minimum 4 MPa, cured for 7 days.

.2 Mortar compression strength minimum 8 MPa, cured for 28 days.

.3 Mortar: (Type N, 1part cement:1part SA lime:6 parts sand)

.1 Compressive strength: 6 MPa at 28days.

.2 Air entrainment test: 9 to 12%.

2.2 MATERIALS

.1 Mortar mix in accordance with CSA A179.

.2 Aggregate: to CSA A179.

.3 Water: potable or from approved non-potable supply.

.4 Sand: to ASTM C144.

.1 Sharp, screened and washed pit sand, free of organic material, and colour as supplied from source to match original aggregate and grading to approval of Departmental Representative.

| Sieve Size | % By Weight Passing Each Sieve | % By Weight Retained on Each Sieve |
|---|---|---|
| No. 4 (4.75 mm) | 100 | 0 |
| No. 8 | 90 | 5 |
| No. 16 | 70 | 25 |
| No. 30 (600 micron) | 50 | 20 |
| No. 50 (300 micron) | 30 | 20 |
| No. 100 (150 micron) | 15 | 15 |
| No. 200 (75 micron) | 0 | 15 |

.5 Lime: Hydrated, dolomitic finishing lime to ASTM C207, type SA.

.6 Cement: to CSA A3000, non-staining.

.7 Grey cement, type 10 Portland.
Brick: Clay Brick to replace brick too deteriorated re-set. Allow for quantity as indicated on the Drawings.

.8 Provide new solid brick masonry units for localized brick replacement at the underground magazine, and brick replacement along the stone retaining wall coping, and new vent bricks to match size and color of existing.

.9 Stone units from fallen to ground stones on the site can be used to reset into gaps in the retaining walls at Belmont Battery,

2.3 MORTAR MIXES

.1 Brick Mortar: Type N, 1part cement:1part SA lime:6 parts sand.
- .1 Grey Portland cement: 1
- .2 SA Lime: 1
- .3 Sand: 6
- .4 Water: to be determined at first mortar test trial.

.2 Premix mortar: 1:1:6.
- .1 Acceptable materials:
  - .1 Daubois Betomix Plus Type N
  - .2 Alternative materials: approved by addendum in accordance with General Instructions to Bidders.

.3 Stone Masonry Mortar: Type N ( 1part cement:1part SA lime:6 parts sand), with coarse aggregate of washed beach sand added, per approved mock-up.

3.0 EXECUTION

3.1 SITE VERIFICATION OF CONDITIONS

.1 Report in writing to Departmental Representative areas of deteriorated masonry not previously identified.

.2 Stop work in that area and report to Departmental Representative immediately evidence of hazardous materials.

3.2 PROTECTION OF IN-PLACE CONDITIONS

.1 Provide protection measures to existing structures suitable for the scope of work.

3.3 SPECIAL TECHNIQUES

.1 Examine mortar joints.

.1 Examine horizontal and vertical joints to determine style, as well as aspects of workmanship which establish authenticity of original work.

.2 Replicate style selected by Departmental Representative.

3.4 BULKING OF SAND

.1 Test sand for bulking:

.1 At start of work;

.2 After each new delivery of sand;

.3 After an excessive change in weather.

3.5 MIXING MORTAR

.1 Cement-Lime mortar.

.1 Prepare measuring boxes.

.1 Ensure accurate proportioning of lime, cement and sand.

.2 Pass ingredients through a sieve.

.1 Ensure no lime and cement balls are in mix.

.3 Mix lime, cement and aggregate thoroughly in standard mixer

.1 Ensure lime and sand are completely blended with no spots or streaks of lime.

.4 Slowly add one (1) litre water and mix.

.1 Use a measuring cup to add more water in small volume to reach desired consistency. Record the final volume of water added.

.2 Natural Cement mortar.

.1 Read and follow manufacturer's instructions.

.2 Prepare whole bag at one time.

.3 Appoint one individual to mix mortar for duration of the Work.

3.6 RAKING JOINTS

.1 Use manual raking tool to obtain clean masonry surfaces.

.1 Remove deteriorated and adhered mortar from masonry surfaces minimum 25 mm deep and to sound mortar.

.1 Leave square corners and flat surface at back of cut.

.2 Clean out voids and cavities encountered.

.2 Remove mortar without chipping, altering or damaging masonry units.

.3 Clean surfaces of joints with non-ferrous brush without damaging texture of exposed joints or masonry units.

.4 Flush open joints and voids; clean open joints and voids with low pressure water and if not free draining blow clean with compressed air.

.5 Leave no standing water.

3.7 RESETTING, REBUILDING LOOSE BRICK or STONE MASONRY

.1 Verify locations and dimensions of areas of Work with Departmental Representative.

.2 During removal, protect sound areas to remain.

.3 Clean out mortar joints as deep as possible with hand tools.

.4 Remove loose bricks, stone units by hand.

.5 Remove adhered mortar from surface of adjacent bricks or stone units that remain in place.

.6 Clean surfaces of void with non-ferrous brush without damaging texture of exposed joints or masonry units.

.7 Flush open joints and voids:

.1 Clean open joints and voids with low pressure water. If joint and void is not free draining blow clean with compressed air.

.8 Shim loose bricks or stone units that become loose for as required for resetting or repointing work.

.9 Rebuild, reset brick or stone units to match original form and jointing. Tool compact and finish using jointing tool and brush to lightly expose sand aggregate. Do not over tool.

3.8 FINISH POINTING:

.1 Dampen joints and porous bricks.

.2 Keep masonry damp while pointing is being performed.

.3 Apply pointing mortar.

.1 Completely fill raked joint with pointing mortar.

.1 If surface of masonry units has worn rounded edges keep pointing back from surface to keep same width of joint.

.2 Avoid feather edges.

.2 Build up pointing in layers not exceeding 12 mm in depth.

.1 Allow each layer to set before applying subsequent layers.

.2 Maintain joint width.

.4 Tool joints to match existing profile.

.1 Tool, compact and finish using jointing tool and brush to lightly expose sand aggregate. Do not over tool.

.5 Clean finished brickwork as work progresses.

.1 Remove mortar splashings on exposed brickwork.

.2 Leave no mortar on face of bricks.

.3 Remove mortar staining before it sets.

.4 Clean masonry with clean water and soft bristle brush only.

.6 Keep new mortar damp for 4 days at a minimum temperature of 10 °C.

.7 Inspect finished brickwork with Departmental Representative.

3.9 PROTECTION DURING CURING PROCESS

.1 Damp cure:

.1 Provide damp cure for pointing mortars.

.2 Install and maintain wetted burlap protection during the curing process.

3.10 SITE QUALITYCONTROL

.1 Perform the following testing standard:

.1 Cube strength: to CAN/CSA-A179, Appendix B.

.1 Compressive strength: two (2) sets of mortar cubes at 7 and 28 days each for each mortar mix type.

3.11 CLEANING

.1 Clean surfaces of mortar droppings, stains and other blemishes resulting from work of this contract as work progresses.

.2 Remove droppings and splashings using clean sponge and water.

.3 Do further cleaning using stiff natural bristle brushes after mortar has attained its initial set and has not fully cured.

.4 Clean masonry with stiff natural bristle brushes and plain water only if mortar has fully cured.

.5 Clean masonry with low pressure 1 to 3 bar clean water and soft natural bristle brush.

.6 Obtain approval of Departmental Representative prior to using other cleaning methods for persistent stains.

.7 Cleaning of biological growth :

.1 Use combined method of washing and brushing to clean masonry surfaces of biological growth.

.2 Use stiff natural bristle brush to remove biological growth.

.3 Clean masonry with low pressure 100 kPa to 300 kPa clean water and soft natural bristle brush. "

.8 Construction Waste Management.

.1 Separate construction waste materials for reuse and recycling in accordance with Section 01 11 15 – General Instructions.

3.12 PROTECTION OF COMPLETED WORK

.1 Protect adjacent finished work against damage which may be caused by on-going work.

END OF SECTION 04 03 07

## 1.0 GENERAL

### 1.1 RELATED REQUIREMENTS

.1 Period Concrete Repairs — Section 03 03 30

.2 Period Concrete Roof-Wall Sections Repair/Replacement — Section 03 03 31

### 1.2 REFERENCES

.1 Reference Standards:

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86 (R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.2 CSA International

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283-06 (R2011), Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

### 1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Ensure collaboration between shoring designer and concrete contractor to facilitate work.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data: provide product technical data sheets minimum two (2) weeks prior to beginning the Work.

.3 Submit two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements.

### 1.5 CLOSEOUT SUBMITTALS

.1 As-Built Record Drawings:

.1 Submit one (1) set of as-built drawings. Indicate:

.1 Location and dimensions of each roof slab, steel beams, and concrete repairs in roof slab.

.2 Concrete Repairs carried out on existing walls.

.3 Materials and mixes used.

### 1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: in accordance with Section 03 03 30 – Period Concrete Repairs.

.2 Packaging Waste Management.

.1 Remove packaging materials for reuse by manufacturer in accordance with Section 01 74 19 – Waste Management Disposal.

### 1.7 AMBIENT CONDITIONS

.1 Ambient conditions in accordance with Section 03 03 30 – Period Concrete Repairs.

1.8 EXISTING CONDITIONS

.1 Designated Substances Report.

.1 Pacific EHS Designated Substances/Hazardous Materials Survey – Project No.: V3800, Fort Rodd Hill National Historic Site, Victoria, BC.

.1 Typical for structures at Fort Rodd Hill NHS.

2.0 PRODUCTS

2.1 MATERIALS

.1 Concrete materials and methods in accordance with Section 03 03 30 – Period Concrete Repairs.

.2 Paint: corrosion protection.

.1 Primer: oil base, rust inhibitive.

.2 Top coat: oil base, rust inhibitive.

.3 Steel cleaner: glass dust.

.4 Waterproofing membrane: self-adhesive, SBS rubberized asphalt compound.

.5 Temporary filler for steel beam pocket repair: extruded polystyrene foam.

3.0 EXECUTION

3.1 VERIFICATION OF CONDITIONS

.1 Verify existing conditions are as indicated on Contract Drawings.

.2 Notify Departmental Representative of conditions not noted on Contract Drawings.

.3 Determine depth of embedment of steel beams into concrete walls using inspection openings, Ground Penetrating Radar.

.4 Verify presence of mechanical connections to underside of beam.

3.2 PROTECTION OF IN-PLACE CONDITIONS

.1 Shoring in accordance with Section 03 03 31 – Period Roof-Wall Section Replacement.

3.3 REMOVALS

.1 Remove debris and natural growth from surfaces of the Work.

3.4 BEAM INSPECTION OPENINGS

.1 Execute one (1) 150 mm x 150 mm inspection opening at each embedded steel beam location.

.1 Inspection opening locations determined by Departmental Representative.

.2 Chip out one pocket at mid-span area to expose steel beam and flanges.

.3 Arrange for Departmental Representative to inspect condition of steel beam.

.4 Measure and record flange and web thicknesses.

.5 Inform Departmental Representative of substantial loss of flange material.

.6 Repair steel beam in accordance with Paragraph 3.5.2, Steel Beam Repair below.

.7 Repair inspection opening in concrete using Deep Spall Repair Mix in accordance with Section 03 03 30 – Period Concrete Repairs.

3.5 STEEL BEAM EDGE REPAIR (RSB-1)

.1 Remove loose concrete adjacent to steel beam.

.1 Chip out deteriorated concrete to sound surface.

.2 Make sawcut in concrete along length of bottom edge of steel beam flange as indicated on Contract Drawings.

.3 Remove corrosion and paint from all exposed edges and all over entire surface of bottom and top of steel beam. Sandblast to remove corrosion and paint from all exposed steel beams to bare metal. Start with minimal pressure and slowly adjust pressure as required to completely remove existing rust but avoid damage to adjacent surfaces.

.1 Apply corrosion protection coating to all exposed steel of beam.

.1 Paint:

.1 Ensure steel beams are dry before application of paint.

.2 Apply primer coat.

.3 Apply top coat.

.4 Painting to match the existing paint colour

.4 Provide beam pocket repair:

.1 Apply waterproofing membrane to underside of steel beam flange within pocket.

.2 Place extruded polystyrene foam insulation filler, approximately 25 mm thickness under steel beam inside the pocket.

.3 Place deep repair concrete mix under steel beam flange in pocket.

.4 Ensure full bed of concrete mix material under steel beam.

.5 Fill pocket with concrete mix. Build up in layers to suit application.

.6 After concrete is sufficiently cured, remove extruded polystyrene foam insulation filler and fill void with dry pack grout with shallow concrete repair mix to ensure full contact for steel beam bearing.

.7 Parge exterior faces of repaired beam pockets.

.5 Sound concrete surfaces adjacent to steel beams and remove loose concrete. Local RLS repairs are to be performed as indicated Section 03 03 30 – Period Concrete Repairs.

3.6 STEEL FRAME REPAIR (RSF-1)

.1 Sandblast to remove corrosion and paint from all exposed steel frame including its connection plates and anchors to bare metal. Start with minimal pressure and slowly adjust pressure as required to completely remove existing rust but avoid damage to adjacent surfaces.

.1 Chip out deteriorated concrete to sound surface.

.2 Make sawcut in concrete around the steel frames as indicated on Contract Drawings.

.3 Remove corrosion and paint from all exposed edges including connections plates & anchors and all over entire surface of bottom of steel frames. Clean steel frame to bare metal.

.1 Apply corrosion protection coating to all exposed steel of the frame.

.1 Paint:

.1 Ensure steel beams are dry before application of paint.

.2 Apply primer coat.

.3 Apply top coat.

.4 Painting to match the existing paint colour

.4 Sound concrete surfaces adjacent to steel frames and remove loose concrete. Concrete repairs are to be performed as indicated Section 03 03 30 – Period Concrete Repairs.

3.7 NEW STEEL BEAM INSTALLATION

.1 Replace existing un-salvageable steel beam with new steel beam where indicated on Contract Drawings.

.2 Remove, form and place concrete to match original condition.

3.8 NEW STEEL LINTEL INSTALLATION (RSB -2)

.1 Replace steel lintel with new steel lintel where indicated on Contract Drawings.

.2 Protect galvanized coating from damage during installation.

.3 Touch-up coating as required.

.4 Form, cast and cure new concrete per Sections 03 03 30 – Period Concrete Repairs and, 03 03 31 – Period Concrete Roof-Wall Sections Repair/Replacement.

3.9 CONCRETE PATCHING REPAIRS

.1 Repair areas of concrete removals adjacent to steel beams and a beam pockets using materials and methods per Section 03 03 30 - Period Concrete Repairs.

.2 Use Shallow Spall Repair Mix and Deep Spall Repair Mix to suit depth of repair.

.3 Bond coat on concrete repair area: Brush cement slurry bonding agent onto cleaned concrete surface.

.4 Mix patching material with selected blend of aggregates.

.5 While cement slurry bonding agent is still tacky:

.1 Fill repair area with concrete patching mix to the appropriate surface depth for the repair type.

.2 Fill area in individual lifts to suit depth of repair area.

.1 Note: Leave sufficient depth back from surface for repairs that are to receive a subsequent parging coat.

.3 Trowel surface flush to existing surrounding concrete.

.4 Apply brush texture finish.

3.10 CONCRETE CURING

.1 Wet Cure for repair areas.

.1 Wet cure period: minimum 4 days at minimum temperature of 15°C.

.2 Cover repaired surfaces of concrete with single layer of clean, pre-soaked burlap. Cover only as soon as surface will not be marred by covering.

.3 Keep fabric wet with soaker hoses.

.4 Keep curing system in place for specified time period.

3.11 CLEANING

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

.2 Dispose Construction Waste Management in accordance with Section 01 74 19 - Waste Management Disposal.

END OF SECTION 05 03 14

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

.1 Section 03 30 00 Period Concrete Repair

.2 Section 05 03 14 Period Embedded Steel Beam Repair

.3 Section 09 91 00 Painting

### 1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)
- .1 ASTM A53/A53M 12, Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless.
- .2 ASTM A269/A269M 14, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- .3 ASTM A307 12, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB 1.40 97, Anti corrosive Structural Steel Alkyd Primer.

.3 Canadian Standards Association (CSA International)
- .1 CAN/CSA G40.20/G40.21 13, General Requirements for Rolled or Welded Structural Quality Steel.
- .2 CAN/CSA G164 M92 (R2013), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CAN/CSA S16.1 09, Limit States Design of Steel Structures.
- .4 CSA W48 14, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co operation with the Canadian Welding Bureau).
- .5 CSA W59 13,Welded Steel Construction (Metal Arc Welding) (Imperial Version).

.4 The Environmental Choice Program
- .1 CCD 047a 98, Paints, Surface Coatings.
- .2 CCD 048 98, Surface Coatings Recycled Water borne.

.5 Master Painters Institute (MPI)
- .1 Architectural Painting Specification Manual – current edition.

### 1.3 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit two copies of WHMIS MSDS Material Safety Data Sheets in accordance with Section 01 33 00 Submittal Procedures. Indicate VOC's:
  - .1 For finishes, coatings, primers and paints.

.2 Shop Drawings
- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

### 1.4 QUALITY ASSURANCE

.1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
Pre installation Meetings: Conduct pre installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, Shipping, Handling and Unloading:
  .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Storage and Protection:
  .1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.
  .2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management And Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated and cardboard packaging material in appropriate on site for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

2.0 PRODUCTS

2.1 MATERIALS

.1 Steel sections and plates: to CAN/CSA G40.20/G40.21, Grade 300W, 350W.

.2 Steel pipe: to ASTM A53/A53M standard weight and extra strong, double extra strong, black, galvanized finish.

.3 Welding materials: to CSA W59.

.4 Welding electrodes: to CSA W48 Series.

.5 Bolts and anchor bolts: to ASTM A307; corrosion resistant types to ASTM A325M, Type 3. Provide all required anchoring devices including anchor clips, bar and strap anchors, expansion bolts and shields, and other devices designed to support and secure work.

.6 Aluminum sheet: proprietary utility sheet, plain, embossed pattern, mm minimum thickness, black, colour.

.7 Stainless steel tubing: to ASTM A269, Type 302, Commercial grade, Seamless welded with AISI No. 4 finish.

.8 Grout: non shrink, non metallic, flowable, 15 MPa pull out strength 7.9 MPa at 24 hours.

.9 Security Mesh: Sheets of carbon steel sheet expanded security mesh to requirements of ASTM A569M and to ASTM F1 267, Style: 20 mm, SWD-25 mm x LWD-54 mm, designed for penetration resistance, in sizes x 3 mm thick, 68% open area and 8.5 kg/m².

.10 Security fasteners: screws and bolts with spanner type heads to prevent removal except with special tools; non-corrosive type.

.11 Shop coat primer: to CAN/CGSB-1.40.

.12 Touch-up primer: to CAN/CGSB-1.40.

2.2 FABRICATION

.1 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Fabricate items from steel unless indicated otherwise; use galvanized steel for exterior items, unless indicated otherwise.

.3 Use self-tapping shake-proof countersunk flat headed screws on items requiring assembly by screws or as indicated. Use screws for interior work. Use welded connections for exterior work, unless approved otherwise by Departmental Representative.

.4 Where possible, fit and shop assemble work, match mark, ready for erection.

.5 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush with sharp edges and corners rounded to 3 mm radius. Where continuous welds may cause distortion of fabrication use stitch welds and plastic filler, grind and sand smooth.

.6 Seal exterior steel fabrications to provide corrosion protection in accordance with CAN/CSA-S16.1.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m2 to CAN/CSA G164.

.2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.

.3 Shop coat primer: to CAN/CGSB 1.40.

.4 Touch-up primer: to CAN/CGSB 1.40.

2.4 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:
- .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
- .2 Concrete, mortar and masonry.
- .3 Wood.

2.5 SHOP PAINTING

.1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.

.3 Clean surfaces to be field welded; do not paint.

3.0 EXECUTION

3.1 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Provide components for building by other sections in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CAN/CSA S16.1, or weld.

.7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

.8 Touch up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

.9 Touch up galvanized surfaces with zinc rich primer where burned by field welding.

3.2 MISCELLANEOUS STEEL BRACKETS, CAPS, SHOES, BEAM SUPPORTS AND ANGLES

.1 Supply for installation by respective trades. Drill for countersunk screws and anchor bolts.

3.4 CLEANING

.1 Perform cleaning after installation to remove construction and accumulate environmental dirt.

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

END OF SECTION 05 50 00

1.0 GENERAL

1.1 RELATED SECTION

.1 Section 08 03 14 Period Wood Door and Miscellaneous Wood Repairs

.2 Section 08 03 52 Period Wood Window Repairs

1.2 REFERENCE STANDARDS

.1 CSA International

.1 CAN/CSA-O80 Series-[15], Wood Preservation.

.2 National Fire Protection Association (NFPA)

.1 NFPA 909-[2017], Code for the Protection of Cultural Resources Properties, Museums, Libraries and Places of Worship.

.2 NFPA 914-[2015], Code for Fire Protection of Historic Structures.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit proposed methods to Departmental Representative for storage and protection of wood.

1.4 DELIVERY, STORAGE AND HANDLING

.1 General Requirements as per Contract Documents.

2.0 EXECUTION

2.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable.

.1 Visually inspect substrate. Advise Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied

.2 Inspect wood for evidence of fungi, mould, decay, damage or insect attack.

.3 Accept wood free from evidence of fungi, mould, decay, damage or insect attack.

.4 Stop work and report to Departmental Representative immediately evidence of deficiencies or insect and fungal attack which will affect the finished product.

2.2 PREPARATION

.1 Site preparation.

.1 Ensure drainage of ground surface at place of storage.

.2 Provide shelter in location approved by Departmental Representative.

2.3 PROTECTION OF IN-PLACE CONDITIONS

.1 Protect wood elements and associated hardware adjacent to area of work from damage during duration of the Work.

2.4 CONSTRUCTION AND STORAGE

.1 Storage criteria:

.1 Prevent direct contact with ground.

.2 Stack wood on levelled cribs or wood blocks above ground surface to allow for air circulation.

.3 Stack wood in layers separated by stickers/battens placed at end of stack and spaced suitably apart along the length of the wood.

.3 Cover with breathable membrane

.4 Protect wood stack from direct sunlight and precipitation.

.5 Screen wood exposed to wood destroying insects or marine borers.

.6 Maintain free air circulation for wood stored in container or other structure, attain specified moisture content.

.7 Store hardware in approved interior location on site.

2.5 CLEANING ACCORDING TO SECTION 01 74 19 WASTE MANAGEMENT DISPOSAL

.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: Per Contract Documents.

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

END OF SECTION 06 03 01.31

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

.1 Wood Repair Section 06 10 11

### 1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.

.2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA O121-08 (R2013), Douglas Fir Plywood.

.4 CAN/CSA-O141-05 (R2014), Softwood Lumber.

.5 CSA O151-09 (R2014), Canadian Softwood Plywood.

.6 CAN/CSA-O325-07 (R2012), Construction Sheathing.

.7 Comply with AWPA.M4 and revisions specified in CAN/CSA-080 Series, Supplementary Requirements to AWPA Standard M2.

.2 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 2014.

### 1.3 QUALITY ASSURANCE

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

.2 Plywood identification: by grade mark in accordance with applicable CSA standards

.3 Plywood, OSB and wood based composite panel construction sheathing identification: by grade mark in accordance with applicable CSA standards.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 11 15 – General Instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused wood materials from landfill to recycling, reuse and composting facility approved by Departmental Representative.

.5 Do not dispose of preservative treated wood through incineration.

.6 Do not dispose of preservative treated wood with materials destined for recycling or reuse.

.7 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Departmental Representative.

.8 Dispose of unused wood preservative material at official hazardous material collections site approved by Departmental Representative.

.9 Do not dispose of unused preservative material into sewer system, into streams, lakes, onto ground or in other locations where they will pose health or environmental hazard.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 15 – General Instructions.

.2 Product Data.

.1 Technical Data Sheets: submit minimum one (1) week prior to beginning Work.

.3 Samples.

.1 Samples of materials proposed for use: submit minimum one (1) week prior to beginning Work, as follows:

Door and window repair parts as requested by Departmental Representative.

2.0 PRODUCTS

2.1 LUMBER MATERIAL

.1 Framing and natural sizes lumber and decking, furring, blocking: New materials, sized to match existing dimensions, form: Custom cut from larger sized members as required to match existing sizes:

Red cedar species, NLGA No. 1 or better.

2.2 ACCESSORIES

.1 Nails, spikes and staples: to CSA B111. Corrosion resistant hot dipped galvanized. All nailing shall be common nails. If P-nails (Power driven nails) are intended as substitution, submit P-nails information for Departmental representative's review prior to use. Adjustment of nails spacing or requirements may be required.

.2 Bolts: Stainless steel - diameter to match existing unless indicated otherwise, complete with nuts and cut steel washers. All bolts and anchor bolts shall conform to ASTM A307. Bolt holes shall be 1mm larger than the bolt diameter. Bolts in wood shall not be less than 7 diameter from the end and 4 diameters from the edge unless otherwise detailed.

.3 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.

.4 Steel plates: All steel plates used in connection details shall be grade 300W.

.5 Lag screws: Lag screws shall be predrilled with a bit size of 65% of the shank diameter for the threaded portion. Lead holes shall be the same length as the unthreaded portion and the same diameter as the shank. Screw all lags into place. Cut washers shall be provided under heads which bear on wood.

.6 No checks or splits allowed at areas to be bolted or lagged.

.7 All bolts, steel plates/connections and nails for use with wood repair or replacement to be stainless steel.

.8 Use stainless steel fasteners for all exterior work and interior areas.

.9 Epoxy Adhesive for anchor bolts: high strength an injectable two-component epoxy adhesive suitable for wet application.

## 3.0 EXECUTION

### 3.1 CONSTRUCTION

.1 Review with Departmental Representative extent of dismantling and reconstruction work specified on the drawings.

.2 Carefully dismantle to salvage for reuse as much existing sound framing and decking material as possible.

.3 Install members true to line, levels and elevations, to match existing construction as closely as possible.

.4 Construct continuous members from pieces of longest practical length.

.5 Install spanning members with “crown-edge” up.

### 3.2 DEFACEMENT MARKS

.1 Install lumber and deck materials so that grade-marks and other defacing marks are not visible or are removed by sanding at location(s) where exposed in final assembly.

### 3.3 FURRING, STRAPPING AND BLOCKING

.1 Install furring, strapping and solid backing in structures as required. Use solid blocking or 19 mm plywood securely nailed to framing members.

.2 Align and plumb faces of furring and blocking to tolerance of 1:600.

### 3.4 FASTENERS

.1 Frames, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.2 Countersink bolts where necessary to provide clearance for other work.

END OF SECTION 06 10 11

## 1.0 GENERAL

### 1.1 RELATED REQUIREMENTS

.1 Wood Repair — Section 06 10 11

.2 Period Exterior Painting — Section 09 03 91.13

### 1.2 REFERENCES

.1 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
- .1 Architectural Woodwork Quality Standards, 1st edition, 2009 (AWS).

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-11.3-M87, Hardboard.

.3 CSA International
- .1 CSA B111-74 (R2003), Wire Nails, Spikes and Staples.
- .2 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA O121-08, Douglas Fir Plywood.
- .4 CSA O141-05, Softwood Lumber.
- .5 CSA O151-09, Canadian Softwood Plywood.
- .6 CSA O153-13 Poplar Plywood.

.4 Forest Stewardship Council (FSC)
- .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .2 FSC-STD-20-002-2004, Structure and Content of Forest Stewardship Standards V2-1.
- .3 FSC Accredited Certified Bodies.

.5 National Lumber Grades Authority (NLGA)
- .1 NLGA Standard Grading Rules for Canadian Lumber 2008.

### 1.3 SUBMITTALS

.1 Submit in accordance with Section 01 11 15 – General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for Cedar Soffit panels, Cedar Siding, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements.

.3 Shop Drawings:
- .1 Submit drawings in accordance with Section 01 11 15 General Instructions.
- .2 Indicate details of construction, profiles, jointing, fastening and other related details.
- .3 Indicate materials, thicknesses, finishes and hardware.

.4 Samples:
- .1 Submit for review and acceptance of each unit.
- .2 Samples will be returned for inclusion into work.

.5 Certifications: submit certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.

.6 Test and Evaluation Reports: submit certified test reports for composite wood from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

.1 Lumber by grade stamp of agency certified by Canadian Lumber Standards Accreditation Board (CLSAB).

.2 Cedar panels to NLGA standards.

.3 Wood fire rated frames and panels: listed and labelled by an organization accredited by Standards Council of Canada to CAN4-S104 and CAN/ULC-S105.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 11 15 – General Instructions 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 wood products from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section

.5 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 11 15- General Instructions.

2.0 PRODUCTS

2.1 MATERIALS

.1 Softwood lumber: S4S, moisture content 19% or less in accordance with following standards:
- .1 CSA O141.
- .2 NLGA Standard Grading Rules for Canadian Lumber
- .3 AWMAC custom or premium grade, where noted, moisture content as specified.
- .4 Machine stress-rated lumber is acceptable.

.2 Hardwood lumber: moisture content 10% or less in accordance:
- .1 AWMAC custom grade, moisture content as specified.

.3 Panel Material: Urea-formaldehyde free
- .1 Recycled content: provide information indicating recycled content on a % (Post-Consumer + ½ Post-Industrial)
- .2 FSC certified.
- .3 Douglas fir plywood (DFP): to CSA O121, standard construction. 6.1.5 and 6.2.5 where both sides exposed to view.
- .4 Hardwood plywood: to ANSI/HPVA HP-1.

.4 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 species except as indicated.
.4 Framing and board lumber: in accordance with NBCC 2015 Subsection 9.3.2, except as follows:
.1 Wall studs: D-Fir species, NLGA No.2 grade or better.

2.2 ACCESSORIES

.1 Nails and staples: Stainless steel for all exterior work and interior area.

.2 Wood screws: plain, type and size to suit application.

.3 Splines: wood

.4 Adhesive and Sealants: in accordance with Section 07 92 00 - Joint Sealants.

2.3 WOOD PRESERVATIVE

.1 Surface-applied wood preservative: clear, coloured, or copper napthenate or 5% pentachlorophenol solution, water repellent preservative.

.2 Pentachlorophenol use is restricted to building components that are in contact with concrete and subject to decay or insect attack only. Where used, pentacholophenol-treated wood must be covered with two coats of an appropriate sealer.

.3 Structures built with wood treated with pentachlorophenol and inorganic arsenicals must not be used for storing food nor should the wood come in contact with drinking water.

3.0 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

.1 Do finish carpentry to AWS Custom Grade.

.2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects.

.3 Form joints to conceal shrinkage.

3.3 CONSTRUCTION

.1 Fastening:
.1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.

.2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.

.3 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round smooth cut hole and plug with wood plug to match material being secured.

.4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 11 15 – General Instructions.

.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 11 15 – General Instructions.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 11 15 – General Instructions.

3.5 PROTECTION

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

.2 Repair damage to adjacent materials caused by finish carpentry installation.

END OF SECTION 06 20 00

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

.1 Section 03 03 30 – Period Concrete Repairs.

.2 Section 07 62 00 – Sheet Metal Flashing and Trim.

### 1.2 REFERENCES

.1 ASTM International Inc.

.1 ASTM D 6164- 05, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 37-GP-56M- 80b (A1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

### 1.3 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with waterproofing contractor's representative and Departmental Representative in accordance with Section 01 11 55 – General Instructions 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.

### 1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 55 – General Instructions.

.2 Product Data:

.1 Provide for review by Departmental Representative prior to commencing work, two copies of most recent technical waterproofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements for: Primers.

.3 Provide shop drawings and indicate:

.1 Flashing, control joints, details.

.4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

.6 Manufacturer's field report: in accordance with Section 01 11 55 – General Instructions.

### 1.5 QUALITY ASSURANCE

.1 For each type of work, obtain primary materials from single manufacturer, which has produced that type of product successfully for not less than 10 Years. Provide ancillary materials only as recommended by manufacturer of membrane materials for use with roofing system specified.

.2 Installer shall be approved by the manufacturer of the materials and shall be experienced in the application of the materials and shall supply job references to show similar installations in satisfactory waterproof condition at least 5 years of age. Submit project reference and relevant experience as requested by Departmental Representative.

.3 Mock-ups
- .1 Construct mock-up in accordance with Section 01 11 15 - General Instructions.
- .2 Mock-up may be part of finished work if acceptable to Departmental Representative.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Provide and maintain dry, off-ground weatherproof storage.

.2 Store rolls of membrane in upright position.

.3 Remove only in quantities required for same day use.

.4 Handle waterproofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.

.5 Store and manage hazardous materials in accordance with Section 01 35 33 - Health and Safety Requirements

.

.6 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 11 55 - General Instructions.

1.7 SITE CONDITIONS

.1 Ambient Conditions in accordance with manufacturer’s requirements.

1.8 MANUFACTURER’S REPRESENTATIVE

.1 At the request of the Departmental Representative, the Manufacturer’s representative is to visit the site and provide in writing to the Departmental Representative a report of their observations noted. All cost for engagement will be paid by the Contractor.

.2 Contractor to permit and facilitate access to the site at all times for the above-mentioned Manufacturer’s representative.

1.9 FIELD QUALITY CONTROL

.1 The waterproofing contractor is responsible to notify the manufacturer at commencement of waterproofing installation.

.2 Manufacturer’s representative to provide periodic inspections during roofing applications.

.3 Inspection of completed base sheet is mandatory.

.4 The waterproofing contractor is required to notify the manufacturer at the base sheet stage of application and is not to proceed with application of cap sheet until base sheet application has been approved by manufacturer in writing.

.5 Manufacturer is to be notified upon completion of the waterproofing and will provide final inspection before the warranty is issued.

.6 Deficiencies apparent upon substantial completion inspection must be corrected to the satisfaction of the manufacturer prior to the warranty being issued.

.7 Contractor to provide at least 1 weeks' notice to the Departmental Representative for field review prior to covering each layer of water proofing component and backfill Contractor's photo record may be accepted only upon approval by Departmental Representative. Any delay in notifying for field review and hence installed material needs to be uninstalled for review will be solely be the responsibility of the Contractor.

1.10 WARRANTY

.1 The product manufacturer shall issue a written and signed document in the name of the Departmental Representative, certifying the product will meet all the physical characteristic published by the manufacturer, for a period of 10 years, starting from the date of completion of installation of membranes. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

2.0 PRODUCTS

2.1 MEMBRANE

.1 Base and Cap sheets: to CGSB 37-GP-56M polyester fibres to ASTM D6164 as follows:
- .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, polyester reinforcement, having nominal weight of 180 g/m2.
- .2 Type 2, fully adhered.
- .3 Class C plain surfaced for base sheet.
- .4 Class A granular surface for cap sheet.
- .5 Grade 2 heavy duty service.
- .6 Top and bottom surfaces: fusible film.
- .7 Thickness: 3.0 mm.
- .8 Acceptable products:
  - .1 Base Sheet – Colphene Flam 180.
  - .2 Cap Sheet – Sopralene Flam 180 GR.

.2 Liquid applied PMMA membrane fully reinforced with proprietary fleece for water proofing transition: Acceptable manufacturers: Soprema's Alsan RS230 or Siplat's Parapro 123.

2.2 PRIMER FOR HEAT WELDED MEMBRANES

.1 A blend of elastomeric bitumen, volatile solvents and adhesive enhancing additives used to prime concrete or metal substrates to enhance the adhesion of torch-applied waterproofing membranes.

2.3 ACCESSORIES

.1 Waterproofing Mastic:
- .1 Black, solvent-based mastic containing SBS modified bitumen, fibres and mineral fillers.

.2 Insulation Adhesive:
- .1 Water-based single component rubberised liquid coating used as insulation adhesive and crack filler. For applications at temperatures above 2°C only.

.3 Protection Board:
- .1 A semi-rigid protection board composed of a mineral fortified asphaltic core formed between two saturated fibreglass felts.
- .3 Characteristics:
  - .1 Thickness: 3mm
  - .2 Board Size: Width: 1.22m Length: 1.52m

.4 Termination Bar:
- .1 Hexagonal Stainless Steel plate and Stainless Steel fasteners for outboard waterproofing. Standard of Acceptance to meet Factory Mutual.

.5 Drainage Layer:

.1 To be double dimpled sheeting with integral geo-textile made of high density polyethylene. Filter mat to be polyethylene. Compressive strength of approximately 90 kg/m2. Drainage capacity of approximately 72 l/min-m. Resistance to root penetration and rotproof.

## 3.0 EXECUTION

### 3.1 EXAMINATION AND PREPARATION OF SURFACES

.1 Surface examination and preparation must be completed in conformance with manufacturer's recommendations.

.2 Before waterproofing work begins, the Departmental Representative and the contractor will inspect and approve substrate condition and ensure that related work has been properly executed. If necessary, a non-conformity notice will be issued to the contractor so that required corrections can be made. The start of the membrane application will mean that substrate conditions are acceptable for work completion.

.3 Before commencing work, all surfaces must be smooth, dry, clean and free of ice and debris as per manufacturer's recommendations.

.4 No materials will be installed during rain or snowfall.

.5 Concrete is existing and an adhesion test is required before membrane application.

.6 Verify the compatibility of all membrane components with curing compounds, coatings or other materials which are already installed on the surfaces to be treated.

.7 Any cracks over 3 mm wide should be reported to the Departmental Representative. After review, the crack should be filled in with waterproofing mastic. A 150 mm (6 inches) wide strip of membrane should be installed, centered over the crack.

### 3.2 METHOD OF EXECUTION

.1 Work shall be performed on a continuous basis as surface and weather conditions allow.

.2 Adjoining surfaces shall be protected against any damage that could result from the waterproofing installation.

### 3.3 EQUIPMENT

.1 Maintain all equipment and tools in good working order.

### 3.4 PRIMER APPLICATION

.1 Surface where heat-welded membrane is applied shall receive an asphalt primer coating at the rate of 0.15 to 0.20 l/m2. Application rate may vary depending on surface condition.

### 3.5 WATERPROOFING MEMBRANE INSTALLATION

.1 To begin application, align the first roll of membrane to a previously drawn chalk line.

.2 All inside and outside corners must be pre-stripped with a 300 mm (12 in.) wide strip of membrane centered over the corner. This membrane must be installed in direct contact with the substrate not leaving any voids under the membrane strip. Outside corners should be double-lapped.

.3 Weld the membrane using a propane gas torch.

.4 Subsequent rolls must be installed in the same manner and should be aligned with the preceding roll with a side lap of at least 75 mm. End laps must be overlapped at least 100 mm.

.5 Holes and tears in the membrane must be repaired with the appropriate membrane material. The repair must exceed the affected surface area by at least 100 mm.

.6 Prior to backfilling, it is recommended to protect waterproofing system with protection boards. Backfilling should commence immediately after installation of protection boards.

.7 The uppermost edge of the membrane is to be mechanically fastened to the concrete substrate using termination bars. The termination bar should surpass the top edge of the membrane.

.8 Apply mastic on the top edge of termination bar to prevent water accumulation and infiltration.

.9 Any waterproofing membrane left exposed after backfilling shall be protected from ultra violet and mechanical damages.

3.6 DRAINAGE BOARD INSTALLATION

.1 Using a torch, melt the plastic film on the surface to cover.

.2 Adhere the drainage panels directly on the exposed bituminous sticky surface by applying a uniform pressure on the entire surface.

.3 Backfill as soon as possible after protection board installation within 72 hours maximum.

3.7 FIELD QUALITY CONTROL

.1 Inspection and testing of waterproofing systems and application will be carried out by testing laboratory designated by Departmental Representative and paid for by the Contractor.

.2 Field Review will be carried out on a daily basis during the entire roof installation procedure.

.3 Written "Daily" inspection reports to be distributed to Departmental Representative.

3.8 DRAINAGE SYSTEM INSTALLATION COORDINATION

.1 Contractor to be aware of the installation of sub-soil drainage in the vicinity of the waterproofing work.

.2 Any implication in schedule and cost due to the drainage work will be borne by the Contractor.

3.9 CLEANING

.1 Remove bituminous markings from finished surfaces.

.2 Repair or replace defaced or disfigured finishes caused by work of this section.

END OF SECTION 07 13 52

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

.1 Section 03 03 30 – Period Concrete Repairs.

.2 Section 03 03 31 – Period Concrete Slab-Wall Sections Repair / Replacement.

.3 Section 04 03 07 – Period Masonry Repointing.

.4 Section 07 62 00 – Sheet Metal Flashing and Trim.

.5 Section 07 92 00 – Joint Sealant.

### 1.2 REFERENCES

.1 ASTM International Inc.
- .1 ASTM C957/C957M-15, Standard Specification for Cold Fluid-Applied Polyurethane Elastomeric Coating Systems Used in Roofing, Dampproofing and Waterproofing.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 37.58-M86, Primer, Unfilled, for Polyurethane Elastomeric Coating Systems for Roofing, Dampproofing and Waterproofing.
- .2 United Fibre Cloth Membrane for Roofing.

.3 Canadian Standards Association (CSA International)
- .1 CSA A123.21, Standard Test Method for the Dynamic Wind Uplift Resistance of Spray Applied Membrane Roofing Systems.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets

.5 Roofing Contractors Association of British Columbia
- .1 RCABC Roofing Practices Manual.

### 1.3 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with roofing contractor's representative, Departmental Representative, and Architect in accordance with Section 01 11 15 – General Instructions to:
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordination with other building sub-trades.
- .4 Review manufacturer's installation instructions and warranty requirements.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 15 – General Instructions.

.2 Product Data.
- .1 Submit two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 33 – Health and Safety Requirements, and indicate VOC content for:
  1. Cleaners.
  2. Primers.

3. Polyurethanes.
4. Acrylic/Epoxies.
5. Sealers.

.3 Shop Drawings.
.1 Submit shop drawings in accordance with Section 01 11 15 – General Instructions.
.2 Indicate slopes, flashing, control joints details.

.4 Manufacturer's Certificate: submit certification that products meet or exceed specified requirements.

.5 Test and Evaluation Reports: submit laboratory test reports certifying compliance of polyurethane coatings, membrane, and granular textured top coats with specification requirements.

.6 Manufacturer's Installation Instructions: submit two copies of instructions including special precautions required for sequencing the installation.

1.5 QUALITY ASSURANCE

.1 Installer qualifications: company or person specializing in application of polyurethane elastomeric coating roofing systems with a minimum of 10 years' documented experience approved by manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 11 15 – General Instructions.

.2 Storage and Handling Requirements:
.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of polyurethane coatings, sealing compounds, primers and caulking materials.
.2 Provide and maintain dry, off-ground weatherproof storage
.3 Store rolls of membrane in upright position. Store membrane rolls with salvage edge up
.4 Remove only in quantities required for same day use.
.5 Place plywood runways over completed Work to enable movement of material and other traffic.
.6 Store sealants at +5 °C minimum.

1.7 FIELD CONDITIONS

.1 Ambient Conditions
.1 Do not install roofing when ambient temperature is below 10 degrees C for spray application or if rain is anticipated within 4 hours of application.
.2 Minimum temperature for solvent-based adhesive is -5 °C.

.2 Install roofing on dry deck, free of snow and ice, use only materials between 10 and 21 degrees C and apply only during weather that will not introduce moisture into roofing system.

1.8 WARRANTY

.1 For Work of this Section 07 14 16 - Cold Fluid-Applied Waterproofing– Polyurethane Elastomeric Coating System Roofing, warranty period is extended to 60 months.

2.0 PRODUCTS

2.1 PERFORMANCE CRITERIA

.1 Compatibility between components of roofing system is essential. Provide written declaration to Architect stating that materials and components, as assembled in system, meet this requirement.

.2 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 DECK CLEANER

.1 Concrete Cleaner: to CAN/CGSB 1.162-M90; ASTM D4258.
- .1 Unitile CCL Cleaner or approved equivalent.

2.3 DECK SEALER

.1 Concrete Sealer: to CAN/CGSB 25.20-95; ASTM C1315.
- .1 Unitile Sealer or approved equivalent.

2.4 COLD FLUID-APPLIED WATERPROOFING

.1 4 coat system of Elastuff 101, 25 year system, or approved equivalent.
- .1 Airless spray equipment applied
- .2 Thickness: 325 microns.
- .3 Solids by Weight: 82% ASTM D2369
- .4 Solids by Volume: 80% ASTM D2697
- .5 Flash Point: 24oC ASTM D2378
- .6 Dry Time to Walk On: 30 minutes to touch; 6 to 8 hours @ 21°C, 50 % R.H.
- .7 Tensile Strength: 6895 kN/m2
- .8 Elongation: 500% ASTM D412
- .9 Tear Strength: 2.2 kg per mm ASTM D1004
- .10 Hardness: 65-70 Shore A
- .11 Abrasion Resistance: Less than 35 mg weight loss using CS-17 abrasive wheels and 1000g. weights after 1000 cycles on Taber Abraser ASTM D4060
- .12 Low Temperature Flexibility: Passes 180° flex over 3 mandrel at -22 °C, Federal Test Method No. 141a-6221
- .13 Low Temperature Impact Resistance: No surface cracks or breaks when impacted with 130 g., 35 mm steel ball dropped from height of 1500 mm @ -25 °C
- .14 Temperature Limits for Normal Service Conditions: -34 °C to 93 °C
- .15 Fire Resistance: UL-790 Class "A"

2.5 MEMBRANE

.1 United Fibre Cloth: to ASTM D3776, D3786, D5733, D5535 or approved equivalent.
- .1 Prefabricated sheet, composite reinforcement, having nominal weight of 0.136 kg/m².
  1. Strain energy (longitudinal/transversal): 0.234 kN/m / 0.350 kN/m.

2.6 ACRYLIC/EPOXY EMULSION COATING- RHINO TOP or approved equivalent

.1 Solids by Weight: 52% ASTM D2369

.2 Solids by Volume: 38% ASTM D2697

.3 Weight per Litre: 0.8 kg

.4 Flash Point: 93oC ASTM D2378

.5 Dry Time:30 minutes to touch; 1 to 2 hours for recoat @ 24 °C, 50 % R.H. ASTM D1640

.6 Cure Time: 48 hours @ 24 °C, 50 % R.H. ASTM D1640

.7 Gloss: 2.5 (60 o Gardner) ASTM D523

.8 Hardness: 3H pencil ASTM D3363

.9 Temperature Limits for Normal Service Conditions: -34 °C to 66 °C

.10 Colour and Surface Characteristics: Black; B-12Y (Cloverdale Paint Inc.); Rhinotop

.11 Textured; Accent Base 4L

2.7 WATER REPELLENT SILANE SEALER

.1 Protectosil BHN, Evonik Industries or approved equivalent
- .1 Colour: white
- .2 Active Substance: alkyltrialkoxysilane
- .3 Active Content: 100%
- .4 Solvent: none
- .5 Density: 0.87 kg/l
- .6 VOC: 390 g/l

3.0 EXECUTION

3.1 VERIFICATION OF CONDITIONS

.1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and Roofing Contractors Association of British Columbia (RCABC) Roofing Practices Manual.

.2 Do not install roofing materials during rain or snowfall or temperatures below 10 °C for time period specified by Manufacturer.

3.2 EXAMINATION AND PREPARATION OF ROOF DECKS

.1 Verification of Conditions:

.2 All existing roofing is to be removed to bare concrete surfaces and concrete repaired as specified in Section 03 03 30 – Period Concrete Repairs, and other related concrete repair specification sections.

.3 Remove all remants of tar-like coating or vapour retarder over the surface of the roof slab to ensure clean surface for new roofing membrane system. The previous roofing membrane has been removed by others by grinding methods along the perimter of the slab and over steel beams, however, remnants exist on the roof slab surface between steel beams.

.4 Fill in minor spalls and areas of exposed aggregate over top surface of concrete roof slab surface with approved concrete repair products to ensure surface is sufficiently smooth for the new waterproofing membrane system, in accordance with roofing membrane manufacturer instructions.

.5 Ensure review of concrete slab edge treatment at downward slope prior to application of deck sealer.

.6 Inspect with Departmental Representative conditions including construction joints, roof drains, chimneys, and ventilation outlets to determine readiness to proceed.

.7 Evaluation and Assessment:
- .1 Prior to beginning of work ensure:

1. Decks are firm, straight, smooth, dry, and free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
2. Concrete at areas of repairs has sufficiently cured- minimum 28 days.

3.3 PROTECTION OF IN-PLACE CONDITIONS

.1 Cover walls, walks, sloped roofs and adjacent work where materials hoisted or used.

.2 Use warning signs and barriers. Maintain in good order until completion of the Work.

.3 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

3.4 DECK CLEANER

.1 Concrete Cleaner
- .1 Etch or roughen concrete surface prior to application.
- .2 Clean surface with non-acidic cleaning agent.

3.5 DECK SEALER

.1 Ensure concrete slab surface is grinded sufficiently even and is clean for new membrane application. Apply deck sealer to concrete roofing substrate at the rate recommended by manufacturer.

3.6 VAPOUR RETARDER (CONCRETE DECK)

.1 Install base coat application as vapour retarder membrane.

3.7 COLD FLUID-APPLIED BASE COAT APPLICATION

.1 Base coat Application:
- .1 Etch/roughen concrete surface prior to application of base coat
- .2 Clean surface of concrete with non-acidic cleaning agent
- .3 Seal surface with acrylic concrete sealer
- .4 Apply base coat of high solids, moisture-catalyzed, single-component polyurethane coating system with airless spray equipment as per manufacturer's recommendations
- .5 Embed Fibre Cloth while base coat is wet
- .6 Application to be free of blisters, wrinkles and fishmouths.
- .7 Apply second coat of polyurethane coating
- .8 Apply first coat of Finish (water-based acrylic coating that incorporates an epoxy additive) to provide a fine uniform non-skid finish as per manufacturer's recommendations. Application to start from north to south.
- .9 Apply final coat of Finish same as first coat as per manufacturer's recommendations and starting from east working west
- .10 Repeat finish coats to suit 25-year service life manufacturer specifications, for membrane.

.2 Flashings:
- .1 Do work in accordance with manufacturer's recommendations and Section 07 62 00 - Sheet Metal Flashing and Trim.

.3 Roof Penetrations:
- .1 Apply and seal membrane to roof drain pans, vent stack covers, and other roof penetration flashings in accordance with manufacturer's recommendations and details.

3.8 WATER REPELLENT SILANE SEALER

.1 Clear penetrating breathable VOC compliant silane treatment that penetrates into the concrete and chemically bonds with silica to form a permanent attachment of the water repellent molecule.

.2 Do work in accordance with manufacturer's recommendations. Ensure acceptable climatic conditions prior to application.

3.9 FIELD QUALITY CONTROL

.1 Inspections and testing:

.1 Inspection and testing of roofing application and membrane thickness will be carried out by testing laboratory approved by Departmental Representative and paid for by the Contractor.

.2 Repair and replace defaced and disfigured finishes caused by work of this section.

.3 Ensure review by Departmental Representative during each stage of membrane application.

3.10 CLEANING

.1 Clean off drips and smears of polyurethane and acrylic/epoxy material immediately.

.2 Remove polyurethane and acrylic/epoxy markings from finished surfaces.

.3 Finished surfaces soiled by work of this section: clean in accordance with manufacturer’s written instructions.

.4 Construction Waste Management.

.1 Separate waste materials for reuse and recycling in accordance with Section 01 11 55 – General Instructions.

1. Place materials defined as hazardous or toxic in designated containers.
2. Clearly label location of salvaged material's storage areas and provide barriers and security devices.
3. Ensure emptied containers are sealed and stored safely.
4. Dispose of bituminous material from selective demolition at official hazardous material collections site as reviewed by Departmental Representative.
5. Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.
6. Dispose of unused sealant material at official hazardous material collections site approved by Departmental Representative.
7. Dispose of unused polyurethane and acrylic/epoxy material at official hazardous material collections site approved by Departmental

3.11 PROTECTION

.1 Protect roof from traffic and damage. Comply with precautions deemed necessary by Departmental Representative.

.2 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

END OF SECTION 07 14 16

## 1.0 GENERAL

### 1.1 SUMMARY

.1 Medium Traffic Crack bridging Waterproofing and Pedestrian/maintenance traffic coating for interior and exterior elevated slabs.

### 1.2 RELATED SECTIONS

.1 Section 03 03 31 – Period Concrete Roof Slab-Wall Section Repair/Replacement

### 1.3 EXTENT OF WATERPROOFING

.1 To the requirements of BCA Section F1.4 (Vol .1) and Section 3.8.1.3 (Vol.2).

.2 The work and material used shall comply with the following standards:

.1 AS 4654.1&2: Waterproofing membrane systems for exterior use (Materials, Design and Installation);

.2 AS/NZS 4858 Wet Area Membranes

.3 AS3740-2010 Waterproofing of Wet Areas within Residential Buildings.

### 1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 55 – General Instructions.

.2 Product Data:

.1 Provide for review by Departmental Representative prior to commencing work, two copies of most recent technical waterproofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 33 - Health and Safety Requirements for: Primers.

.3 Provide shop drawings and indicate:

.1 Flashing, control joints, details.

.4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

.6 Manufacturer's field report: in accordance with Section 01 11 55 – General Instructions.

### 1.5 WARRANTY REQUIREMENT

.1 Provide manufacturer’s warranty against fading, cracking and flaking for a period of 10 years for traffic coating system.

### 1.6 QUALIFICATIONS

.1 Manufacturer Qualifications: Company with minimum 15 years of experience in manufacturing of specified products and systems.

.2 Manufacturer Qualifications: Company shall be ISO 9001:2000 Certified.

.3 Applicator Qualifications: Company with minimum of 5 years’ experience in application of specified products and systems on projects of similar size and scope.

1.7 FIELD SAMPLE

.1 Install at Project site or pre-selected area of building an area for field sample, as directed by Architect.

.2 Provide mock-up of at least 10 m2 to include surface profile and preparation, sealant joint, crack handling, flashing, and juncture and termination details and allow for evaluation of slip resistance and appearance.

.3 Apply material in strict accordance with manufacturer's written application instructions.

.4 Manufacturer's representative or designated representative will review technical aspects; surface preparation, and application.

.5 Field sample will be standard for judging workmanship on remainder of Project.

.6 Maintain field sample during construction for workmanship comparison.

.7 Do not alter, move, or destroy field sample until Work is completed and approved by Departmental Representative.

.8 Obtain Architect's written approval of field sample before start of material application, including approval of aesthetics, color, texture, and appearance.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

.2 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

.3 Store materials in unopened packaging in clean, dry area protected from sunlight.

1.9 PROJECT CONDITIONS

.1 Environmental Requirements:

.2 Do not apply above 35ºC or below 5 ºC or when temperatures are expected to fall below 5 ºC within 24 hours. Minimum application temperature is 5 degrees C and rising.

.3 Do not apply in rain or when rain is expected within 24 hours.

.4 The temperature of the substrate must be at least 3 ºC above the dew point during the application.

.5 The primer shall be applied when the ambient temperature is constant or falling, as this will decrease the risk of bubble formation due to expansion of air that is enclosed in the concrete.

2.0 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 A liquid applied, crack bridging traffic deck waterproofing system based on advanced polymeric materials. It consists of a primer, an elastomeric single pack polyurethane waterproofing membrane and a polyurethane combination wear and top coat. The system is skid resistant, UV and weather resistant.

.1 Performance Requirements:

| | |
|---|---|
| Colour | Grey |
| Supply Form | Liquid single pack |
| Specific Gravity: (approx.) | Membrane: 1.3-1.35 kg/L<br>Top Coat: 1.05 kg/L |
| Viscosity<br>ASTM D 2393 | Membrane: 4,000 to 9,000 cps.<br>Top Coat: 2,000 to 4,000 cps. |
| Non-volatiles,% (Solids by weight)<br>ASTM D 1259 | Membrane: 91<br>Top-Coat: 80 |
| Elongation, %<br>ASTM D 412 | Membrane: 690<br>Top Coat: 160 |
| Tensile Strength, MPa<br>ASTM D 412 | Membrane: 2<br>Top Coat: 13 |
| Shore A hardness<br>ASTM D 2240 | Membrane: 40<br>Top-Coat: 87 |
| Angle Tear Strength, Kg/cm<br>ASTM D1004 | Membrane:11 |
| VOC Content<br>(*SCAQMD Method 304-91)* | Membrane:135 g/L<br>Top-Coat: 180 g/L |
| Low Temperature Flexibility and Crack Bridging | Membrane: No cracking<br>Top-Coat: No cracking |
| Chemical Resistance Tensile Retention, ASTM C 957<br>Ethylene Glycol, Minimum 70 | Membrane: 88<br>Top-Coat: 92 |
| Chemical Resistance Tensile Retention, ASTM C 957<br>Mineral Spirits, Minimum 45 | Membrane: 47<br>Top-Coat: 60 |
| Chemical Resistance Tensile Retention, ASTM C 957<br>Water, Minimum 70 | Membrane: 96<br>Top Coat: 83 |

2.2 MATERIALS

.1 Acceptable Product:
Liquid-applied, moisture-curing, polyurethane, waterproofing, traffic-bearing, membrane deck coating system.

.2 Primer: Two-component, solvent free, epoxy primer and sealer.

.3 Membrane: One-component, moisture-curing polyurethane.

.4 Wear coat/top coat: One-component, aliphatic, moisture-curing polyurethane.

.5 Aggregate: Filler as required to establish the slip resistance.

.6 Cementitious patching materials: as recommended by manufacturer.

.7 Adhesion Promoter and Sealant Primer: as recommended by manufacturer

.8 Sealant: refer section 07 92 00 Joint Sealant

2.3 MIXING

.1 Mix material until colour is homogeneous.

.2 Color: Grey

## 3.0 EXECUTION

### 3.1 SURFACE PREPARATION

.1 Ensure the substrate has properly cured. Mechanically remove efflorescence before proceeding.

.2 Concrete is profile free, no ridges or troughs, etc.

.3 Concrete:
- .1 Minimum Compressive Strength: 25 MPa.
- .2 Minimum Bond Strength: 1.5 MPa
- .3 Cure for a minimum of 28 days or 80 percent of design strength.

.4 The substrates shall be free of laitance, loose or friable materials, debris and all contaminants by mechanical means preferably by captive shot blasting with hand held diamond grinders for edge work to achieve CSP 3 finish.

.5 Roughen or brush blast extremely smooth surfaces to ensure good mechanical adhesion.

.6 Bag up blowholes, especially on vertical surfaces, and carry out any necessary repairs in good time prior to priming. "Bagging up" should be carried out using a suitable epoxy putty.

.7 Repair voids and delaminated areas with MasterEmaco cementitious patching materials.

.8 To vertical surfaces, all form release agent must be removed prior to applying any primer.

.9 Ensure adequate masking off of adjacent areas has been completed and all detailing is in accordance with the project drawing.

### 3.2 APPLICATION – GENERAL

.1 Priming:
- .1 Mix in accordance with manufacturer's instructions. See individual datasheet for details.
- .2 Apply a thin coat of MasterEmaco 2525 to the prepared substrate by spreading with a squeegee at the minimum rate of 0.3 – 0.5 kg/m² and finished with a roller.
- .3 Porous substrates may require a second coat to ensure the surface is fully sealed.
- .4 Broadcast MasterTop Filler F5 at a rate of 0.8 – 1.0kg/m2 into the still-wet primer to produce a light, even cover. Allow to cure for at least 6hours before removing all excess sand with a stiff broom and vacuum.
- .5 Metal Surfaces:
- .6 Remove dust, debris, and other contaminants from vent, drain pipe, and post penetrations; reglets; and other metal surfaces. Clean surfaces to bright metal and prime with sealant primer.
- .7 Provide cant with deep joint sealant to eliminate 90-degree angles.
- .8 Detail cant with primer and base coat in accordance with manufacturer's instructions before application of deck coating system.

.2 Surface Pre-striping and Detailing:
- .1 Pre-stripe with primer 25 mm beyond surfaces that require detail work.
- .2 For non-moving joints and cracks less than 1.5 mm wide, apply 0.5 mm pre-striping of base coat over cured primer. Apply base coat to fill and overlap joint or crack 75 mm on each side. Feather the edges.

.3 Dynamic cracks and joints over 1.5 mm wide shall be routed to a minimum of 6 mm by 6 mm and cleaned. Install bond breaker tape to prevent adhesion to bottom of joint. Prime joint faces only with sealant primer and fill with sealant. Fill joints deeper than 6 mm with backer rod and deep joint sealant. For cracks, sealant shall be flush with adjacent surface. For expansion joints, sealant shall be slightly concave.

.4 Sealed joints 12 mm or less shall be coated over with deck coating system.

.5 Expansion joints exceeding 12 mm wide, including primary wide expansion-joint system, shall not be coated. Joints should be reflected through the coating and suitable protection provided as required by the architect.

.6 Where coating system will be terminated and no wall, joint, or other break exists, cut 6 mm by 6 mm keyway into concrete. Fill and coat keyway as application of base coat progresses.

.3 Membrane: MasterSeal M210

.1 Ensure surface for application is dry, free from dust, debris and all other contaminants which may inhibit adhesion between the membrane and concrete.

.2 Before mixing, pre-condition to a temperature of approximately 15 to 30 °C.

.3 Empty material in the bladder into the empty drum and mix with a mechanical drill and paddle at a low speed (approx. 300 rpm) for at least 2 minutes or until the colour is homogeneous.

.4 Pour onto the prepared substrate and spread with a notched trowel or spreader (rubber or steel) over the “tack free” primer at a coverage of 1.3-1.5kg/m2 to achieve a 0.8-1.0mm thick uniform grey membrane. Allow the membrane to cure for at least 6 hour or until tack free prior to subsequent topping.

.5 The curing time of the material is influenced by the ambient, material and substrate temperatures. At low temperatures, the chemical reactions are slowed down, this lengthens the pot-life, open time and curing times.

.6 High temperatures speed up the chemical reactions thus the time frames mentioned above are shortened accordingly. To fully cure, the material, substrate and application temperatures should not fall below the minimum.

.4 First Top-Coat: MasterSeal TC 465

.1 Ensure surface for application is dry, free from dust, debris and all other contaminants.

.2 Before mixing, pre-condition to a temperature of approximately 15 to 30 °C.

.3 Mix with a mechanical drill and paddle at a very low speed (ca. 300rpm) for at least 2 minutes. Scrape the sides and the bottom of the container several times to ensure complete mixing. Keep the mixer blades submerged in the coating to avoid introducing air bubbles.

.4 Apply the Top-coat over the Membrane with a squeegee at the minimum rate of 0.4 – 0.8 kg/m2.(WFT of 0.3 – 0.6mm)

.5 Fully broadcast with MasterTop Filler F10 into the still wet wear coat at the rate of 1.0 – 3.0 kg/m2. Allow to cure for at least 6 hours before removing all excess quartz with a stiff broom and vacuum. The achieved thickness shall be 0.8-1.5mm. This can be repeated to create thicker wear-coat layers if desired.

.5 Sealing Top-Coat: MasterSeal TC 465

.1 Ensure surface for application is dry, free from dust, debris and all other contaminants.

.2 Prior to application, MasterSeal TC 465 shall be preconditioned to a temperature of between 15 and 29 °C.

.3 Mix with a mechanical drill and paddle at a low speed (approx. 300 rpm) until product is homogeneous.

.4 Apply MasterSeal TC 465 polyurethane sealer over MasterSeal TC 465 wear-coat with a squeegee and followed by back rolling with 12-14mm nap roller at least 6hours later to

specified colour at a rate of 0.3 – 0.6 kg/m² (WFT of 0.2-0.5mm) in one coat to achieve a dry film thickness of 0.2 – 0.32mm.

.5 Allow to cure for at least 4 days before opening to traffic.

3.3 PROTECTION

.1 Pedestrian Traffic: Allow minimum curing time of 48 hours before pedestrian use.

.2 Vehicular Traffic: Allow minimum curing time of 72 hours before vehicular use.

.3 Extend curing time in cool-weather conditions.

.4 Protect system from damage during construction.

END OF SECTION 07 18 13

## 1.0 GENERAL

### 1.1 SUMMARY

.1 Work described in this section includes but is not limited to the following:

.1 All labour, materials, equipment and services necessary for the application of self-adhesive membrane for wall and metal roof assemblies.

### 1.2 REFERENCES

.1 ASTM D412 Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.

.2 CGSB 37-GP-9 Primer, Asphalt, Unfilled, for Asphalt Roofing, Damproofing and Waterproofing.

.3 CGSB 37-GP-15 Application of Asphalt Primer for Asphalt Roofing, Damproofing and Waterproofing.

.4 CGSB 37.29 Rubber-Asphalt Sealing Compound.

.5 CGSB 37-GP-56 Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

### 1.3 STORAGE AND HANDLING

.1 Provide and maintain dry, off-ground weatherproof storage.

.2 Store rolls of membrane in upright position.

.3 Remove only in quantities for same day use.

### 1.4 ENVIRONMENTAL REQUIREMENTS

.1 Do not install membrane system when ambient temperatures are at or below 5°C for 24 hours before application, and only during dry conditions.

.1 Use cold weather products where required by manufacturers guidelines.

.2 Minimum temperature for installation of primer is 5°C.

.1 Use cold weather products where required by manufacturer's guidelines.

.3 Install membrane on dry substrates, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into membrane system.

.4 If water penetrates through the membrane assembly due to inadequate protection including from interior sources, Contractor to cut and inspect damages, remove and replace all materials at his own cost, to eliminate all trace of water in the assembly.

.5 Do not allow membrane to remain exposed longer than 6 weeks.

### 1.5 QUALITY ASSURANCE

.1 Applicator: Company specializing in performing the work of this section with minimum two years documented experience. Provide list of previous projects and references upon request by the Departmental Representative.

## 2.0 PRODUCTS

### 2.1 MEMBRANE – BELOW METAL ROOFS AND FLASHINGS

.1 SBS modified bitumen self-adhesive membrane to meet the following minimum criteria:

.1 Membrane is to be 40 mils thick (including release film) and must have a release film to protect the adhesive surface.

.2 The membrane system must not show any signs of softening, flow or deterioration at temperatures 110 °C or below.

.3 Acceptable products:
- .1 Lastobond Shield HT, by Soprema
- .2 Blueskin PE 200 HT, by Monsey Bakor
- .3 Jiffy Seal Ice & Water Guard HT, by ProtectoWrap
- .4 Approved equivalent.

2.2 ACCESSORIES

.1 Primer: High tack SBS rubber based primer: to CGSB 37-GP-9Ma as recommended by manufacturer.

.2 Mastic sealant: As recommended by the manufacturer.

.3 Termination bars:
- .1 Minimum 18 Ga.for steel, 1/16" for aluminium
- .2 G200 galvanized steel or aluminium
- .3 1.5" (38 mm) wide x continuous lengths where possible.
- .4 Gum lip as required.

.4 Metal termination flashings: Refer to 07 62 00 Sheet Metal Flashings.

3.0 EXECUTION

3.1 EXAMINATION OF SURFACES

.1 Examine surfaces to have membrane installed and immediately inform Departmental Representative in writing of defects.

3.2 PREPARATION

.1 Protect adjacent surfaces not designated to receive membrane.

.2 Clean and prepare surfaces to receive membrane in accordance with manufacturer's recommendations. Surfaces are to be clean, dry and free of foreign matter.

.3 Ensure substrate is continuous. Provide solid backing as required. Unsupported membrane of 8 mm or greater is unacceptable. Fill voids as required or reinstall sheathing to meet maximum gap requirement.

.4 All sharp metal edges to be rounded or smoothed off to prevent puncture of membrane.

3.3 INSTALLATION

.1 Install membrane in accordance with manufacturer's instructions. Observe temperature and humidity limitations for application.

.2 Prime areas to receive membrane in accordance with manufacturer's recommendations. Primer must be dry prior to application of membrane. Primer is typically required on all surfaces including underlying layers of membrane. Membrane must be applied to primed area that same day.

.3 Roll out sheets. Discard wrinkled or bubbled membrane.

.4 Remove release paper layer. Roll out on substrate with a mechanical roller to encourage full contact bond. Use heat gun as required to achieve adequate continuous bond.

.5 Lap sides and ends in accordance with manufacturer's instructions and with the project details. All laps to be a minimum of 50 mm.

.6 All exposed laps except shingle laps to be masticed.

.7 Prestrip membrane (and sheathing paper) as required to ensure shingle fashion laps at tie-ins.

.8 Patch deficient areas with membrane extending 150 mm minimum in all direction from affected area. Seal top and sides of patch with mastic.

.9 Extend membrane onto items protruding to or penetrating assembly and seal termination with mastic.

.10 Ensure no membrane or membrane accessories extend to future exterior sealant locations or on finished surfaces. Clean any affected areas as required.

.11 Install termination bars (if required) onto membrane to continuously secure as indicated and directed by Departmental Representative. Fasten as required to provide continuous support of membrane and to eliminate bowing of termination bar (minimum 6" o/c).

.12 Seal leading edge with mastic at the end of each day's work.

3.4 METAL ROOF AREAS

.1 Review existing self adhered membrane conditions. All existing metal roof screw fastener holes to be sealed with 4" x 4" patch of new membrane complete with primer and mastic around edge of patch.

.2 Install new membrane at damaged locations of the existing membrane surface. Overlap onto undamaged membrane a minimum of 4" beyond damaged area. All patches require primer and mastic at free edges.

3.5 CLEAN UP AND PROTECTION

.1 Clean off drips and smears of bituminous material and primers off adjacent materials immediately.

.2 At end of each day's work, provide protection for completed work and materials out of storage.

END OF SECTION 07 27 13

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

.3 Section 06 10 11 – Rough Carpentry

### 1.2 DESCRIPTION

.1 The work in this section includes but is not limited to:

.1 Installation of 2-ply modified bitumen membrane, and associated roofing assembly components, at built-in gutters and penetrations as identified in the project drawings.

### 1.3 REFERENCES

.1 CGSB-37-GP-56M “Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing”.

.2 CGSB-37-GP-15M “Application of Asphalt Primer for Asphalt Roofing, Damproofing and Waterproofing”.

.3 Roofing Contractors’ Association of B.C. (RCABC), Roofing Practices Manual. Where the word “should” is used, it shall read as “shall”.

### 1.4 SAMPLES

.1 Submit samples in accordance with Section 01 11 15 - General Instructions.

### 1.5 QUALIFICATIONS

.1 The Contractor shall have completed similar work over a period of not less than five years.

.2 The Contractor is to be a member in good standing of the Roofing Contractors Association of British Columbia (RCABC).

### 1.6 QUALITY ASSURACE

.1 Installer Qualifications: Only competent, qualified tradesmen experienced with membranes shall execute the work of this section.

.2 For the work, obtain primary materials from a single manufacturer which has produced that type of product and system for not less than five years. All accessory materials shall be only as recommended or accepted by the primary manufacturer.

.3 Contractor’s Field Supervision and Crew Qualifications: Contractor must maintain full-time supervisor/foreman on the job during times roofing work is in progress. Supervisor must have roofing trade certification and have minimum five years’ experience in roofing work similar in nature and scope of specified roofing.

.4 Confirm that surfaces to which modified membrane is to be applied are in a condition suitable for this application. The commencement of roofing or flashing will imply unconditional acceptance of the surfaces to receive work of this section.

.5 Unless otherwise specified, comply with manufacturer’s latest printed instructions for materials and installation methods.

.6 Notify Departmental Representative in writing of any conflict between these specifications and manufacturers instructions. Departmental Representative will designate which document is to be followed.

1.7 PROTECTION

.1 A minimum of one 4A40BC fire extinguisher with current charge tags intact is required for each torch on the roof. The extinguisher at all times shall be within 6m of the worker using the torch. The worker shall be able to demonstrate verbal competence in the use of the extinguisher upon the request of the Departmental Representative. Be advised the project may be delayed or shut down for non-compliance.

.2 Do not store any roofing or equipment within 30 m of the building when the roofing crew is not on site.

.3 Maintain fire watch for one hour after each day's waterproofing operations cease.

1.8 WARRANTY

.1 Provide the Departmental Representative, through the Membrane Manufacturer a material guarantee stating this roofing system shall provide a waterproof surface for ten years after installation. The warranty shall cover both material and workmanship and shall not exclude random areas of ponding from coverage.

2.0 PRODUCTS

2.1 WATERPROOFING MEMBRANE

.1 Torched base sheet and base sheet stripping: high performance torch grade modified bitumen base ply designed for use in homogeneous multi-layer modified bitumen roof membrane systems that consists of a lightweight random fibrous glass mat coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen and a back surface coated with high performance modified asphalt adhesive layer specifically formulated for torch applications. Basis of design is Soprema Sopralene Flam 180, or approved equal.

.2 Cap sheet and cap sheet stripping: high performance modified bitumen finish ply designed for use in multi-layer modified bitumen roof membrane systems that consists of fiberglass scrim/polyester mat composite coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen and surfaced with ceramic granules. Basis of design is Soprema Sopralene Flam 250 GR, or approved equal.

.3 Liquid Membrane: liquid applied membrane consisting minimum two coats of polyurethane with bitumen resin encapsulating a layer of polyester fleece fabric to form a monolithic self flashing and self adhering reinforced membrane. Basis of design is Soprema Alsan RS230 Flash, or approved equal..

.4 Accessories:

.1 Primer: As per manufactures recommendations.

.2 Mastics: As per manufactures recommendations.

.3 Protection board in accordance with manufacturer requirements. Protection board to be installed over all wood to receive torch applied base sheet.

2.2 ROOFING ACCESSORIES

.1 Vent Stack Flashing: Spun Aluminum Plumbing Vent Flashing complete with vandleproof spun aluminum caps. To suit existing vent stack and cavity to be vented as manufactured by Menzies or acceptable products.

.2 Flexible Conduit Flashing: MEF-2A Liquid Tight Flexible Conduit Flashing to suit existing conduit diameter, as manufactured by Thaler or acceptable products.

.3 Recovery board, to be installed over insulation. Board to consist of two asphalt saturated glass mat reinforcement covering a mineral fortified asphaltic core. Fasten as per manufactures requirements. Bases of design is Soprema Sopraboard, or approved equal.

## 3.0 EXECUTION

### 3.1 WORKMANSHIP

.1 Do waterproofing work in accordance with applicable standard in Roofing Contractors' Association of B.C., Roofing Practices Manual.

.2 Do priming for asphalt waterproofing in accordance with CGSB-37-GP-15M "Application of Asphalt Primer for Asphalt Roofing, Damproofing and Waterproofing".

.3 Install waterproofing elements on clean dry substrate in accordance with the Manufacturer's written instructions.

.4 Waterproofing work shall be scheduled and performed in a sequence such that no component of the assembly is left unprotected when operations are interrupted.

### 3.2 PLANT AND EQUIPMENT

.1 Maintain all equipment and tools in good working order.

.2 Use torch type recommended by the manufacturer of the elastomeric asphalt membranes.

### 3.3 REMOVALS

.1 Remove all existing materials required to install new waterproofing as shown on the drawings including all existing metal flashings, insulation, ballast, membrane flashing, guardrails, down to the existing substrate.

.2 Sweep deck completely clean of loose debris just before commencing waterproofing work.

.3 Maintain waterproofing in a watertight condition. Ensure membrane is watertight at end of each shift.

### 3.4 PREPARATION OF PARAPETS

.1 Remove all existing membrane flashing and blocking. Install new blocking as detailed and raise existing curbs to minimum profiles as indicated on drawings.

### 3.5 EXAMINATION

.1 Examine roof deck insulation and other surfaces to receive roofing. These surfaces must be clean, smooth, flat, dry and free from defects or irregularities, which can jeopardize the quality of the work. No roofing work shall be performed on defective areas until suitable corrections have been made.

.2 Inspect and approve the installation of roof deck vapour barrier, roof deck insulation, roof deck protection board, sheet metalwork, wood nailers, metal framing members, roof specialties and accessories in connection with the roofing work.

.3 Prior to commencement of work ensure:
- .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris.
- .2 Curbs have been built and decks have been constructed in accordance with the drawings.
- .3 Plywood and lumber nailer plates have been installed to deck, walls, curbs and parapets as indicated.

3.6 PRIMER

.1 Install Primer to all substrates where membrane is to be applied at a rate in accordance with Manufacturer's instructions.

3.7 MEMBRANE

.1 Installation of base sheet:
- .1 Base sheet membrane shall be unrolled dry on deck for alignment.
- .2 Base sheet shall be unrolled starting from the low point of the roof. Base sheet shall be re-rolled from both ends. Care must be taken to ensure good alignment of the first roll (parallel with the edge of the roof).
- .3 Where the base sheet is being tied into an existing membrane the existing membrane is to be degranulated 400 mm back from termination.
- .4 Base sheet shall be torch welded in accordance with recommendations of the membrane manufacturer. During this application, under surfaces shall be melted, forming an asphalt bead that shall be pushed out in front of the base sheet.
- .5 Care must be taken not to burn the membrane.
- .6 Base sheet shall have side laps of 75 mm and end laps 150 mm.
- .7 Heat seal all joints and overlaps
- .8 Application shall provide a smooth surface without air pockets, wrinkles, fish-mouths or tears.
- .9 After installation of the base sheet, check all lap seams on the base sheet.

.2 Installation of base sheet stripping:
- .1 Primer coating must be dry before application of the base sheet stripping.
- .2 Base sheet stripping shall be laid in strips one meter wide to vertical surfaces, extending on to the flat surface of the roof a minimum of 100mm. Side laps shall be 75mm and shall be staggered a minimum of 100mm with the laps of the base sheet.
- .3 Base sheet stripping shall be torch welded directly on its support from bottom to top. Torch welding shall soften the underside of the base sheet without overheating, resulting in a uniform adhesion over the entire surface. When allowed by the support, the base sheet top edge shall be nailed on 300mm centers.
- .4 Provide 100mm x 200mm gussets at all inside and outside corners prior to cap sheet installations.

.3 Installation of cap sheet:
- .1 Once the base sheet and stripping has been applied and does not show any defects, the cap sheet can then be laid.
- .2 Cap sheet shall be unrolled starting from the low point on the roof. Cap sheet shall be re-rolled from both ends prior to torching. Care must be taken to ensure alignment of the first roll (parallel with the edge of the roof).
- .3 Cap sheet shall be torch welded in accordance with the recommendations of the membrane manufacturer, to the base sheet membrane. During this application, both

surfaces shall be simultaneously melted, forming an asphalt bead that shall be pushed out in front of the cap sheet.

.4 Care must be taken not to burn the membranes, and their respective reinforcements.
.5 Base and cap sheet seams shall be staggered a minimum of 300 mm.
.6 Cap sheet shall have side laps of 75 mm and end laps of 150 mm.
.7 Make sure the two membranes are properly welded, without air pockets, wrinkles, fish-mouths or tears.
.8 After installation of the cap sheet, check all lap seams on the cap sheet.
.9 During installation, care must be taken to avoid asphalt seepage greater than 5 mm at seam.

.4 Installation of cap sheet stripping:
.1 Cap sheet stripping shall be laid in strips one meter wide. Side laps shall be 75mm, and shall be staggered a minimum of 100mm from cap sheet laps in order to avoid excessive thickness.
.2 Using a chalk line, lay-out a straight line on the cap sheet surface, parallel to roof edge, 200mm inside roof, from base of wall.
.3 Cap sheet stripping shall be torch welded directly on its base sheet proceeding from bottom to top. Torching shall soften the two membranes and ensure a uniform weld.
.4 Cap sheet stripping shall be applied to extend onto on top of parapet walls 50mm (mini). Cut roll into required lengths and use width of roll (I meter) down length of roof, maintaining specified 75mm side laps.

3.8 SEALING

.1 Apply sealant where shown and/or required by common roofing practice.

.2 Perform sealing in compliance with the workmanship, preparation and application requirements specified.

.3 Install liquid applied PMMA membrane at all locations shown on the drawings.

3.9 FIELD QUALITY CONTROL

.1 The roofing contractor is responsible to notify manufacturer at commencement of roofing.
.2 Manufacturer will provide periodic inspections during roofing applications, as required.

.3 Inspection of completed base sheet is mandatory.

.4 The roofing contractor is required to notify manufacturer at the base sheet stage of application and is not to proceed with application of cap sheet until base sheet application has been approved by manufacturer in writing.

.5 Manufacturer is to be notified upon completion of the roofing and will provide final inspection before the guarantee is issued.

.6 Deficiencies apparent upon final inspection must be corrected to the satisfaction of manufacturer prior to the guarantee being issued.

3.10 FLOOD TESTING

.1 The Departmental Representative may require the membrane installations be flood tested, to the following requirements. The Contractor is to conduct all testing as part of the contract. The cost of any re-testing required due to failure of the first test on any specific installation will be carried by the Installer. Do not conceal any waterproofing until inspection and testing are completed to satisfaction of Departmental Representative.

.1 Temporarily plug drains and dam horizontal surface areas to be tested and flood with water to minimum depth of 50mm (2”).
.2 Maintain flooded depth for 24 hours.
.3 If leaks occur repair per the Manufacturer’s recommendations and re-test.
.4 Remove water at end of each test.

END OF SECTION 07 52 00

## 1.0 GENERAL

### 1.1 RELATED REQUIREMENTS

.1 Section 03 03 30 – Period Concrete Repairs.

.2 Section 03 03 31 – Period Concrete Slab-Wall Sections Repair / Replacement.

.3 Section 04 03 07 – Period Masonry Repointing.

.4 Section 07 14 16 – Cold Fluid-Applied Waterproofing Roofing.

.5 Section 07 92 00 – Joint Sealant.

### 1.2 REFERENCES

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

.1 ASTM A653/A653M 07e1, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.

.2 ASTM A792/A792M 06a, Standard Specification for Steel Sheet, 55% Aluminum Zinc Alloy Coated by the Hot Dip Process.

.3 ASTM B32-08(2014), Standard Specification for Solder Metal.

.2 Canadian Roofing Contractors Association (CRCA)

.1 Roofing Specifications Manual [1997].

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 51.32 M77, Sheathing, Membrane, Breather Type.

.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 SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 55 – General Instructions.

.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 33– Health and Safety Requirements.

.3 Samples:

.1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.

.2 Submit 200 mm length of flashing to verify profile and dimensions.

.4 Quality assurance submittals: submit following in accordance with Section 01 11 15 – General Instructions.

.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 Article 3.3 Field Quality Control.

1.4 QUALITY ASSURANCE

.1 Pre Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and Departmental Representative in accordance with Section 01 11 15 – General Instructions to:
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordination with other building sub-trades.
- .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 11 15 – General Instructions.

.2 Packaging Waste Management and Disposal.
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 55 – General Instructions.

2.0 PRODUCTS

2.1 SHEET METAL MATERIALS

.1 Zinc coated steel sheet: minimum 22ga thickness, commercial quality to ASTM A 792, with Z275 designation zinc coating, finish with PVDF factory applied coating to CGSB 93-GP-3m Class F29, color to match Cascadia Metal Parchment (SRI 58).

2.2 PREFINISHED SHEET METAL FLASHING

.1 Finish: factory applied coating to CAN/CGSB 93.1 supplemented and amended as follows:
- .1 Type 1.
- .2 Class F1S
- .3 Colour selected by Departmental Representative from manufacturer's standard range.
- .4 Specular gloss: 30 units.
- .5 Coating thickness: not less than 22 micrometres.
- .6 Outdoor exposure period: 2500 hours.
- .7 Exposure period for humidity resistance: 5000 hours.
- .8 Exposure period for salt spray resistance: 2500 hours.

.2 Thickness specified for prefinished steel sheet applies to base metal.

2.3 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: to CAN/CGSB 37.5.

.3 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.

.4 Sealants: in accordance with Section 07 92 00 – Joint Sealing.

.5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.

.6 Fasteners: heavy duty concrete screws of same material as sheet metal, to CSA B111, suitable for metal flashing application.

.7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.8 SPEC NOTE: Refer to ASTM B32, Annex (Mandatory Information) A1. Intended use and select alloy composition designation to suit intended use.

.9 Solder: to ASTM B32, alloy composition Sn 50 (50/50) type.

.10 Touch up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.

.2 Form pieces in 2400 mm maximum lengths.
- .1 Make allowance for expansion at joints.
- .2 All ends of each length to be S-locked joined and sealed.

.3 Hem exposed edges on underside 12 mm.
- .1 Mitre and seal corners with sealant.

.4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

.1 Form flashings, copings and fascias to profiles as indicated on Contract Drawings of 0.60 mm thick prefinished steel sheet.

2.6 REGLETS AND CAP FLASHINGS

.1 Form recessed reglets and metal cap flashing of 0.60 mm thick sheet metal to be built in concrete and masonry work for base flashings as detailed.
- .1 Provide slotted fixing holes and steel/plastic washer fasteners.
- .2 Cover face and ends with plastic tape.

3.0 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 Install sheet metal work in accordance with CRCA FL series details as detailed.

.2 Pre-drill fastener locations as indicated on Contract Drawings.

.3 Use concealed and watertight fastenings except where approved before installation.

.4 Provide underlay under sheet metal.
- .1 Secure in place and lap joints 100 mm.

.5 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
- .1 Flash joints using S lock forming tight fit over hook strips, as detailed.

.6 Lock end joints of all sections using S-Lock and caulk with sealant.

.7 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.

.8 Caulk flashing at reglet and cap flashing with sealant.

.9 Install pans, where shown around items projecting through roof membrane.

3.3 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.

3.4 CLEANING

.1 Proceed in accordance with Section 01 11 15 – General Instructions.

.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 07 62 00

## 1.0 GENERAL

### 1.1 RELATED REQUIREMENTS

.1 Section 03 03 30 – Period Concrete Repairs.

.2 Section 05 03 14 – Period Embedded Steel Beam Repair.

.3 Section 07 14 16 – Cold Fluid-Applied Waterproofing Roofing.

.4 Section 07 62 00 – Sheet Metal Flashing and Trim.

### 1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB 19.24 M90, Multi component, Chemical Curing Sealing Compound.

.2 Department of Justice Canada (Jus)
- .1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.4 Transport Canada (TC)
- .1 Transportation of Dangerous Goods Act, 1992 (TDGA).

### 1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 11 55 – General Instructions.

.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 samples in accordance with Section 01 11 55 – General Instructions.

.4 Submit duplicate samples of each type of material and colour.

.5 Cured samples of exposed sealants for each color where required to match adjacent material.

.6 Submit manufacturer's instructions in accordance with Section 01 11 55 – General Instructions.
- .1 Instructions to include installation instructions for each product used.

### 1.4 QUALITY ASSURANCE/MOCK-UP

.1 Construct mock up in accordance with Section 01 11 55 – General Instructions.

.2 Construct mock up to show location, size, shape and depth of joints complete with back up material, primer, caulking and sealant.

.3 Mock up will be used:
- .1 To judge workmanship, substrate preparation, operation of equipment and material application.

.4 Locate where directed.

.5 Allow 24 hours for inspection of mock up by Departmental Representative before proceeding with sealant work.

.6 When accepted, mock up will demonstrate minimum standard of quality required for this Work. Approved mock up may remain as part of finished Work.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, handle, store and protect materials in accordance with Section 01 11 55 – General Instructions.

.2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

.3 Packaging Waste Management.

.1 Separate waste materials for reuse and recycling in accordance with Section 01 11 55 – General Instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.6 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.7 Divert unused joint sealing material from landfill to official hazardous material collections site approved by Departmental Representative.

.8 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.

.9 Fold up metal banding, flatten, and place in designated area for recycling.

1.6 PROJECT CONDITIONS

.1 Environmental Limitations:

1 Do not proceed with installation of joint sealants under following conditions:

.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 5 °C.

.2 When joint substrates are wet.

.2 Joint Width Conditions:

.1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint Substrate Conditions:

.1 Do not proceed with installation of joint sealants until 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 Labour Canada.

.2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

2.0 PRODUCTS

2.1 SEALANT MATERIALS

.1 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior or are applied several months before occupancy to maximize offgas time.

.2 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Urethanes Two Part.

.1 Non Sag to CAN/CGSB 19.24, Type 2, Class B, colour light grey.

.2 Preformed Compressible and Non Compressible back up materials.

.1 Polyethylene, Urethane, Neoprene or Vinyl Foam.

.1 Extruded closed cell foam backer rod.

.2 Size: oversize 30 to 50 %.

.2 Bond Breaker Tape.

.1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 JOINT CLEANER

.1 Non corrosive and non staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

.2 Primer: as recommended by manufacturer.

3.0 EXECUTION

3.1 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

3.2 INSTALLATION

.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 Cleanup.

- .1 Clean adjacent surfaces immediately and leave Work neat and clean.
- .2 Remove excess and droppings, using recommended cleaners as work progresses.
- .3 Remove masking tape after initial set of sealant.

END OF SECTION 07 92 00

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

.1 Section 09 03 91.13 Period Exterior Painting

.2 Section 06 03 01.31 Period Wood Storage and Protection

### 1.2 REFERENCE STANDARDS

.1 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
- .1 Architectural Woodwork Standards Manual? Latest Edition - [8th Edition, 2003].

.2 Canadian Standards Association (CSA International)
- .1 CAN/CSA-O132.5-M1992(R1998), Stile and Rail Wood Doors.
- .2 CAN/CSA-O141-[05](R2014), Softwood Lumber.

.3 National Lumber Grading Authority (NLGA)
- .1 NLGA Standard Grading Rules for Canadian Lumber [2017].

### 1.3 DEFINITIONS

.1 Bolection moulding: a moulding on a panel that projects above the adjoining surfaces.

.2 Box locks: a surface-mounted lock with the mechanism in a rectangular metal or wood casing.

.3 Bead: a small, linear moulding with a round cross-section that ranges from quarter round to three quarter round.

.4 Sticking: a planed moulding with a groove or a rabbet that holds a panel or window pane in place.

.5 Batten door: a door formed of full height boards glued edge to edge with horizontal and vertical battens applied. A double batten door has battens on both sides.

.6 Ledged door: a door with horizontal boards (ledges) used as cleats to fasten the vertical boards.

.7 Haunched mortise and tenon: the tenon is narrower at the tip than the root.

.8 Run through: the tenon is allowed to run through the mortised member for wedging.

.9 Wedged: a wood wedge used in a dovetail-shaped mortise to secure a tenon.

.10 Draw-bore pin: a tapered wood peg used to fasten a mortise and tenon joint.

.11 Blind mortise: a mortise joint in which the tenon is entirely surrounded by wood.

.12 Stub tenon: a short tenon used in a closed mortise joint.

.13 Dowelled door: a wood door with rails and stiles fastened with dowels rather than tenons.

.14 Tongued: a projecting portion of a member, such as a tenon.

.15 Half-lapped: a lap joint in which a rectangular notch in the end of one wood member overlaps a corresponding rectangular notch in the end of another wood member.

.16 Stop chamfered: a corner chamfer that does not extend to the end of the timber or moulding; typically terminated with a small, triangular plane surface.

1.4 QUALITY ASSURANCE

.1 Mock-ups:
- .1 Prepare mock-ups of various repairs for inspection by Departmental Representative before proceeding with further Work.

.2 Mock-up:
- .1 Size: to approval of Departmental Representative.
- .2 Surfaces: ready for coatings but not treated with coatings unless asked for.
- .3 Install hardware.

.3 Notify Departmental Representative 96 hours in advance of required inspection.

.4 Approved mock-up becomes standard of acceptance for finished Work.

.5 Approval of mock up and approval of installation will occur at the same time.

.6 Obtain approval of Departmental Representative before installing approved mock-up.

.7 Approved mock-up will be incorporated in finished work.

1.5 QUALIFICATIONS

.1 Carry out repair and fabrication work using skilled tradesperson trained and experienced in fabrication and installation of wood doors.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Protect doors from scratches, handling marks and other damage.

2.0 PRODUCTS

2.1 MATERIALS

.1 Softwood lumber: to CAN/CSA-O141 and National Lumber Grades Authority (NLGA) requirements, with maximum moisture content of 16% for interior work 16% for exterior work.

.2 Hardwood lumber: to National Hardwood Lumber Association (NHLA) requirements, moisture content of maximum 16% for interior work 16% for exterior work.

.3 Fasteners: nails, wood screws, wood pegs, wood pins, wood glues.

.4 Hardware: Existing Hardware to be re-used where indicated. Where replacement hardware is indicated, it is to be custom fabricated to match existing similar original hardware on site. Refer to Section 09 03 61; 2.01 Materials, for hardware treatment.

2.2 FABRICATION

.1 Repair or Replace Doors or components thereof in-kind where identified in woodwork schedule. Replacement Work to match existing in quality, design, materials, unless otherwise indicated by Departmental Representative.

## 3.0 EXECUTION

### 3.1 PREPARATION

.1 Review scope of work identified on woodwork schedule with Departmental Representative.

.2 Photograph and label door and hardware elements

.3 Review with Departmental Representative intended approach for repairs or replacement of door or components where identified.

### 3.2 PROTECTION OF IN-PLACE CONDITIONS

.1 Protect adjacent surfaces from damage prior to undertaking removals, in-situ repairs and refinishing.

### 3.3 IN-SITU REPAIR AND REPAINTING

.1 Paint Removal

.1 Remove existing paint with tools in the following order:

.1 Wire brush
.2 Wire wool
.3 Wet and dry sandpaper
.4 Contractor may propose other methods for approval by Departmental Representative.

.2 Undertake minor repairs including:

.1 Fill of the surface voids.

.1 Fill surface voids with compounds formulated for wood.
.2 Apply patching compound. Build up surfaces.
.3 Slope built-up surfaces away from glazing.

.3 Re-painting and refinishing in accordance with Section 09 03 09.13 Period Exterior Painting.

.1 Keep moving parts and flexible components free from primer and paint.

### 3.4 REMOVAL OF DOOR & FRAME FOR REPAIR OR REPLACEMENT

.1 Selectively strip and remove, with care, adjacent components required to remove window door and frame.

.2 Protect door and components and transport to workshop.

### 3.5 SPLICING IN NEW MATERIAL REPAIR

.1 Material.

.1 Same wood species as existing parent wood component.
.2 Grain orientation to match existing parent wood component.

.2 Cut out damaged wood sections where indicated on Contract Drawings.

.3 Splice in new wood sections to match profile of existing wood section.

.4 Shop fit parts before connecting and gluing.

.5 Stile, rail and muntin joints: glue, plane and sand smooth.

3.6 DUTCHMAN REPAIRS

.1 Restore original profile and ensure proper fit of wood components:
- .1 Repair damage in sashes and frames with Dutchman repairs.
- .2 Employ Dutchman repairs only where wood is broken or missing.
- .3 Areas with minor wear of wood are acceptable for re-use.

.2 Material.
- .1 Same wood species as existing parent wood component.
- .2 Grain orientation to match existing parent wood component.

.3 Joints.
- .1 Ensure joints are tight and visible only on close inspection.
- .2 Exterior exposed joints: weather tight, bevelled for moisture drainage to exterior.

.4 Application.
- .1 Prepare damaged area of existing parent wood component for Dutchman repair.
- .2 Cut out damaged wood sections.
- .3 Splice Dutchman repair piece into parent wood component.
- .4 Shop fit parts before connecting and gluing.
- .5 Attach Dutchman repair piece to parent wood component only. Do not attach to adjacent wood component.
- .6 Clamp repair piece in place until adhesive has set. Protect repair piece and other wood components from pressure marks.
- .7 Avoid using surface fasteners.
- .8 Larger Dutchman repairs:
  - .1 Fasten repair piece to parent wood component with brass or stainless steel screws, size to suit.
  - .2 Countersink screw and fill hole with wood plug.
  - .3 Match grain orientation of wood plug to parent wood component.
- .9 Stile, rail and muntin joints glue, plane and sand smooth.

3.07 RE-PAINTING AND FINISHING

.1 Perform re-painting and finishing of wood windows in accordance with Section 09 03 91.13 Period Exterior Painting.

3.8 RE-INSTALLATION OF HARDWARE

.1 Reinstall hardware to operate smoothly.

.2 Lubricate hinges and moving parts with light machine oil.

3.9 INSTALLATION

.1 Install Door and components thereof to match installations on site to satisfaction of Departmental Representative.

.2 Install and adjust hardware for correct function.

3.10 ADJUSTING

.1 Re-adjust doors and hardware just prior to completion of the building to function freely and properly.

END OF SECTION 08 03 14

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

.1 Section 06 03 01.31 Period Wood Storage and Protection

.2 Section 09 03 91.13 Period Exterior Painting

### 1.2 REFERENCE STANDARDS

.1 America Architectural Manufacturers Association (AAMA) / Window and Door Manufacturers Association (WDMS) / Canadian Standards Association (CSA)
- .1 AAMA/WDMA/CSA 101/I.S.2/A440 - 11[R2016] - NAFS - North American Fenestration Standard/Specification for windows, doors, and skylights

.2 ASTM International
- .1 ASTM E 779-10, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
- .2 ASTM E 1186 - 17, Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
- .3 ASTM E 1827-11 (2017), Standard Test Methods for Determining Air tightness of Buildings Using an Orifice Blower Door.
- .4 ASTM E 2178 -13, Standard Test Method for Air Permeance of Building Materials.

.3 CSA Group
- .1 CAN/CSA-A440 -CAN/CSA-A440-00 (R2005) Windows.
- .2 CAN/CSA-A440.2-14/A440.3-14, Fenestration Energy Performance/Energy Performance of Windows and Other Fenestration Systems / User Guide to CSA A440.2-14, Fenestration Energy Performance

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

### 1.3 SEQUENCING

.1 Sequence work of this Section with adjacent concrete repair works as required.
- .1 Sequence work to suit scope of work specified.
- .2 Review Section 01 33 00 wood window repair schedule to verify scope with Departmental Representative.
- .3 Protect adjacent materials around the window.
- .4 Remove window hardware.
- .5 Leave wood pieces in good condition embedded in the concrete.
- .6 Remove and repair existing rotten wood sashes
- .7 Remove and repair window frame
- .8 Remove and repair or replace window sill.
- .9 Repaint wood.
- .10 Install restored, repaired and new window components in window opening.
- .11 Re-install restored hardware.
- .12 Restore affected exterior finishes, interior finishes, plaster and paint.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Shop Drawings.
- .1 Provide shop drawings, sketches of repairs upon request by Departmental Representative: in accordance with Submittal Procedures.

.2 Provide samples of wood components upon request by Departmental Representative. in accordance Submittal Procedures, and review the following component materials with the Departmental Representative where applicable based on the repair schedule.

- .1 Replacement wood:
  - .1 Sills
  - .2 Stiles and Rails
  - .3 Muntin bars
  - .4 Parting strips
  - .5 Brick molds
- .2 Replacement glazing.
- .3 Replacement Hardware.
  - .1 Stay bars.
  - .2 Locks.
  - .3 Latches.
  - .4 Ventilator fasteners.
  - .5 Handles.
  - .6 Hinges.
  - .7 Pivots.
  - .8 Closing bars.
  - .9 Glazing beads.
  - .10 Cam fasteners.
  - .11 Spring catches.
  - .12 Roto operator.
  - .13 Sill pulls.
  - .14 Weather bars.
  - .15 Water dams.
- .4 Weatherstripping: 150 mm long samples for each type of application:
- .5 Weatherseals.
- .6 Gaskets.
- .7 Backer rods.
- .8 Sealants.
- .9 Adhesives.
- .10 Patching compounds.
- .11 Epoxy.
- .12 Screws, bolts and fasteners.
- .13 Lubricants.
- .14 Glazing compound.
- .15 Component labels.

1.5 CLOSEOUT SUBMITTALS

.1 Record Documentation of all woodwork to the satisfaction of the Departmental Representative.

.2 Provide digital of photographic documentation before, during and after the wood window repairs, keyed to repair schedule.

1.6 QUALITY ASSURANCE

.1 Work of this Section: only undertaken by Contractor with minimum of 10 years of experience in conservation of historic wood window work and in traditional carpentry techniques required for repairing wood windows.

.2 Mock-ups:
.1 Construct mock-ups as requested for review by Departmental Representative.
.1 Undertake each initial step, from labelling, disassembly and surface preparation through repair and painting of mock-up
.2 When accepted, mock-up demonstrates minimum standard for this work.
.3 Mock-up may remain as part of finished work.

.2 Prepare a mock-up of a window repair and repainting at:
.1 A window at the Upper Battery Warrant Officer's Quarters
.2 Review the removal of the putty, glass and its re-installation.

1.7 DELIVERY, STORAGE AND HANDLING
.1 Storage and handling of dismantled components:
.1 Protect from weather.
.2 Ensure easy accessibility.
.3 Store together in logical groupings.
.4 Pad, support and stack sashes and frames. Prevent damage to components.
.5 Maintain component labels in good condition and securely attached to components until re-installation.

1.8 WARRANTY
.1 Extended Correction Period.
.1 For work of this Section 08 03 52 - Period Wood Window Repairing, Provide an extended warranty period of 24 months for all labours and materials.

2.0 PRODUCTS

2.1 MATERIALS
.1 Existing components.
.1 Glazing: Retain, restore and store existing glazing for re-installation.
.2 Hardware: Retain, restore and store existing hardware for re-installation.
.3 Sashes: Retain, restore and store existing for re-installation.
.4 Frame: Retain, restore and store existing frame for re-installation.

.2 New Wood components.
.1 Species, sizes and shapes to match existing. Confirm with Departmental Representative.

.3 Hardware: Existing to be restored and re-used where applicable based on the repair schedule.
.1 Stay bars.
.2 Locks.
.3 Latches.
.4 Ventilator fasteners.
.5 Handles.
.6 Hinges.
.7 Pivots.
.8 Closing bars.
.9 Glazing beads.
.10 Cam fasteners.
.11 Spring catches.
.12 Roto operator.
.13 Sill pulls.

.14 Weather bars.
.15 Water dams.

.4 Sash Balances: restore and re-use existing.
.1 Counterweight.
.2 Sash
.3 Spring.
.4 Spiral.
.5 Coiled tape.
.6 Filler.
.1 Consolidant to approval of Departmental Representative.
.7 Replacement Fasteners.
.1 Screws: to match existing heads and threading.
.2 Match existing profile, size and head.
.3 Stainless steel grade 316.
.8 New Fasteners.
.1 Nails: galvanized finishing nails, size to suit application.
.2 Screws for larger Dutchman repairs: brass or stainless steel, size to suit application.

2.3 ACCESSORIES

.1 Hardware: Retain, restore and store existing hardware for re-installation.
.1 Non-corroding glazing points.

.2 Adhesive.
.1 Two-part formulated for architectural woodwork in exterior locations.

.3 Component labels for:
.1 Wood components: cardboard tag with hole at one end, marked with required component information, and secured to component with stainless steel wire.
.2 Hardware components: cardboard tag, and secured to component with stainless steel wire.
.3 Glazing components: gasket paper and waterproof marker. Secured to component.

.4 Glazing compound: linseed oil-based glazing putty.

2.4 FABRICATION / REPAIR

.1 Existing Glazing Removal
.1 Remove existing glazing lights from ventilators and label.
.2 Remove existing glazing putty, paint and corrosion products from sash and frame
.3 Remove remnants of glazing putty
.4 Replace broken glazing lights where applicable to match existing.
.5 Replace glazing broken during removal procedures at contractor's own expense.

.2 Surface preparation: Remove paint products.
.1 Conduct surface preparation work in shop.

.3 Splicing in new material.
.1 Cut out damaged wood sections where indicated on Drawings.
.2 Splice in new wood sections to match profile of existing wood section.
.3 Shop fit parts before connecting and gluing.
.4 Connect and dress corners.
.5 Stile, rail and muntin joints: glue and plane smooth

.4 Glazing installation.

.1 Sand and clean rebates.

.2 Prime rebates with light coat of mix of equal parts of boiled linseed oil and turpentine. Allow to dry for 24 hours.
.3 Apply back putty to rebate.
.4 Bed glass firmly into position in rebate. Ensure it is evenly seated.
.5 Install glazing points.
.6 Neatly apply exterior putty bevel in line with edges of stiles and rails.
.7 Strike off excess putty.
.8 Allow putty to cure for minimum 3 weeks before painting.

.5 Replicate existing damaged hardware for replacements where applicable from the repair schedule. Refer to Section 09 03 91.13 Period Exterior Painting for hardware treatment.

2.5 SOURCE QUALITY CONTROL

.1 Make repair workshop accessible to Departmental Representative for inspection of work in progress.

3.0 EXECUTION

3.1 PREPARATION

.1 Photograph window sash, frame elements and hardware.

.2 Protect window frames with tarpaulins for duration of the Work.
.1 Protect from direct sun.
.2 Keep dry.

.3 Identify, label and photograph window sash and frame elements.
.1 Use same component designation as shown on Contract Drawings.
.1 Provide sufficient additional information: ensure component configuration and orientation is recorded on label.
.2 Record component label information on Contract Drawings.
.3 Labels: gasket paper marked with waterproof marker. Securely attach to component on hidden surface.
.4 Metal components: ensure required component information is on sheet brass tag. Secure tag to component with stainless steel wire.
.5 Glazing components: ensure required component information is marked on gasket paper with waterproof marker. Securely attach to component on hidden surface.
.6 Hardware: place component in sealable plastic bag. Ensure label visible in bag.

.4 Discuss with Departmental Representative intended approach for removal of window sash, frame and hardware.
.1 Obtain Departmental Representative's approval of approach for removal of window frame and hardware.

.5 Notify Departmental Representative before removing window sash, frame and hardware.
.1 Remove sashes, ventilators and frames from sub-frame, label components, carefully pack in crates and transport to shop for repairs.

3.2 PROTECTION OF IN-PLACE CONDITIONS

.1 Protect adjacent surfaces from damage prior to undertaking dismantling, in-situ repairs and refinishing.

.2 Window coverings and tracks: remove and store for re-installation.

3.3 IN-SITU RE-FINISHING

.1 Paint Removal

.1 Remove existing paint with tools in the following order:

.1 Wire brush

.2 Wire wool

.3 Wet and dry sandpaper

.4 Contractor may propose other methods for approval by Departmental Representative.

.2 Undertake minor repairs including:

.1 Fill of the surface voids.

.1 Fill surface voids with compounds formulated for wood.

.2 Apply patching compound. Build up surfaces.

.3 Slope built-up surfaces away from glazing.

.3 Re-painting and refinishing in accordance with Section 09 03 91.13 Period Exterior Painting

.1 Keep moving parts and flexible components free from primer and paint.

3.4 DISMANTLING EXISTING WINDOW SASHES

.1 General.

.1 Remove paint as required using appropriate techniques

.2 Avoid damaging materials and finishes adjacent to the windows being dismantled.

.3 Avoid damaging material and window components.

.4 Avoid marring, crushing or splitting components.

.5 Minimize risk of breakage: reinforce panes of glass with vinyl adhesive tape on both sides.

.6 Remove interior stop and parting bead.

.7 Remove lower or interior sash.

.8 Detach sash cords from sides of sash and pin (with a nail) or tie (in a knot) loose ends.

.9 Carefully remove parting bead set in a groove in the center of stile.

.10 Remove upper sash.

.11 Remove glazing stops and glass panes from sash/ventilators.

.12 Retain dismantled components for duration of the Work.

.13 Cover window openings as required.

.2 Label dismantled components, including hardware.

.1 Labels: gasket paper, marked with waterproof marker and securely attached to component on hidden surface.

.2 For smaller components such as hardware: place component in sealable plastic bag with label visible in bag.

.3 Storage and handling of dismantled components.

.1 Protect from weather.

.2 Ensure easy accessibility.

.3 Store together in logical groups.

.4 Pad, support and stack sashes. Prevent damage to sashes.

.4 Removal of hardware and screws.

.1 Clean screw heads.

.2 Apply penetrating oil to screw heads 24 hours in advance of removal.
.3 Use only screwdrivers that exactly fit screw heads.
.4 Retain and store for restoration removed hardware and screws.

.5 Components let into a groove or mortise, such as parting strips.
.1 Carefully and neatly cut adjacent paint using a sharp chisel or knife. Avoid tear out.

.6 Extraneous fasteners.
.1 Nails requiring removal: cut or pull nail through the back of component. Do not drive nail through face of component.
.2 Remove and discard extraneous fasteners.

.7 Removal of ventilators.
.1 Lift out ventilator from frame.
.2 Prepare, store and handle ventilators in accordance with Article [1.7] Delivery, Storage and Handling.

3.5 REMOVAL OF WINDOW FRAME

.1 Selectively strip and remove, with care, adjacent components required to remove window frame.
.1 Remove as much of the window assembly as possible prior to removal of window frame, such as:
.1 Exterior.
.1 Remove brick mouldings.
.2 Interior.
.1 Remove birch jamb extensions.
.2 Remove interior stops.
.3 Remove lower sashes.
.4 Remove parting strips.
.5 Remove upper sashes.
.6 Remove wood trim and stool components.
.7 Cut back plaster, mortar and masonry back-up around interior perimeter of window frame.
.8 Access shim space and remove shims

.2 Carefully remove window frame from window opening.

.3 Sub-frame to remain in place.

.4 Protect window and components and transport to off-site workshop.

.5 Prepare, store and handle frames in accordance with Article 1.7, Delivery, Storage and Handling above.

3.6 CONFIRMATION OF SEALANT LOCATIONS FOR RE-INSTALLATION

.1 Inside and outside perimeters of window frame.
.1 Confirm sealant locations for re-installation of window frame with Departmental Representative during window removal process.
.2 Obtain Departmental Representative's approval for sealant locations.

3.7 REPAIR OF WINDOW FRAME

.1 Decayed Sills will generally be replaced in-kind.

.2 Stabilize joints in window frame:
.1 Add wood screws and glue blocks at locations that will be hidden when window frame is re-installed.
.1 Allow for each window frame corner to require this work.

.3 Repair minor holes, checks and small pockets of decay using epoxy

3.8 SPLICING IN NEW MATERIAL

.1 Material.
.1 Same wood species as existing parent wood component.
.2 Grain orientation to match existing parent wood component.

.2 Cut out damaged wood sections.

.3 Splice in new wood sections to match profile of existing wood section.

.4 Shop fit parts before connecting and gluing.

.5 Stile, rail and muntin joints: glue, plane and sand smooth.

3.9 DUTCHMAN REPAIRS

.1 Restore original profile and ensure proper fit of wood components:
.1 Repair damage in sashes and frames with Dutchman repairs.
.2 Employ Dutchman repairs only where wood is broken or missing.
.3 Areas with minor wear of wood are acceptable for re-use.

.2 Material.
.1 Same wood species as existing parent wood component.
.2 Grain orientation to match existing parent wood component.

.3 Joints.
.1 Ensure joints are tight and visible only on close inspection.
.2 Exterior exposed joints: weather tight, bevelled for moisture drainage to exterior.

.4 Application.
.1 Prepare damaged area of existing parent wood component for Dutchman repair.
.2 Cut out damaged wood sections.
.3 Splice Dutchman repair piece into parent wood component.
.4 Shop fit parts before connecting and gluing.
.5 Attach Dutchman repair piece to parent wood component only. Do not attach to adjacent wood component.
.6 Clamp repair piece in place until adhesive has set. Protect repair piece and other wood components from pressure marks.
.7 Avoid using surface fasteners.
.8 Larger Dutchman repairs:
.1 Fasten repair piece to parent wood component with brass or stainless steel screws, size to suit.
.2 Countersink screw and fill hole with wood plug.
.3 Match grain orientation of wood plug to parent wood component.
.9 Stile, rail and muntin joints glue, plane and sand smooth.

3.10 REPAIR OF SASH

.1 Repair of Upper and Lower sash Stiles.
.1 Cut out existing kerf and groove where indicated on Contract Drawings.
.2 Splice-in new wood Dutchman repair as described in Article 3.9 above.

.3 Cut in new kerf and groove: minimum size to suit hardware and weather stripping.

.2 Repair of bottom rail of lower hung sash.
- .1 Cut out existing kerf where indicated on Contract Drawings.
- .2 Splice-in new wood Dutchman repair.
- .3 Cut in new kerf: minimum size to suit weather stripping.

.3 Repair of meeting rails of hung sashes.
- .1 Cut back damaged existing wood.
- .2 Splice-in new wood Dutchman repairs.

.4 Repair of interior wood stops.
- .1 Reduce width of existing wood stops by 6 mm.
- .2 Re-install interior wood stops.

.5 Parting strips repair.
- .1 Repair groove for parting strips where required. Cut out existing damaged portions and splice in new wood portions as required.
- .2 Allow for repairs in four (4) locations, average length of 150 mm.
- .3 Replace parting strips in pulley stiles.

.6 Weight boxes repair
- .1 Allow for repairs to each weight box cover and adjacent area of window frame.
- .2 Repair with glue or with splicing in new wood pieces.

.7 Existing Glazing.
- .1 Remove existing glazing lights from ventilators and label.
- .2 Remove existing glazing putty, paint and corrosion products from sash and frame
- .3 Remove remnants of glazing putty
- .4 Replace broken glazing lights to match existing.
- .5 Replace glazing broken during removal procedures at own expense.

.8 New glazing installation.
- .1 Sand and clean rebates.
- .2 Prime rebates with light coat of mix of equal parts of boiled linseed oil and turpentine. Allow to dry for 24 hours.
- .3 Apply back putty to rebate.
- .4 Bed glass firmly into position in rebate. Ensure it is evenly seated.
- .5 Install glazing points.
- .6 Neatly apply exterior putty bevel in line with edges of stiles and rails.
- .7 Strike off excess putty.

.9 Allow putty to cure for minimum 3 weeks before painting.

## 3.11 RE-PAINTING AND FINISHING

.1 Perform re-painting and finishing of wood windows in accordance with Section 09 03 91.13 Period Exterior Painting.

## 3.12 RESTORATION OF EXISTING HARDWARE

.1 Reuse existing hardware.

.2 Remove paint from hardware and screws:
- .1 Boil in vinegar.
- .2 Strip paint using methylene chloride-based paint strippers. Take care not to damage patina. Clean with water. Dry thoroughly.

.3 Lubricate parts including restored sash pulleys prior to re-installation.
.4 Straighten 50 % of casement stay arms and 10 % of closer bars.

.5 Replace existing fasteners with new fasteners.

.6 Steel and Brass latch hardware and window pulleys: after cleaning, apply microcrystalline wax.

.7 Store restored hardware and screws for re-installation.

3.13 RE-INSTALLATION OF HARDWARE

.1 Reinstall hardware to operate smoothly.

.2 Lubricate hinges and moving parts with light machine oil.

3.14 SASH WEIGHTS

.1 Weigh pair of sash weights and weigh new upper sash. Ensure the combined weight of counterweights match the sashes to which they are attached.
  .1 Ensure pair of sash weights is 0.9 kg. heavier than upper sash.
    .1 Add or remove weight from pair of sash weights to achieve weight differential.

3.15 RE-INSTALLATION OF WINDOW FRAME

.1 Ensure sub-frame is anchored securely in surrounding construction.

.2 Re-install restored and repaired window frame in sub-frame.

.3 Install new shims in shim space.

.4 Repair mortar and masonry back-up around interior perimeter of window frame as required.

.5 Apply backer rod and sealant around re-installed window frame.
  .1 Interior and exterior perimeters of re-installed window frame.
    .1 Install backer rod in locations agreed to with Departmental Representative during removal of window frame.
    .2 Apply sealant.

.6 Repair exterior adjacent material disturbed during removal of window frame.

3.16 RE-INSTALLATION OF SASHES

.1 Install restored glazed upper and lower sashes with new weather stripping and associated trim such as weight pocket covers, parting strips and interior stops.

.2 Set units plumb, level and true to line.

.3 Ensure that lower sashes are operable for their full height.

.4 Seal upper sashes at sides and interior with latex caulking.

.5 Install weather-stripping
  .1 Coordinate installation of sash with installation of weather-stripping.
  .2 Install new weather-stripping in accordance with manufacturer's written

instructions.

.3 Install weather-stripping.

.1 Install weather-stripping in a fine, neat bed of silicone sealant.

.4 Install new weather-stripping without breaks at corners and perimeter.

.6 Install new interior storm sashes with new weather-stripping and hardware.

3.17 SEALANT BEAD APPLICATION

.1 Prime wood frame.

.2 Apply clean bead of sealant on primed frame.

.3 Install bond-breaker tape on operable sash.

3.18 CAULKING

.1 Install approved sealant between exterior window frames and sills and perimeter masonry.

.2 Apply sealant after re-installation of shop-repaired windows and before final top coat of paint.

.3 Paint sealant.

END OF SECTION 08 03 52

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

.1 Section 06 20 00 Finish Carpentry

.2 Section 08 03 14 Period Wood Door and Miscellaneous Wood Repairs

.3 Section 08 03 52 Period Wood Window Repairs

.4 Section 09 91 00 Painting

### 1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.2 Master Painters Institute (MPI)
- .1 Maintenance Repainting Manual current edition, Master Painters Institute (MPI) including Identifiers, Evaluation, Systems, Preparation and Approved Products List.

.3 National Fire Code of Canada (NFC), 2015.

### 1.3 DEFINITIONS

.1 Exterior surfaces: refers to surfaces of a historic structure which is exposed to exterior weather including wet conditions of rain, sleet or snow, high temperatures and sunlight as well as temperatures below the freezing point.

### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 11 55 – General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for paints and coating products and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 11 55 – General Instructions.

.3 Samples:
- .1 Submit full range of coating colour sample matches for review and selection.
- .2 Submit 2 one-litre samples of each paint delivered to site:
  - .1 1 sample from manufacturer's containers; and,
  - .2 1 sample from painter's pot.
  - .3 Take samples in presence of Departmental Representative.

### 1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 11 55 – General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for paints and coatings for incorporation into manual.
- .1 Provide records of products used. List products in relation to finish system and include following:
  - .1 Product name, type and use (e.g. materials and location).
  - .2 Manufacturer's product number.
  - .3 Colour code numbers.

.4 MPI Environmentally Friendly classification system rating Environmental Rating.
.5 Manufacturer's Material Safety Data Sheets.

.3 Submit maintenance record of painting work.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:

.1 Submit one 4 litre can of each type and colour of linseed oil paint. Identify type and colour in accordance with established colour schedule and finish system.

1.7 QUALITY ASSURANCE

.1 Regulatory Agency Sustainability Approvals:

.1 Compliance Report indicating requirement to purchase energy efficient and environmentally friendly products.
.2 Conform to applicable standards and requirements for exterior repainting work including cleaning, preparation and priming.
.3 Retain purchase orders, invoices and other documents and produce when requested by Departmental Representative.

.2 Qualifications:

.1 Contractor: minimum of 5 years' experience with historic structures painting.
.2 Journeypersons: minimum of 5 years' experience with historic structures
.3 Apprentices: work under direct supervision journeyperson with the experience as defined above.

.3 Mock-ups:

.1 Construct mock-ups of each step of surface preparation and painting for review by Departmental Representative.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 11 55 – General Instructions 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.
.1 Labels: to indicate:
.1 Type of paint or coating.
.2 Compliance with applicable standard.
.3 Colour number in accordance with established colour schedule.

.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 paints and coatings.
.3 Keep areas for storage, cleaning and preparation, clean and orderly.
.4 Remove paint materials from storage in quantities required for same day use.
.5 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
.6 Store materials and equipment within temperature range between 7 degrees C to 30 degrees C.

.7 Store materials and supplies away from heat generating devices and sensitive materials above minimum temperature as recommended by manufacturer.
.8 Replace defective or damaged materials with new.

.4 Fire Safety Requirements:
.1 Provide adequate storage for rags soaked with linseed oil as the rags may spontaneously combust.
.2 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
.3 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site daily.
.4 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada (NFC).

1.9 AMBIENT CONDITIONS

.1 Substrate and ambient temperatures: in accordance with limits prescribed by manufacturer.

.2 Apply paint finish in areas where:
.1 Dust is no longer being generated by related construction operations.
.2 Wind conditions are such that airborne particles will not affect quality of finished surface.

.3 Substrate and ambient air temperature, humidity and moisture content levels:
.1 Do not perform repainting work when:
.1 Ambient air and substrate temperatures are below 10 degrees C.
.2 Substrate temperature is over 32 degrees C, unless paint is specifically formulated for application at high temperatures.
.3 Substrate and ambient air temperatures are expected to fall outside paint manufacturers or MPI prescribed limits.
.4 Substrate is wet, damp or frosted.
.6 Maximum moisture content of substrate exceeds: 15% for wood.
.7 Relative humidity is above 85%.
.8 Dew point is less than 3 degrees C variance between air/surface temperature.
.9 Precipitation is forecast to occur before paint has thoroughly cured.
.10 It is foggy, misty, raining, icing or snowing at site.
.2 Damp and cold weather conditions:
.1 Provide and maintain cover for paint finish.
.2 Heat substrates and surrounding air to comply with temperature and humidity conditions required.
.3 Protect until paint is dry.
.4 Protect until weather conditions are suitable.

.4 Perform work on surfaces exposed to direct, intense sunlight in early morning.

2.0 PRODUCTS

2.1 MATERIALS

.1 Primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, and solvents: in accordance with Paint Manufacturer's printed instructions.

.1 For black metal hardware, use 1 coat primer and 2 finish coats for exterior application.
.1 Submit proposed paint to match existing for Departmental Representative approval.

.2 For wood components, use Linseed Oil Paint System.

.2 Raw, purified linseed oil: highest quality product of an approved manufacturer.
- .1 Compatible with other coating materials as required.
- .2 Clean, filtered, purified raw linseed oil containing no proteins, no VOCs.
  - .1 Allback Purified Linseed Oil, or approved equivalent.
  - .3 Minimum 2 coats of raw linseed oil to new wood surfaces.

.3 Linseed oil paint: highest quality product of an approved manufacturer.
- .1 Compatible with other coating materials as required.
- .2 Cold-pressed, filtered, solvent-free, 100% linseed oil plus pigment, no VOCs.
- .1 Allback Linseed Oil Paint, or approved equivalent.
- .3 Minimum 2 coats of linseed oil paint to wood and metal surfaces.

.4 Linseed oil putty: highest quality product of an approved manufacturer.
- .1 Compatible with other coating materials as required.
- .2 Purified, raw linseed oil glazing putty.
  - .1 Allback Glazing Putty or approved equivalent.

2.2 SUSTAINABILITY CHARACTERISTICS

- .1 Sustainability characteristics for paints, coatings, thinners, solvents, cleaners and repainting fluids:
  - .1 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.
  - .2 Manufactured without formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
  - .3 Manufactured and transported in a manner that the steps of process, including disposal of waste products, will meet requirements of applicable government acts, bylaws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection ACT (CEPA).
- .2 Paints and coatings: not manufactured with formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.

2.2 COLOURS

.1 Colour Schedule: provided by Departmental Representative.

.2 Obtain written approval from Departmental Representative for change in Colour Schedule.

2.4 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site.

.2 Obtain Departmental Representative written approval for on-site tinting of paint materials.

.3 Reproduce historic paint colour and gloss level using compatible materials meeting current standards.

.4 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.5 Where thinner is used, addition not to exceed paint manufacturer's recommendations.

.6 Do not use kerosene or other organic solvents to thin water-based paints.

.7 Thin paint in accordance with paint manufacturer's recommendations.
.1 Obtain instructions in writing from manufacturer and provide copy of instructions to Departmental Representative.

.8 Re-mix paint in containers prior to and during application. Ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.5 SPECIAL FINISHES
.1 Pre-treatment mixture:
.1 Use 2 coats of raw linseed oil on new wood.

2.6 ACCESSORIES
.1 Use tools that do not damage adjacent materials or raised grain of aged wood.

.2 Only light hand scraping will be permitted. For areas where a scraper cannot reach, a brass (not steel) bristle brush will be permitted.

.3 Pre-treatment mixture and linseed oil paint require stiff, natural bristles.

.4 Window putty scraper, tool for re-puttying.

.5 Smaller natural bristle brushes for window muntins, sashes, rails, frame and sills.

3.0 EXECUTION

3.1 EXAMINATION
.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for painting in accordance with manufacturer's written instructions.
.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION
.1 Ensure workers are kept safe in accordance with Reviewed Safety Plan Federal, Provincial, Municipal regulations.

.2 Implement safety measures as required in preparation for implementing work.

.3 Place safety devices and signage in locations as required by Reviewed Safety Plan, in accordance with Federal, Provincial, Municipal regulations.

3.3 PROTECTION OF IN-PLACE CONDITIONS
.1 Protect existing building surfaces and adjacent structures with non-staining covers against paint spatters, markings and other damage.

.2 Remove and safely secure and store light fixtures, surface hardware on doors, and surface mounted equipment, fittings and fastenings prior to undertaking painting operations.

.3 Move and cover exterior furniture and portable equipment as necessary to carry out painting

operations. Replace as painting progresses.

.4 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas.

.5 Protect drying paint from wind-borne dust.

3.4 SURFACE PREPARATION

.1 Perform preparation and operations for exterior painting in accordance with MPI, Maintenance Repainting Requirements except where specified otherwise.

.2 Clean and prepare exterior surfaces in accordance with MPI Maintenance Repainting Manual requirements. Refer to manual for specific requirements as follows:

.1 Remove dust, dirt, and surface debris by brushing, wiping with dry, clean cloths.

.2 Wash surfaces with ion neutral biodegradable detergent and clean warm water using a stiff bristle brush. Remove dirt, oil and surface contaminants. Ensure existing substrate is not damaged by process.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Use trigger operated spray nozzles for water hoses at low pressure.

.5 Allow surfaces to drain completely and dry thoroughly.

.6 Use water-based cleaners.

.3 Clean metal surfaces: remove rust, dirt, oil, grease and foreign substances in accordance with MPI requirements. Scrape flaking paint.

.1 Remove contaminates from surfaces, pockets and corners: brush with clean brushes.

.2 Carry out cleaning and surface preparation in accordance with Manufacturer's written instructions. Do not disturb or affect existing coatings that contain lead based paint.

.4 Protect glass. Warm and carefully scrape away putty from windows.

.5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, corrosive chemicals, grease, oil and solvents before priming.

.6 Touch-up, spot prime, and apply primer, paint, or pre-treatment immediately after cleaning.

3.5 APPLICATION

.1 Apply pre-treatment mixture to new wood:

.1 Brush on coat of raw linseed oil. Oil may be warmed for better penetration into wood.

.2 Allow to penetrate wood and dry for 24 hours.

.3 Repeat coat of raw linseed oil until wood no longer soaks up mixture.

.4 Allow a minimum of 2 applications on new wood.

.5 The goal of pre-treatment mixture is to soak wood with linseed oil so that fewer coats of linseed oil paint are necessary.

.2 Windows: Do pre-treatment procedure in .1 above to window rebates before re-puttying. Cure new application of new putty before repainting.

.3 Metal surfaces: All painting to be applied in accordance with manufacturer's printed instructions and may be by spray or brush but free of sags, runs, drips or other imperfections.

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

.5 Apply paint materials in accordance with paint manufacturer's written application instructions.
- .1 Apply paint:
  - .1 To adequately prepared surfaces and within moisture limits.
  - .2 When pre-treatment is absorbed or previous coat of paint is dry.
  - .3 In accordance with manufacturer's written instructions.
  - .4 With stiff natural bristle brush.
- .2 Apply a minimum of 2 coats of paint over worn painted areas, or new wood.
- .3 Apply coats thinly to facilitate drying and avoid runs and sags.
- .4 Apply three coats of paint to windows. Paint to go over putty and onto glass 2mm.

3.6 FIELD QUALITY CONTROL

.1 Standard of acceptance:
- .1 When viewed using natural prevailing sunlight at peak period of day (mid-day) on surface viewed, surfaces to indicate following:
  - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
  - .2 Soffits: no defects visible from grade at 45 degrees to surface.
  - .3 Final coat: to exhibit uniformity of colour and sheen across full surface.

.2 Co-operate with Paint Inspection Agency and provide access to areas of work.

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 Reinstall and clean removed items after painting is completed.

.3 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.
- .1 Clean and restore as directed by Departmental Representative.

.4 Wipe spills and spots immediately with a damp cloth.

.5 Minimize use of kerosene and organic solvents to clean up water-based paints.

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

3.8 HARDWARE RE-INSTALLATION

.1 Clean and re-install hardware items removed and stored previous to commencement of the Work.

.2 Re-install newly painted hardware items in original locations.

3.9 PROTECTION

.1 Protect freshly completed surfaces from paint droppings and dust. Avoid scuffing newly applied paint.

.2 Remove paint splashings on exposed surfaces. Remove smears and spatter immediately as

operations progress, using compatible solvent.

.3 Protect completed work from paint droppings. Use non-staining coverings.

.4 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

.5 Remove protective coverings and warning signs as soon as practical after operations cease.

END OF SECTION 09 03 91.13

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

.1 Section 03 03 30 Period Concrete Repairs.

.2 Section 07 62 00 Sheet Metal Flashing and Trims.

.3 Section 07 92 00 Joint Sealant

### 1.2 SUMMARY

.1 This specification only relates to the exterior stucco at the Belmont Battery Director's Tower.

.2 Perform mock-up to evaluate the performance and appearance of materials for the acceptance by Departmental Representative.

.3 Remove existing exterior stucco and associated assembly.

.4 Repair underlying concrete as necessary as per Section 03 03 30 and prepare for lath and plaster assembly application.

.5 Install suitable lath/mesh and stucco assembly.

### 1.3 SUBMITTALS

.1 Provide submittal in accordance with Section 01 33 00 – Submittal Procedures.
- .1 Repair and coating manufacturers' specifications, details, installation instructions and product data.
- .2 Samples for approval as directed by Departmental Representative.
- .3 Manufacturer's standard material warranty.
- .4 A list of minimum three job references.

### 1.4 REFERENCES

.1 ASTM Standards
- .1 ASTM C 926 Specification for Portland Cement Plaster
- .2 ASTM C150 / C150M - 17 Standard Specification for Portland Cement
- .3 ASTM C 920 Specification for Elastomeric Joint Sealants

### 1.5 DESIGN REQUIREMENTS

.1 Provide flashing installation, repair and/or replacement details for applicable conditions listed in this specification and each repair locations on drawings. Flashing replacement shall be based on section 07 62 00 – Sheet Metal Flashing and Trims listed below and indications of distress or leakage observed during inspection.
- .1 Provide head flashing above all window and door openings.
- .2 Provide weep screed and/or flashing at the bottom of the stucco system.
- .3 Provide flashing at floor lines at each floor.
- .4 Terminate stucco system minimum 2-inches (51 mm) above paved grade and roofing materials.
- .5 Terminate stucco system minimum 4-inches (102 mm) above soil and landscaped finished grades.
- .6 Provide metal cap flashing for parapets. Cap flashing shall be sloped to drain water onto the roof system.
- .7 Provide metal flashing for non-vertical or low slope projections to drain water away from the wall exterior.
- .8 Provide metal mesh to replace the noted exposed metal mesh.

.2 Integrate all flashing repair and replacement with the water-resistive barrier system to provide direct and continuous drainage to the exterior of the wall.

.3 Terminate stucco system using casing bead around perimeters of windows and doors. Provide minimum ½-inch-wide (12.5 mm) space between casing and window frame. Install sealant joint at perimeters of window, doors and mechanical penetrations.

.4 Indicate on the project drawings locations where resurfacing, refinishing, and/or recoating is required.

.5 Provide detail drawings consistent with recommendation in SMA technical bulletins.

.6 Where lath is cut to facilitate repairs, wire-tie replacement lath to surrounding lath with 1/2-inch (12.5 mm) overlap.

1.6 QUALITY ASSURANCE

.1 Manufacturer's requirements

.1 Stucco and finish material manufacturer shall be experienced provider of cementitious based materials for use in stucco construction and repair for minimum 25 years.

.2 Contractor requirements

.1 Contractor shall be licensed and insured and shall have been engaged in stucco and stucco repair construction for minimum five years.

.3 Contractor shall employ skilled mechanics who are experienced and knowledgeable in the repair procedures and requirements of the specified project.

.4 Contractor shall have completed minimum three projects of similar size, scope and complexity to the project being specified.

.5 Contractor shall provide the proper equipment, manpower and supervision on the job site to perform the repair procedures in accordance with manufacturer's published repair specifications, applicable manufacturer's details and the contract documents.

.6 On-Site Mock-Ups:

.1 Prior to commencement of work, provide on- site mock-up for each of the following location :

.1 1000mm x 1000mm wall surface for the 3 coat system at the upper tower level
.2 door head and door jamb
.3 shutter head and shutter seal
.4 through-wall flashing at floor line

.2 Mock-up shall represent construction using the same quality/techniques to be utilized on the project. Mock-up will include full assembly with strapping, building paper, metal lath and stucco mix.

.3 Mock up to consist of a choice of the 2 different stucco mix including a historical mix (2:0.5:5) with white portland cement, and the contemporary mix, both as per article 2.4, including the finishing coat, for assessment of performance and compatibility.

.4 Retain approved mock-up at job site throughout the application process.

.1 Where acceptable to the Departmental Representative, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

.2 Contractor shall follow the practice and guidelines in the Stucco Manufacturers Association (SMA) technical Bulletins.

.3 Submit letter at completion that the lath and plaster is installed per SMA recommendations.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver all materials in their original sealed containers bearing manufacturer's name and product identification.

.2 Protect liquid products (pails) from freezing and temperatures greater than 90 degrees F (32 degrees C). Do not store in direct sunlight.

.3 Protect portland cement based materials (bag products) from moisture and humidity. Store under cover and off of the ground in a dry location.

.4 Inspection: Inspect the materials upon delivery to assure that specified products have been received. Report defects or discrepancies to the responsible party according to the construction documents; do not use reported material for application.

.5 Storage: Store all products per manufacturer's recommendations. Generally, store materials in a cool, dry location; away from direct contact with the ground and/or concrete; out of direct sunlight; and protect from weather and other damage.

1.8 PROJECT/SITE CONDITIONS

.1 Follow product manufacturer's recommendations for environmental conditions and surface preparation.

.2 Provide supplementary heat for installation in temperatures less than 40 degrees F(4 degrees C).

.3 Prior to installation, inspect the wall for surface contamination or other defects that may adversely affect the performance of the materials, and shall be free of residual moisture. Do not apply the portland cement plaster to substrates whose temperature are less than 40 degrees F ( 4 C) or contain frost or ice.

.4 All wood based products covered shall be dry and have a moisture content below 19% . DO NOT COVER WET FRAMING.

.5 Protect applied material from deleterious effects until cured or dry.

.6 Contractor shall walk the project prior to starting work and notify departmental representative of any deficiencies that will negatively impact the plaster assembly. Do NOT proceed until remedied.

.7 Provide protection of surrounding areas and adjacent surfaces from spillage, splatter, overspray or other unintended contact with the materials that are being applied.

1.9 COORDINATION AND SCHEDULING

.1 Do not start repairs in an area unless sufficient work can be completed such that the area is weather-tight at the end of the work shift. Alternatively allow sufficient time before the end of the work shift to provide weather protection until work can resume.

.2 Coordinate with all trades involved to schedule work to result in the proper sequencing of materials within the repair (proper lapping of water resistive system components and flashing).

.3 Schedule finish and coating application to large areas such that each day's application will end at an architectural break.

1.10 WARRANTY

.1 Provide manufacturer's standard warranty for products used.

1.11 MAINTENANCE

.1 The following materials shall be presented to the Departmental Representative following the application of the work:
  .1 One container of finish for each color and texture utilized on the project.
  .2 Supply a maintenance program for Departmental Representative O&M manual as required.

2.0 PRODUCTS

2.1 MANUFACTURERS

.1 Provide stucco, surface leveling, primer, waterproofing, and coatings (as applicable) from a single source.

.2 Provide stainless steel metal lath and stucco accessory components from qualified manufacturer.

.3 Provide a high quality stucco material which consists of Portland cement, reinforcing fibres and chemical additives.

2.2 SCRATCH AND BROWN COAT (BASECOAT)

.1 Cement: A Portland cement complying with ASTM C150.

.2 Sand: Field mixes shall comply with ASTM C-926 and must have sand that is clean and free from deleterious amounts of loam, clay, silt, soluble salts and organic matter. Sampling and testing shall comply with ASTM C144 or C897.

.3 An "engineered performance mix" by an SMA manufacturer is acceptable with appropriate approvals (ICC ES, IAPMO or Interek report).

.4 Water: Clean and potable without foreign matter.

.5 SMA approved admixture to impart increased tensile, bond, and flexural strength:
  .1 Provide high-build polymer-modified portland cement-based base coat for surface leveling over cementitious finishes and brown coat.
  .2 Provide acrylic surface leveler/base coat for surface leveling over elastomeric finishes.
  .3 Provide waterproof polymer-modified portland cement-based base coat.

2.3 WATER-RESISTIVE BARRIER

.1 Provide water-resistive barrier coating and transition membrane system.

.2 Provide ASTM D 226 compliant asphalt saturated kraft building paper, Grade D, No. 15 over barrier coat.

2.4 MIXING

.1 Portland Cement Plaster Basecoats (Scratch coat, Brown Coat):

.1 Prescriptive Method: Ratios and Mix Design shall be per ASTM C926.

.1 Historic mixture:

| | |
|---|---|
| Portland Cement | 2 parts |
| Lime (type S) | ½ part |
| Sand | 5 parts |

.2 Contractor may use the following mix as alternative subject to approval by Departmental Representative only :

.1 Contemporary Mixture:

| | |
|---|---|
| Portland Cement | 1 part |
| Lime (type S) | ¼ to ½ part |
| Sand | 3 to 4 parts per cement & Lime |
| Fibers | Maximum 3 oz per batch |

.2 Parging Mixture:
Refer to Section 03 03 30 Period Concrete Repair Sub-section 2.4.2.

.2 Finish Coats: Mixing and tinting instructions are contained in the appropriate product data sheets. To be approved by the Departmental Representative.

2.5 LATH

.1 Expanded Lath: Nominal 3.4lb/yd$^2$ weight, 38 (1½") grid, stainless steel grade 316.

2.6 ACCESSORIES

.1 Fasteners: Nails, staples, or screws used to rigidly secure lath and associated accessories shall be stainless steel grade 316.

.2 Accessories: The following accessories shall be fabricated from grade 316 stainless steel.

.3 Corner Aid: Minimum 26-gauge thick; expanded flanges shaped to permit complete embedding in plaster; minimum 50mm wide; Square edge style.

.4 Strip Mesh: Metal Lath, 3.4lb/yd$^2$ expanded metal; 6 in. wide x 18 in. long.

.5 Vent Screed: Minimum 26-gauge thick; thickness governed by plaster thickness; minimum 4-inch (102 mm) width, double "V" profile, with perforated expanse between "V's" of longest possible lengths.

.6 Casing Bead: Minimum 26-gauge thick; thickness governed by plaster thickness; maximum possible lengths; expanded metal flanges, with square edges.

.7 Drip Screed: Minimum 26-gauge thick, depth governed by plaster thickness, minimum 3-1/2 in. high flange, maximum possible lengths.

.8 Control and Expansion Joints: Depth to conform to plaster thickness; use maximum practical lengths.

.1 Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; removable protective tape on plaster face of control joint.

.2 Expansion Joints: Pair of casing beads with sealant between.

.3 Strapping to be rigid vinyl 20mm thick by approximate 60mm wide installed vertically.

2.7 PORTLAND CEMENT

.1 Provide ASTM C 150 Type I, Type II, or Type I-II cement.

2.8 PRIMER

.1 Provide pH resistant acrylic primer to be used on stucco brown coat according to Manufacturer's recommendation.

2.9 FINISHES

.1 Portland cement-based blended stucco finish:

.1 Pigments:

.1 Natural and synthetic, milled, blended iron oxides.

.2 Carbon added for darker colors shall not exceed 4 percent.

.3 Produce uniform and consistent color.

.4 Inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, lime proof and non-bleeding.

.5 Free of deleterious fillers and extenders.

.2 Color and Texture: Color and finish texture to match existing and confirmed by Departmental Representative.

3.0 EXECUTION

3.1 EXAMINATION

.1 Prior to the application of the portland cement plaster basecoat the plastering contractor shall ensure that:

.1 Surface and site conditions are ready to receive work.

.2 Grounds and Blocking: Verify that the items within the walls for other sections of work have been installed.

.3 Notify Departmental Representative of any defects that may impact the finished assembly. Proceed as directed.

.4 Substrates:

.1 Acceptable substrates must be sound, secure and suitable for lath and plaster.

.2 Substrates and adjacent materials must be and clean. Substrate surface must be flat, free of protrusions or planar irregularities greater than ¼-inch in 10-feet (6mm in 3m).

.5 Flashings: All flashing around windows, at deck attachments, utility penetrations, roof lines, etc. and all kick-out flashing must be properly installed prior to application of portland cement plaster. Notify Departmental Representative if flashings are missing, proceed as directed.

.6 Unsatisfactory conditions or concerns shall be reported to Departmental Representative. Do not proceed until directed in writing by Departmental Representative.

3.2 PREPARATION

.1 Substrate/Framing: inspect all work prior to starting lath and plastering. Notify Departmental Representative of any issues impacting performance, proceed as directed.

.2 Surrounding Areas: Protect surfaces near the work of this section from damage, disfiguration, and overspray. Mask off all dissimilar materials.

3.3 GENERAL INSTALLATION

.1 General Installation: Refer to ASTM C-926 and manufacturer's product data sheet for additional installation requirements and recommendations of the SMA.

3.4 INSTALLING WEATHER PROTECTION

.1 Water-Resistive Barrier: Apply water-resistive barrier complying with Section 1404.2 of the IBC or Section R703.2 of the IRC. Start at base of wall and overlap flashing flanges and in a "shingle-fashion" by a minimum of two (2) inches (50mm) horizontal and six (6) inches (152mm) vertical. Integrate with flashings to insure incidental moisture drains down and weeps out. Reverse laps shall not be allowed.

.2 Window Flashing: install flashing between the shutter and door, and the cement plaster appropriate for the condition. Refer to SMA flashing guidelines for nail flange style windows.

.3 Flashing: Install flashing and trim per current Building Code.

3.5 INSTALLING LATH/TRIMS

.1 General: Installed per ASTM C1063. Trims shall be full length and installed plumb/level to within 3mm in 2.4m.

.2 Weep screed shall be installed at the base of all framed walls.

.3 Trims shall be attached per the trim manufacturer's instructions; however do not exceed 24 inches on center spacing.

.4 Apply lath per manufacturers recommendations. Laps shall occur at horizontal and vertical joints. Attach lath six (6) (152mm) to seven (7) inches (170mm) on center along vinyl strapping. Fastener shall penetrate wood by a minimum ¾ inch, penetration of wood based sheathing shall count as 50% of dimensional lumber. Metal framing by a minimum of three (3) full threads and engage the lath.

.5 Lath shall lap the flange of accessories by more than 50%.

.6 Control Joints: Installed per Architects direction. Single-piece control joint may be installed over continuous lath if approved by Departmental Representative. If lath is discontinuous, framing shall support lath terminations. Notify Departmental Representative of issues or changes.

.7 Expansion Joints: Install per Departmental Representative direction. Two piece joints (expansion) must have lath terminate each side.

.8 Contractor shall honor control or expansion joints in substrates.

.9 Do not mix lath products on same wall.

.10 Avoid excessive laps with expanded metal lath.

.11 Do not use rib lath on walls.

.12 Use wire nose corner for cement finish, PVC nose for acrylic finish.

.13 Lath shall cover more than 75% of solid flanges.

3.6 INSTALLING PORTLAND CEMENT PLASTER

.1 Per ASTM C926, apply portland cement plaster by hand-troweling or machine-spraying to a nominal thickness of 3/8-inch (9.5mm) for scratch coat. Then apply a second coat to a nominal thickness of 3/8-inch (9.5 mm) brown coat. Total basecoat shall be a nominal ¾ inch thickness.

.2 Scratch coat shall substantially cover the lath and be applied with sufficient pressure to encase the lath in cement. Slickers to apply cement plaster are prohibited. Score in a horizontal pattern.

.3 Allow to cure 48 hours, or until sufficiently rigid to accept a brown coat.

.4 Apply brown coat to fill and complete basecoat. Nominal ¾ inch thickness. Rod to a flat plane. Do not apply to frozen or soft scratch coat. When excess moisture leaves brown coat, hard float to provide densification per ATSM. Hard floating procedure may be omitted if the "Base coat and Mesh or Stucco crack reduction system" is selected.

.5 Moist Curing: Provide sufficient moisture by fog or moist curing to permit proper hydration of the cementitious materials. The length of time and most effective procedure for curing will depend on climatic and job conditions. Refer to SMA curing guidelines.

3.7 INSTALLING FINISH COAT

.1 General: Mix and apply per manufacturer's product data sheet.

.2 Do not apply to soft, contaminated or frozen basecoat.

.3 Avoid applying to excessively hot walls.

.4 Verification: Verify the desired color, material and texture to match the approved sample and/or mock-up prior to installation.

.5 Avoid scaffold lines and cold joints.

.6 Fog coat as needed to blend color variations.

.7 Finish coat shall be free of eye catching imperfections.

3.8 CLEANING/PATCHING/TOLERANCE

.1 Cleaning: Remove any and all materials used, overspray from adjacent surfaces, and all protective masking.

.2 Patch and repair as needed, including but not limited to fog coating, imperfections and blisters.

.3 Cracks shall be repaired per the most current SMA Crack Policy (Technical Bulletin 4).

.4 The basecoat of plaster shall be in tolerance: Not to exceed ¼ inch in ten (10) feet.

.5 Eye catching variations in color or texture pattern will not be accepted.

3.9 PROTECTION

.1 Protection: Protect applied material from inclement weather until dry and prevent it from freezing for a minimum of 24-hours after set and/or until dry. Refer to manufacturer's product data sheet for additional requirements.

END OF SECTION 09 24 00

1.0 GENERAL

1.1 RELATED SECTIONS

.1 Section 06 20 00 Finish Carpentry

.2 Section 09 03 91.13 Period Exterior Painting

1.2 REFERENCES

.1 ASTM (ASTM):

.1 ASTM E 96, "Standard Test Methods for Water Vapor Transmission of Materials."

.2 ASTM E 514, "Standard Test Method for Water Penetration and Leakage Through Masonry."

.3 ASTM G 154, “Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.”

.4 ASTM D 6886-12, “Standard Test Method for Determination of the Individual Volatile Organic Compounds (VOCs) in Air-Dry Coatings by Gas Chromatography.”

1.3 SECTION INCLUDES

.1 Paint all surfaces (new and existing) to remain exposed in the finished work whether specifically indicated or not, except shop and factory finished items and those specifically indicated not to be painted. No surface shall have less than one prime coat and two finish coats.

.2 Paint all existing interior walls, exterior walls and ceilings.

.3 Paint all existing millwork, windows and doors.

.4 Paint all exposed electrical services to match existing

.5 Paint interior baseboard, wall siding.

.6 Paint exterior soffit / deck, columns and beams.

.7 Paint all exterior and interior structural steel and metal work with high performance coating system

.8 High pressure washing and abrasive blasting in accordance with requirement of the Society for Protective Coatings (SSPC).

.9 Colour Scheme: All color scheme to match historical colour. Confirm with Departmental Representative the historical color by carrying out stripping and investigation to confirm original colour prior to painting.

1.4 QUALITY ASSURANCE

.1 This Contractor shall have a minimum of five (5) years’ experience in related painting work and shall maintain a crew of painters of similar or more experience throughout the duration of the work.

.2 Only qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting and decorating work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.

.3 For paint system specified as using the MPI system, conform to the standards contained in the Master Painters Institute Architectural Painting Specification Manual, latest edition (hereafter referred to as MPI Painting Specification Manual) for all painting products including preparation and application of materials. MPI Painting Specification Manual as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.

.4 Single-Source Responsibility: provide primers and undercoat paint produced by the same manufacturer as the finish coat.

.5 Standard of Acceptance:

.1 Wall: No defects visible from a distance of 1000mm at 90° to surface.

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

.6 All steel requiring high performance coating to be reviewed by Departmental Representative after cleaning prior to coating application.

1.5 SYSTEM DESCRIPTION

.1 A materials-compatible highly vapor permeable decorative coating system offering strong weathering protection for exterior exposure.

.1 Silicate Coating: An incombustible three coat system comprising a textured minerally filled primer coat, a smooth intermediate coat, and a smooth top coat.

.1 Silicate coating penetrates the surface and in a chemical reaction combines with the substrate through chemical and mechanical bonds forming a hard amorphous microporous layer with extremely high vapor permeability.

.2 Unaffected by acids, UV exposure, or air-borne pollutants.

.3 Unique alkaline mineral layer structure prevents liquid water penetration into the coated substrate and maintains moisture balance through vapor diffusion to keep wall assemblies breathable and dry, thus resisting mold and biological growth.

.4 Will not reduce substrate vapor permeability.

.5 Textured filling coat optically blends together patched or indifferent substrates and fills existing hairline cracks and crazing.

.2 Conform to safety precautions in accordance with the latest requirements to Industrial Health and Safety Regulations, latest edition, of authorities having jurisdiction.

1.6 SAMPLE AND MOCK-UPS

.1 Provide duplicate minimum 300 mm (12") square samples of surfaces or acceptable facsimiles requested painted with specified paint or coating in colours, gloss/sheen and textures required to match historical color. Allow to provide 6 different color samples for Departmental Representative

to review and confirm color scheme. When approved, samples shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

.2 Provide mock up high performance coating application to a typical steel item for approval by Departmental Representative.

1.7 SUBMITTALS

.1 All submittals shall be in accordance with the requirements of Section 01 33 00 – Submittal Procedures

.2 Submit a list of all painting materials to the Consultant for review prior to ordering materials.

.3 Submit two sets of Material Safety Data Sheets (MSDS) prior to commencement of work for review and for posting at job site as required.

.4 Submit Source of VOC Data (letter, cutsheet, or MSDS) for all paint products indicating Product Name and VOC content.

.5 At project completion provide an itemized list complete with manufacturer, paint type and colour coding for all colours used for Departmental Representative`s later use in maintenance.

.6 At project completion provide properly packaged maintenance materials as noted herein and obtain a signed receipt.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver all painting materials in sealed, original labeled containers bearing manufacturer's name, brand name, type of paint or coating and colour designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.

.2 Store all paint materials in original labeled containers in a secure (lockable), dry, heated and well ventilated single designated area meeting the minimum requirements of both paint manufacturer and authorities having jurisdiction and at a minimum ambient temperature of 45 degrees F (7 degrees C). Only material used on this project to be stored on site.

.3 Where toxic and/or volatile/explosive/flammable materials are being used, provide adequate fireproof storage lockers and take all necessary precautions and post adequate warnings (e.g., no smoking) as required. Take adequate measures to prevent the release of volatile organic compounds (VOC) into the atmosphere.

.4 Take all necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect the environment from hazard spills. Materials that constitute a fire hazard (paints, solvents, drop clothes, etc.) shall be stored in suitable closed and rated containers and removed from the site on a daily basis.

.5 Comply with requirements of authorities having jurisdiction, in regard to the use, handling, storage and disposal of hazardous materials.

1.9 PROJECT / SITE REQUIREMENTS

.1 UNLESS specifically pre-approved by Departmental Representative, perform no painting or decorating work when the ambient air and substrate temperatures are below 50 degrees F (10 degrees C) for both interior and exterior work.

.2 Perform no painting or decorating work when the relative humidity is above 85% or when the dew point is less than 5 degrees F (3 degrees C) variance between the air/surface temperature.

.3 Perform no painting or decorating work when the maximum moisture content of the substrate exceeds:

- 12% for concrete and masonry (clay and concrete brick / block).
- 15% for wood.
- 12% for plaster and gypsum board.

.4 Conduct all moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple “cover patch test.”

.5 Test concrete, masonry and plaster surfaces for alkalinity as required.
NOTE: Concrete and masonry surfaces must be installed at least 28 days prior to painting and decorating work and must be visually dry on both sides. This is not to be construed as including a “wetting down” process for Latex.

.6 Perform no painting or decorating work unless a minimum lighting level of 323 Lux (30 foot candles) is provided on surfaces to be painted or decorated. Adequate lighting facilities shall be provided by the General Contractor.

.7 Perform no painting or decorating work unless adequate continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 50 degrees F (10 degrees C) for 24 hours before, during and after paint application. Provide supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.8 Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

1.10 EXISTING CONDITIONS

.1 Before starting work ensure that surfaces are clean and dry and free of defects before commencing painting. Starting work shall imply acceptance of surfaces for painting.

1.11 PROTECTION

.1 Protect adjacent work from droppings, overrun, damage or disfigurement.

.2 Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations. These items shall be carefully stored, cleaned and replaced on completion of work in each area. No solvent shall be used to clean hardware that will remove the permanent lacquer finish on some of these items

.3 Protect items that are permanently attached such as Fire Labels on doors and frames.

.4 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.5 As painting operations progress, place “WET PAINT” signs in occupied areas.

.6 Make good all damage caused without extra expense to Departmental Representative’s satisfaction.

1.13 GUARANTEE

.1 Furnish a 100% two (2) year Maintenance Bond.

1.14 MAINTENANCE MATERIALS

.1 At project completion provide 4 litres (1 gallon) of each type and colour of paint from the same production run (batch mix) used in unopened cans, properly labeled and identified for Departmental Representative`s later use in maintenance. Store where directed.

2.0 PRODUCTS

2.1 MATERIALS

.1 Silicate Coating, Primer Coat: Provide mineral-silicate based opaque coating meeting or conforming to:

.1 ASTM E 96 Vapor Permeability – 77 perms.

.2 ASTM G 154 Accelerated Weathering – no fading, cracking, peeling.

.3 ASTM E 514 62-MPH Wind-Driven Rain Test – no water penetration.

.4 ASTM D 6886-12 Standard Test Method for Individual Volatile Organic Compounds (VOCs) – Less than 1 gram per liter VOC (Volatile Organic Content).

.5 Having mineral fillers in grains from 0 to 0.5 mm.

.6 Tinted lighter than the top finish coating.

.7 Basis of Design: KEIM Soldalit-Grob, or approved equivalent.

.2 Silicate Coating, Intermediate and Top Coats: Provide mineral-silicate based opaque coating meeting or conforming to:

.1 ASTM E 96 Vapor Permeability – 77 perms.

.2 ASTM G 154 Accelerated Weathering – no fading, cracking, peeling.

.3 ASTM E 514 62-MPH Wind-Driven Rain Test – no water penetration.

.4 ASTM D 6886-12 Standard Test Method for Individual Volatile Organic Compounds (VOCs) – Less than 1 gram per liter VOC (Volatile Organic Content).

.5 Tinted to the desired finish color.

.6 Basis of Design: KEIM Soldalit,.or approved equivalent.

.3 Dilution for Silicate Coating: Provide mineral silicate dilution meeting or conforming to:

.1 ASTM E 96 Vapor Permeability – 77 perms.

.2 ASTM D 6886-12 Standard Test Method for Individual Volatile Organic Compounds (VOCs) – Less than 1 gram per liter VOC (Volatile Organic Content).

.3 Basis of Design: KEIM Concretal Dilution, or approved equal.

2.2 EQUIPMENT

.1 Painting and decorating equipment – to best trade standards for type of product and application.

.2 Spray painting equipment – of ample capacity, suited to the type and consistency of paint or coating being applied and kept clean and in good working order at all times.

.3 Silicate Coating, Primer, Intermediate, and Top Coats: Apply by natural bristle façade brush, professional roller, or professional airless spray equipment and back-roll as required for even distribution.

2.3 MIXING AND TINTING

.1 Unless otherwise specified, paints shall be ready-mixed. Re-mix prior to application to ensure colour and gloss uniformity.

.2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.

.3 Perform all colour tinting operations prior to delivery of paint to site.

.4 Where thinner is used, addition shall not exceed paint manufacturer's recommendations.

2.4 FINISHES

.1 Colours shall match existing.

.2 The Departmental Representative shall decide the extent of all colour areas, where the colour shall terminate or commence, and where colour and texture shall match or contrast with adjacent areas.

.3 Silicate Coating, Primer, Intermediate, and Top Coats:

.1 Apply in full coverage evenly distributed coats to a smooth mineral matte finish without lap lines, voids, "holidays", or drips. Compare manufacturer-verified mock up consumption data with application consumption data to ensure enough product is applied.

.2 Maintain a wet edge to prevent sight lines and textural differences.

.3 Apply enough product to prevent shading and textural differences that contribute to striping, especially with the primer coat. Applying inadequate amount of product requires corner to corner recoating.

.4 When rolling product, roll off in same direction across façade to prevent shading differences that affect appearance of color.

.5 When spraying product:

.1 Do not strain silicate coatings.

.2 Remove paint filters from spray gun and spray pump.

.3 Use only new hoses. Used hoses may contain paint thinners or solvents.

.4 Paint thinners and cleaning solvents are not compatible with silicate coatings.

.5 Clear gun and spray equipment with warm soapy water and rinse well with clean water to remove residual paint thinners and solvents.

.6 Never use tips with smaller orifices than recommended. Smaller tips clog and prevent proper coating application. Improper application voids warranty and shortens longevity of the coatings.

.7 Prevent overspray drift or misting onto glass objects.

.6 When working from scaffolding, work as a team moving across façade maximum 2.4m per applicator to ensure complete coverage and wet edge left to right and top to bottom of each section.

## 3.0 EXECUTION

### 3.1 CONDITION OF SURFACES

.1 Prior to commencement of work of this section, thoroughly examine surfaces scheduled to be painted.

.2 Report in writing to the Consultant any condition adversely affecting this work.

.3 Do not proceed with Work until all such defects have been corrected and surfaces are acceptable to the Painting Contractor.

.4 Commencement of work shall be held to imply acceptance of surfaces except as qualified herein.

### 3.2 PREPARATION

Before applying the paint, the various surfaces shall be prepared as described below:

.1 All steel and iron component (frame, hinges, screens, etc.) must be removed from the existing concrete opening and be cleaned off-site. All surfaces to be cleaned in accordance with SSPC SP1 to remove all visible contaminants, but also non-visible contaminants such as chloride soluble salts. This can be achieved by pressure washing using water, together with a cleaning agent, non-ionic detergent, or hot water alone with a minimum pressure of 2,500 psi. For sea coast marine environments, it is referred to maximum 7ug/cm$^2$ soluble chloride salts. All steel and iron to be abrasive blasted in accordance with SSPC SP6 with a minimum of 1.5 mil jagged angular profile. Surface defects revealed by the blast cleaning process to be ground, filled, or treated in appropriate manner.

.2 For silicate paint coating application, lay ground cloths and take measures as necessary to protect surfaces subject to contact by Silicate paint coatings and dilution. It may etch or bond to glass, metal, and concrete.

.3 Prepare all surfaces in accordance with MPI Architectural Painting Manual for all specified MPI paint systems.

3.3 APPLICATION

.1 Use method of paint application generally as accepted by the trade method.

.2 Painting coats specified are intended to cover surfaces satisfactorily when applied in strict accordance with recommendations. Apply each coat at the proper consistency.

.3 Sand lightly and dust between coats to achieve required finish.

.4 Do not apply finishes on surfaces that are not sufficiently dry. Each coat of finish should be dry and hard before a following coat is applied unless the manufacturer's directions state otherwise.

.5 Back prime interior woodwork which is to receive a paint or enamel finish upon arrival at the job site with enamel undercoater paint. Finish tops of cabinet and projecting ledges, both above and below sightlines as specified for surrounding surfaces.

.6 Immediately after fitting and sanding and before hanging, seal the entire door with undercoater, stain or varnish as specified, including the top, bottom, opening and hardware recess edges. Finish with at least two coats of good quality oil based paint, varnish or lacquer as specified.

.7 Apply paint and decorating material in a workmanlike manner using skilled and trade qualified applicators as noted under Quality Assurance.

.8 Minimum painting standards shall be in accordance with MPI Architectural Painting Specification Manual Premium Grade finish requirements.

.9 Paint all surfaces requiring paint or stain finish to minimum MPI Architectural Painting Specification Manual finish requirements with application methods in accordance with best trade practices for type and application of materials used.

.10 Apply paint and coatings within an appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or the manufacturer’s paint specifications require earlier applications.

.11 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer’s recommendations.

.12 Tint each coat of paint progressively lighter to enable confirmation of number of coats.

.13 Apply a minimum of four coats of paint where deep or bright colours are used to achieve satisfactory results. Apply minimum of four coats of paint where light colour is used to cover existing dark colour surface.

.14 Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1000mm (39”).

.15 Prime coat of stain or varnish finishes may be reduced in accordance with manufacturer’s directions.

.16 Application of high performance coating system on existing steel to be in accordance with manufacturer's recommendation.

.17 Application of silicate coating as follows:

.1 Primer Coat:

.1 Dilute mineral-silicate texture coating with maximum 10 percent dilution (4 gallons with 1.5 liters dilution). Stir well by hand or 600-800 RPM mixing equipment.

.2 Apply primer coat of diluted mineral silicate texture coating.

.3 Allow minimum 12 hours drying time.

.2 Intermediate Coat:

.1 Do not dilute. Stir well by hand or 600-800 RPM mixing equipment.

.2 Apply intermediate coat of undiluted silicate coating.

.3 Top Coat:

.1 Do not dilute. Stir well by hand or 600-800 RPM mixing equipment.

.2 Apply top coat of undiluted silicate coating.

.4 Touch Up:

.1 Some colors touch up well, some do not. Always perform a test and allow the touch up to cure minimum 12 hours before evaluation. Colors become lighter upon drying.

.2 For colors that do not touch up well, expect corner to corner recoating for acceptable results.

.3 When touching up or recoating, use the same tools and techniques for best results.

.4 Articulate the application confining the recoating to the borders of the repair.

## 3.4 CLEANING

.1 Upon completion, remove from the building materials and debris created by this work. During the progress and on completion of the work carefully clean and remove paint from adjoining surfaces, hardware, glass, etc. The whole shall be left in perfect condition. Touch up and make good any paint work damaged by other trades.

## 3.5 SCHEDULES

EXTERIOR (RE-PAINT ITEMS):

.1 Concrete Horizontal Surfaces (Patio, Sidewalk, Stair)
MPI REX 3.2G Concrete floor sealer finish

.2 Concrete Vertical Surfaces
Mineral silicate coating as specified

.3 Steel and Iron (exposed metal, metal gate and metal screen, stair, handrail)

Highly durable (above 15 years) coating designed for environments classified by ISO 12944-2 as C5-M very high corrosivity (Marine).

Prime – Apply one coat Catha coat 302H Reinforced Inorganic Zinc at 3-4 mils DFT.

Mid – Apply one coat Bar Rust 235 HB Epoxy at 5-8 mils DFT.

Finish – Apply one coat Bar Rust 235 HB Epoxy at 4-8 mils DFT.

Min 12 mils TDFT / Max 20 mils TDFT

Multiple application by brush may be required to achieve the min 12 mils TDFT.

.4 Stucco
REX 9.1C Elastomeric coating

INTERIOR (RE-PAINT ITEMS)

.1 Steel and Iron: All metal work but not limited to exposed metal, metal gate and metal screen, stair, handrail, door, metal frame and shutter
Highly durable (above 15 years) coating designed for environments classified by ISO 12944-2 as C5-M very high corrosivity (Marine).

Prime – Apply one coat Catha coat 302H Reinforced Inorganic Zinc at 3-4 mils DFT.

Mid – Apply one coat Bar Rust 235 HB Epoxy at 5-8 mils DFT.

Finish – Apply one coat Bar Rust 235 HB Epoxy at 4-8 mils DFT.

Min 12 mils TDFT / Max 20 mils TDFT

Multiple application by brush may be required to achieve the min 12 mils TDFT.

.2 Brick
Lime wash (white wash) – 2 coats minimum to achieve solid color.

.3 Concrete Horizontal Surfaces (Floor)
MPI RIN 3.2E Concrete floor sealer

.4 Concrete Vertical Surfaces
Mineral silicate coating as specified.

END OF SECTION 09 91 00

1.0 GENERAL

1.1 RELATED SECTIONS

.1 Excavating, Trenching and Backfilling Section 31 23 10

.2 Storm Utility Drainage Piping Section 33 41 00

1.2 REFERENCES

.1 ASTM; AWWA; CAN – As specified in the contract document

1.3 SAMPLES

.1 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Divert unused granular materials from landfill to local facility as approved by Departmental Representative.

2.0 PRODUCTS

2.1 MATERIALS

.1 Gravel to be composed of inert, durable material, reasonably uniform in quality and free from soft or disintegrated particles. In absence of satisfactory performance records over a five year period for particular source of material, soundness to be tested according to ASTM test procedure C-88 or latest revised issue. Maximum weight average losses for course and fine aggregates to be 30% when magnesium sulphate is used after five cycles.

.2 All crushed gravel when tested according to ASTM C-136 and ASTM C-117, or latest revised issue, to have a generally uniform gradation and conform to following gradation limits and 60% of the material passing each sieve must have one or more fractured faces. Determination of the amount of fractured material shall be in accordance with the Ministry of Transportation and Highways' Specification I-11, Fracture Count for Coarse Aggregate, Method "A", which determines fractured faces by count. The Plasticity Index for crushed gravel to not exceed 6.0.

2.2 NATIVE MATERIALS

1. To be any workable soil free of organic or foreign matter; any material obtained within limits of Contract may be approved by the Department Representative. Native material content or compact to specified density.

2.3 PIT RUN GRAVEL

1. To be well graded granular material, substantially free from clay lumps, organic matter and other extraneous material, screened to remove all stones in excess of maximum diameter specified in material description (300 mm Pit Run Gravel, 200 mm Pit Run Gravel, 100 mm Pit Run Gravel). Material to compact to specified density and conform to following gradations:

| Sieve Designation | Percent Passing |
|---|---|
| (300mm) | (100) |
| (200mm | (100) |
| (100mm | (100) |
| 75mm | 100 |
| 50mm | 70-100 |
| 25mm | 50-100 |

| | |
|---|---|
| 4.75mm | 22-100 |
| 2.36mm | 10-85 |
| 0.075mm | 2-8 |

Recycled concrete free from contaminated and other extraneous material, conforming to the specified gradations may be used as pit run gravel.

2.4 DRAIN ROCK

.1 To consist of clean round stone or crushed rock conforming to the following gradations:

| | Percent Passing | |
|---|---|---|
| **Sieve Designation** | **Course** | **Fine** |
| 25.0mm | 100 | |
| 19.0mm | 0-100 | |
| 9.5mm | 0-5 | 100 |
| 4.75mm | 0 | 50-100 |
| 2.36mm | | 5-15 |
| 1.18mm | | 15-38 |
| 0.600mm | | 0-8 |
| 0.300mm | | 0-5 |
| 0.150mm | | 0-2 |
| 0.075mm | | 0 |

.2 Drain rock to be used only where specified on Contract Drawings. Use of drain rock other than as specified requires approval of Department Representative after examination of soils against which drain rock will be placed.

2.5 GRANULAR PIPE BEDDING AND SURROUND MATERIAL

**.1** Crushed or graded gravels to conform to following gradations:

| | Percent Passing | |
|---|---|---|
| **Sieve Designation** | **Type 1*** | **Type 2*** |
| 25.0mm | 100 | 100 |
| 19.0mm | 90-100 | 90-100 |
| 12.5mm | 65-85 | 70-100 |
| 9.5mm | 50-75 | |
| 4.75mm | 25-50 | 40-70 |
| 2.36mm | 10-35 | 25-52 |
| 1.18mm | 6-26 | 15-38 |
| 0.600mm | 3-17 | 6-27 |
| 0.3mm | | 3-20 |
| 0.075mm | 0-5 | 0-8 |

Type 1* standard gradation

Type 2* to be used only in dry trench conditions and with Departmental Representative's prior approval

2.6 SOURCE QUALITY CONTROL

.1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing production.

.2 If, in opinion of Departmental Representative, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet

specified requirements.

.3 Advise Departmental Representative 4 weeks in advance of proposed change of material source.

.4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

## 3.0 EXECUTION

### 3.1 PREPARATION

.1 Topsoil stripping

.1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

.2 Begin topsoil stripping of areas as directed by Departmental Representative after area has been cleared of brush and grasses and removed from site.

.3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.

.4 Dispose of topsoil to location as indicated off site.

.2 Aggregate source preparation

.1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as approved by authority having jurisdiction.

.2 When excavation is completed dress sides of excavation in accordance with the Geotechnical Report, and provide drains or ditches as required to prevent surface standing water.

.3 Trim off and dress slopes of waste material piles and leave site in neat condition.

.3 Processing

.1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.

.2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Departmental Representative.

.3 Wash aggregates, if required to meet specifications. Use only equipment approved by Departmental Representative.

.4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.

.4 Handling

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

.5 Stockpiling

.1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.

### 3.2 CLEANING

.1 Leave aggregate stockpile site in tidy, well-drained condition, free of standing surface water.

.2 Leave any unused aggregates in neat compact stockpiles as directed by Departmental Representative.

END OF SECTION 31 05 16

## 1.0 GENERAL

### 1.1 RELATED SECTIONS

| | | |
|---|---|---|
| .1 | Aggregate Materials | Section 31 05 16 |
| .2 | Manholes and Catch Basin Structures | Section 33 05 13 |
| .3 | Storm Utility Drainage Piping | Section 33 41 00 |

### 1.2 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 C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .3 ASTM D 422-63, Standard Test Method for Particle-Size Analysis of Soils.
- .4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft $^3$) (600 kN-m/m$^3$).
- .5 ASTM D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft $^3$)(2,700 kN- m/m$^3$).
- .6 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
- .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)
- .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .2 CSA-A3001, Cementitious Materials for Use in Concrete.
- .3 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

### 1.3 DEFINITIONS

.1 Excavation classes: one class of excavation will be recognized; common excavation.
- .1 Rock: solid material in excess of 1.00m $^3$ and which cannot be removed by means of heavy duty mechanical excavating equipment with 1.0m$^3$ bucket. Frozen material not classified as rock.
- .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Topsoil:
- .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

.5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.6 Unsuitable materials:

.1 Weak, chemically unstable, and compressible materials.

.2 Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.1.

.2 Coarse grained soils containing more than 10 % by mass passing 0.075 mm sieve.

.7 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

## 1.4 QUALITY ASSURANCE

.1 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of BC, Canada.

.2 Keep design and supporting data on site.

.3 Engage services of qualified professional Engineer who is registered or licensed in Province of BC, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.

.4 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Health and Safety Requirements.

## 1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Divert excess materials from landfill to local facility for reuse as directed by Departmental Representative.

## 1.6 EXISTING CONDITIONS

.1 Buried services:

.1 Before commencing work establish location of buried services on and adjacent to site.

.2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.

.3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

.4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.5 Prior to beginning excavation Work, notify applicable Departmental Representative, establish location and state of use of buried utilities and structures.

.6 Confirm locations of buried utilities by careful soil hydrovac methods.

.7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing/re-routing.
.9 Record location of maintained, re-routed and abandoned underground lines.
.10 Confirm locations of recent excavations adjacent to area of excavation.

.2 Existing buildings and surface features:
.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
.3 Where required for excavation, cut roots or branches as directed by Departmental Representative.
.4 Restore roadway to existing conditions or better upon completion.

## 2.0 PRODUCTS

### 2.1 MATERIALS

.1 Type 1 and Type 2 fill: properties to Section 31 05 16 - Aggregate Materials and the following requirements:
.1 Crushed, pit run or screened stone, gravel or sand.
.2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.

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

## 3.0 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 sediment and erosion control plan, specific to site, that complies with requirements of authorities having jurisdiction.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 3.2 SITE PREPARATION

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

### 3.3 PREPARATION/PROTECTION

.1 Protect existing features.

.2 Keep excavations clean, free of standing water, and loose soil.

.3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.

.4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

.5 Protect buried services that are required to remain undisturbed.

3.4 STRIPPING OF TOPSOIL

.1 Begin topsoil stripping of areas as directed by the Departmental Representative after area has been cleared of brush, weeds and grasses and removed from site.

.2 Strip topsoil to depths as directed by Departmental Representative.
.1 Do not mix topsoil with subsoil.

.3 Stockpile in locations as directed by Departmental Representative.
.1 Stockpile height not to exceed 2 m and should be protected from erosion.

.4 Dispose of unused topsoil off site.

3.5 STOCKPILING

.1 Stockpile fill materials in areas designated by Departmental Representative.
.1 Stockpile granular materials in manner to prevent segregation.

.2 Protect fill materials from contamination.

.3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 DEWATERING AND HEAVE PREVENTION

.1 Riprap and headwall installation are to be done in dry conditions.

.2 Keep excavations free of water while Work is in progress.

.3 Provide for Departmental Representative's review details of proposed dewatering.

.4 Protect open excavations against flooding and damage due to surface run-off.

.5 Dispose of water in a manner not detrimental to public and private property, or portion of Work completed or under construction.
.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

.6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.7 EXCAVATION

.1 Excavate to lines, grades, elevations and dimensions as indicated.

.2 Remove concrete, masonry, paving, walks demolished foundations and rubble and other obstructions encountered during excavation.

.3 Excavation must not interfere with bearing capacity of adjacent foundations.

.4 Do not disturb soil within branch spread of trees or shrubs that are to remain.

.1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

.5 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.7 Restrict vehicle operations directly adjacent to open trenches.

.8 Dispose of surplus and unsuitable excavated material off site.

.9 Do not obstruct flow of surface drainage or natural watercourses.

.10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.11 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

.12 Correct unauthorized over-excavation as follows:

.1 Fill under bearing surfaces and footings with Type 2 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.

.2 Fill under other areas with Type 2 fill compacted to not less than 95% of corrected Standard Proctor maximum dry density.

.13 Hand trim, make firm and remove loose material and debris from excavations.

.1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

.2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.

3.8 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact granular material for bedding and surround of underground services as indicated.

.2 Place bedding and surround material in unfrozen condition.

3.9 BACKFILLING

.1 Do not proceed with backfilling operations until completion of following:
- .1 Departmental Representative has inspected and approved installations.
- .2 Departmental Representative has inspected and approved of construction below finish grade.
- .3 Inspection, testing, approval, and recording location of underground utilities.
- .4 Removal of concrete formwork.
- .5
- .6 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.4 Do not use backfill material which is frozen or contains ice, snow or debris.

.5 Place backfill material in uniform layers not exceeding 300mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.6 Backfilling around installations:
- .1 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
- .2 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.30 m.

3.10 RESTORATION

.1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.

.2 Replace topsoil as directed by Departmental Representative.

.3 Reinstate lawns to elevation which existed before excavation.

.4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.

.5 Clean and reinstate areas affected by Work as directed by Departmental Representative.

.6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

.7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION 31 23 10

## 1.0 GENERAL

### 1.1 SUMMARY

.1 This section specifies a hydraulically-applied, 100% biodegradable, High Performance-Flexible Growth Medium (HP-FGM) that is composed of 100% recycled thermally refined (within a pressure vessel) wood fibers, crimped interlocking man-made biodegradable fibers, mineral activators, naturally derived crosslinked biopolymers and water absorbents. The HP-FGM is phytosanitized, free from plastic netting, requires no curing period and upon application forms an intimate bond with the soil surface to create a continuous, porous, absorbent and flexible erosion resistant blanket that allows for rapid germination and accelerated plant growth.

.2 Related Sections: Refer Appendix 4 Hydro Seed Application Guide of this specification.

### 1.2 SUBMITTALS

.1 Product Data: Submit manufacturer's product data and installation instructions. Include required substrate preparation, list of materials and application rate.

.2 Certifications: Manufacturer shall submit a letter of certification that the product meets or exceeds all technical and packaging requirements.

### 1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials and products in UV and weather-resistant factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage, weather, excessive temperatures and construction operations.

## 2.0 PRODUCTS

### 2.1 MATERIALS

.1 The HP-FGM shall conform to the following property values when uniformly applied at a rate of 3500 pounds per acre (3900 kilograms/hectare) under laboratory conditions.

| Property | Test Method | Req. Value (English) | Req. Value (SI) |
|---|---|---|---|
| **Physical** | | | |
| Mass Per Unit Area | ASTM D6566[1] | 12 oz/yd$^2$ minimum | 407 g/m$^2$ minimum |
| Thickness | ASTM D6525[1] | 0.22 inch minimum | 5.6 mm. minimum |
| Wet Bond Strength | ASTM D6818[1] | 9 lb/ft | 131 N/m |
| Ground Cover | ASTM D6567[1] | 99% minimum | 99% minimum |
| Water Holding Capacity | ASTM D7367 | 1700% minimum | 1700% minimum |
| Material Color | Observed | Green | Green |
| **Performance** | | | |
| Cover Factor[2] | Large Scale Testing[4] | 0.01 maximum | 0.01 maximum |
| % Effectiveness[3] | Large Scale Testing[4] | 99 % minimum | 99 % minimum |
| Cure time | Observed | 0 - 2 hours | 0 - 2 hours |
| Vegetation Establishment | ASTM D7322[1] | 800 % minimum | 800 % minimum |
| Yield[5] | Calculated | 2.6 minimum | 2245 minimum |
| Kinetic Energy Absorption Potential[6] | Calculated | 2.0 minimum | 734 minimum |
| **Environmental** | | | |
| Functional Longevity[7] | ASTM D5338 | Up to 18 months | Up to 18 months |

| | | | |
|---|---|---|---|
| Ecotoxicity | EPA 2021.0 | 96-hr LC50 > 100% | 96-hr LC50 > 100% |
| Effluent Turbidity | Large Scale Testing[4] | 100 NTU maximum | 100 NTU maximum |
| Biodegradability | ASTM D5338 | 100% minimum | 100% minimum |

1. ASTM test methods developed for Rolled Erosion Control Products and have been modified to accommodate Hydraulically-Applied Erosion Control Products.
2. Cover Factor is calculated as soil loss ratio of treated surface versus an untreated control surface.
2. % Effectiveness = One minus Cover Factor multiplied by 100%.
4. Large scale testing conducted at Utah Water Research Laboratory. For specific testing information please contact a Profile technical service representative at 866-325-6262.
5. Yield = (Mass per Unit Area)*(Thickness)*(Ground Cover Percentage).
6. Kinetic Energy Absorption Potential = (Wet Bond Strength)*(Thickness)
7. Functional Longevity is the estimated time period, based upon ASTM D5338 testing and field observations, that a material can be anticipated to provide erosion control and agronomic benefits as influenced by composition, as well as site-specific conditions, including; but not limited to – temperature, moisture, light conditions, soils, biological activity, vegetative establishment and other environmental factors.

2.3 COMPOSITION

.1 All components of the HP-FGM shall be pre-packaged by the Manufacturer to assure both material performance and compliance with the following values. No chemical additives with the exception of fertilizer, soil pH modifiers, extended-term dyes and biostimulant materials should be added to this product.

.1 Thermally Processed (within a pressure vessel) Wood Fiber – 80% + 3%

.1 Heated to a temperature greater than 380 degrees Fahrenheit (193 degrees Celsius) for 5 minutes at a pressure greater than 50 psi (345 kPa)
Crosslinked Biopolymers and Water Absorbents – 10% + 1%
Crimped, Man-made Biodegradable Interlocking Fibers – 5% + 1%
Micro-Pore Granules – 5% + 1%

2.4 PACKAGING

.1 Bags: Net Weight – 50 lb, UV and weather-resistant plastic film
Pallets: Weather-proof, stretch-wrapped with UV resistant pallet cover
Pallet Quantity: 40 bags/pallet or 1 ton/pallet

3.0 EXECUTION

3.1 SUBSTRATE AND SEEDBED PREPARATION

.1 Examine substrates and conditions where materials will be applied. Apply product to geotechnically stable slopes that have been designed and constructed to divert runoff away from the face of the slope. Do not proceed with installation until satisfactory conditions are established.

.2 Depending upon project sequencing and intended application, prepare seedbed in compliance with other specifications under Section 1.01 B

3.2 INSTALLATION

.1 Strictly comply with equipment manufacturer's installation instructions and recommendations. Use approved hydro-spraying machines with fan-type nozzle (50-degree tip). To achieve optimum soil surface coverage, apply HP-FGM from opposing directions to soil surface. Rough surfaces (rocky terrain, cat tracks and ripped soils) may require higher application rates to achieve 100% cover. Slope interruption devices or water diversion techniques are recommended when slope lengths exceed 100 feet (30 m). Maximum slope length is for product applications on a 3H:1V slope. For application on steeper slopes, slope interruption lengths may need to be decreased based on actual site conditions. Not recommended for channels or areas with concentrated water flow. This product may be applied on saturated soils and does not require a curing period to be effective. No chemical additives with the exception of fertilizer, liming and biostimulant materials should be added to this product.

.2 For Erosion Control and Revegetation: To ensure proper application rates, measure and stake area. For maximum performance, apply HP-FGM in a two-step process*:

.1 Step One: Apply fertilizer with specified prescriptive agronomic formulations and 50% of seed with a small amount of HP-FGM for visual metering.

.2 Step Two: Mix balance of seed and apply HP-FGM at a rate of 50 lb per 125 gallons (23 kg/475 liters) of water over freshly seeded surfaces. Confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.

.3 Depending upon site conditions HP-FGM may be applied in a one-step process where all components may be mixed together in single tank loads. Consult with Manufacturer for further details.

.4 Best results and more rapid curing are achieved at temperatures exceeding 60°F (15°C). Curing times may be accelerated in high temperature, low humidity conditions with product applied on dry soils.

.5 Over-application of product may inhibit germination and plant growth.

.3 Mixing: A mechanically agitated hydraulic-application machine is strongly recommended:

.1 Fill 1/3 of mechanically agitated hydroseeder with water. Turn pump on for 15 seconds and purge and pre-wet lines. Turn pump off.

.2 Turn agitator on and load low density materials first (i.e. seed).

.3 Continue slowly filling tank with water while loading fiber matrix into tank.

.4 Consult application and loading charts to determine number of bags to be added for desired area and application rate. Mix at a rate of 50 lb of HP-FGM per 125 gallons (23 kg/475 liters). Contact Equipment manufacturer to confirm optimum mixing rates.

.5 All HP-FGM should be completely loaded before water level reaches 75% of the top of tank.

.6 Top off with water and mix until all fiber is fully broken apart and hydrated (minimum of 10 minutes — increase mixing time when applying in cold conditions). This is very important to fully activate the bonding additives and to obtain proper viscosity.

.7 Add fertilizer.

.8 Shut off recirculation valve to minimize potential for air entrainment within the slurry.

.9 Slow down agitator and start applying with a 50-degree fan tip nozzle.

.10 Spray in opposing directions for maximum soil coverage.

.4 Application Rates: These application rates are for standard conditions. Designers may wish to reduce rates to encourage faster vegetation establishment or may need to increase application rates on rough surfaces.

| **Slope Gradient / Condition** | **English** | **SI** |
|---|---|---|
| ≤ 4H to 1V | 2500 lb/ac | 2800 kg/ha |
| > 4H to 1V and ≤ 3H to 1V | 3000 lb/ac | 3400 kg/ha |
| ≥ 3H to 1V and ≤ 2H to 1V | 3500 lb/ac | 3900 kg/ha |
| > 2H to 1V and ≤ 1H to 1V | 4000 lb/ac | 4500 kg/ha |
| > 1H to 1V | 4500 lb/ac | 5100 kg/ha |

3.3 CLEANING AND PROTECTION

.1 After application, thoroughly flush the tank, pumps and hoses to remove all material. Wash all material from the exterior of the machine and remove any slurry spills. Once dry, material will be more difficult to remove.

.2 Clean spills promptly. Advise Departmental Representative of methods for protection of treated areas. Do not allow treated areas to be trafficked or subjected to grazing.

END OF SECTION 31 25 14.13

1.0 WORK INCLUDED

.1 The unit prices submitted in the Form of Tender shall include the entire cost of supplying all labour, material, equipment and applicable taxes required to install micro-pies where called for on the drawings and outlined in this specification. The work to be performed under this section shall consist of drilling, furnishing, grouting, and testing of piles at locations shown on the plans, or as directed by the Departmental Representative, and in conformity with this specification.

2.0 DEFINITIONS

.1 Bond Length: Refers to the portion of the pile that transmits the load to the surrounding rock.

.2 Tendon: Refers to the complete length of anchor.

.2 Alignment Load (AL): AL = 10% of design load ($P_d$)

.3 Design Load ($P_d$): Refers to the factored yield load of the pile in the contract drawings.

.4 Maximum Test Load (Pt): Pt = 1.15Pd. Note: Test load factor can vary from 1.1Pd to 2.0Pd, depending on the application.

.5 Proof Test: Refers to the incremental loading of a pile by recording the incremental movement of the pile at each specified load stage.

.6 Creep Test: Refers to a test used to determine the movement of the pile at constant load over a specific period of time.

3.0 GENERAL

.1 Performance

.1 Perform all work and supply materials as specified herein and in accordance with the Contract documents.

.2 Geotechnical Report

.1 A copy of the geotechnical report is available for reference and review upon request.

.3 Responsibility of the Contractor

.1 Firms undertaking to bid this work shall have a minimum of five years experience in projects of this magnitude and shall have equipment and manpower suitable and available for the entire duration of the project.

.4 Inspection and Testing

.1 The Departmental Representative will retain an independent testing agency for the testing of cement grout and the inspection of the work. The costs will be borne by the contractor. The contractor shall submit to the Departmental Representative the mill test certificate of the steel used to fabricate the micro-piles. The Contractor is responsible for carrying out performance testing of the piles.

.5 Shop Drawings

.1 Submit shop drawings for approval to the Departmental Representative a minimum of 4 weeks prior to commencement of work.

.2 Shop drawings shall include the following information:

.1 Pile layout
.2 Pile component details, pile length and borehole diameter
.3 Pile design capacity
.4 Grade and properties of the pile material
.5 Percent of pile yield load at working procedure
.6 Grout: cement type, strength, addictives, mix design
.7 Proposed drilling method
.8 Sequence of drilling and installation

.6 Acceptability

.1 Failure of any pile to meet the performance test criteria will result in rejection of the pile in question. The criteria for performance acceptance are outlined in paragraph 9.

.7 Jobsite Conditions

.1 The length of piles has been determined based on available geological data.
.2 If during construction, the site conditions are found to be significantly different from those anticipated, the length and/or the spacing of piles may be changed as directed by the Departmental Representative.

.8 Basis of Payment

.1 The price shall include all costs for mob and demobilization, supply, drilling, installation, grouting and testing of successfully completed anchors as measured by the Departmental Representative.

## 4.0 PRODUCTS

.1 General Description

.1 The DYWIDAG micro-pile is a pressure grouted compression and tension pile of small diameter (micro-pile). The load-bearing component is a DYWIDAG Threadbar. The grout cylinder encases the Threadbar, which is kept in the center of the borehole by centralizers.
.2 The cement grout protects the steel against corrosion, and stabilizes the pile within the soil against buckling. The load is transferred to the ground by skin friction between the grout body and the soil or rock.

.2 ~~DYWIDAG~~ DYWIDAG Threadbar

.1 The micro-piles shall consist of a 25mm diameter DYWIDAG Threadbar manufactured in accordance with ASTM A706 or CSA G30.18M weldable grade.

Grade Steel: 500/550 MPa
Steel Area: $A_s$ = 491 $mm^2$
Yield capacity: $P_y$ = 246 KN

.3 Corrosion Protection

.1 The Threadbar shall be shop grouted inside a corrugated PVC sheathing for the entire length. Corrugated sheathing shall be made of PVC material with a minimum compressive strength of 103 MPa (14,500 psi) and a minimum tensile strength of 48 MPa (7,000 psi). PVC material shall be free of water-soluble chlorides and other ingredients that might enhance corrosion, hydrogen embrittlement or stress corrosion on the steel tendon. The ultimate bond stress between the PVC sheathing and the cement grout shall be a minimum of 4.8 MPa (700psi) based on the minimum compressive grout strength of 28 MPa. The cement grout for the pile shall be non-shrink Portland Cement grout with a minimum 28 day compressive strength of 30 MPa.

.4 Anchorage Nuts and Couplers

.1 Anchor nuts and couplers shall be compatible with the ~~DYWIDAG~~ Threadbar Anchor micro-pile system, and shall develop at least 100% of the ultimate tensile strength of the ~~DYWIDAG~~ Threadbar Anchor in tension and compression.

## 5.0 MICRO-PILE FABRICATION

.1 Micro-piles shall be shop-fabricated in accordance with approved shop drawings, using personnel trained and qualified in this type of work.

.2 The prefabricated pile assemblies shall be protected against physical damage and corrosion at all times prior to installation. Any pile or pile component (including the protective sheathing) that is damaged during the work shall be replaced at the expense of the Contractor.

## 6.0 DRILLING

.1 Casing is required for drilling of the piles through all materials except sound rock to the minimum borehole diameter as indicated on the contract drawings.

.2 Pile holes shall be drilled within plus or minus 1% of the theoretical centerline and shall be located within plus or minus 50mm from the location as shown on the contract drawings.

.3 Pile holes shall be thoroughly cleaned by flushing with water immediately prior to the installation of piles.

.4 Prior to installing micro-pile in the cleaned holes, the bond zone shall be inspected by a Departmental Representative using a suitable waterproof downhole video camera system supplied by the Contractor. Methods and equipment used for inspection are to permit accurate determination of soundness, weathering, fracturing, jointing of rock exposed on bond zone surface. If sound rock is not found within the bond zone, the drill hole shall be extended, re-cleaned and re-inspected until the bond zone is entirely within sound rock.

.5 The Contractor shall keep a record of all drilling procedures, drilling time, and video inspections, which shall be made available to the Departmental Representative.

2.3 INSTALLATION

.1 The Departmental Representative shall be notified 48 hours in advance of installation of individual anchors and provided access and opportunity to review all tasks associated with the installation and to verify the recorded depth of the anchor.

.2 The installation of the micro-piles shall be supervised by a Professional Engineer or by his/her representative.

.3 Steel or plastic centralizers shall be provided to ensure that the micro-pile assembly is centrally located in the hole, providing a minimum grout cover of 15.0 mm.

.4 The Contractor shall maintain a record showing the weather, recorder, equipment, pile number, bonded length, drill diameter, cement grout quantity and installation time and date for each micro-pile.

.5 Anchors are to be installed to meet the specified test loads.

.6 Provide copies of records upon request by the Departmental Representative.

2.4 GROUTING

.1 The pile grout shall be Portland Cement grout with a minimum design compressive strength of 35 MPa at 28days. The mixing water shall be free of any deleterious material. No detrimental quick-set additives such as calcium chloride are permitted.

.2 Mix-design for grout to be designed by the Contractor, meeting the requirements specified herein.

.3 Use equipment capable of continuous mechanical mixing and pumping to produce a grout free of lumps and undispersed cement.

.4 The grout shall be pumped into the cased hole through a grout tube from the bottom until neat grout exits from the top of the drill casing.

.5 The grout shall always be injected at the lowest point of the pile.

.1 Post-grouting shall be performed in accordance with the manufacturer's recommendations.

.6 After each grouting operation, the piles shall remain in an undisturbed condition until adequate grout strength has been achieved.

2.5 PERFORMANCE TEST

.1 All performance testing equipment must be used in accordance with the specifications of the manufacturer and must at all times be maintained in good condition.

The contractor shall provide all necessary devices and instruments for testing of the piles, meeting standard pile testing procedures and measuring anchor elongation.

.2 Proof testing shall not be carried out until the grout has reached its specified strength.

.3 All performance test data shall be recorded and made available to the Departmental Representative upon request.

.4 Load versus displacement data for each test shall be plotted on a load extension graph.

.5 Pile displacements under constant creep test load shall be plotted as displacement in millimetres versus the log of time in minutes.

.6 The Contractor is to provide the Departmental Representative with a copy of the calibration certificate of the jack to be used for testing dated no longer than 1 month before the start of anchor testing.

.7 The stressing equipment is to:
- .1 Be capable of applying at least 120 % of the specified test load.
- .2 Have a calibrated pressure gauge indicating the hydraulic jack pressure to an accuracy of ±3%.
- .3 Have been calibrated by an acceptable authority within 4 weeks prior to use on this site.

.8 Elongation and displacements are to be measured and recorded to the nearest 0.025mm with respect to an independent reference point.

.9 Performance testing for the micro-piles shall be conducted as follows:
- .1 The Departmental Representative may select that all or a certain number of piles be performance tested and creep tested. Cost for testing shall be borne by the Contractor. Allow costs for 6 piles at the locations selected by the Departmental Representative.
- .2 All selected piles shall be proof tested to 115% of design load.
- .3 An alignment load (AL), equivalent to 10% of the design load shall be applied to remove the slack from the pile and to engage the equipment. At this time, the dial gauge for elongation measurement shall be set to zero. The pile shall then be loaded by a hydraulic jack in a single operation to 0.5Pd and maintained at that load for 30 minutes for creep measurement. The creep measurement shall be recorded at 1, 3, 5, 10, 15, 20, and 30 minutes. The pile shall then be unloaded to AL and the residual displacement recorded.
- .4 Repeat the test at 1.0Pd and 1.15Pd. Hold load at 1.0Pd for 30 minutes for creep measurement. Unload the pile to AL and record the residual displacement. Acceptance criteria are met when the slope of the free displacement versus log time plot is less than 1.5 mm per log cycle and the test load levels of 1.15Pd.

END OF SECTION 31 63 00

1.0 GENERAL

1.1 RELATED SECTIONS

.1 Section 31 23 10-Excavating, Trenching and Backfilling.

.2 Section 33 41 00-Storm Utility Drainage Piping.

1.2 REFERENCES

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

.1 ASTM A48 / A48M, Standard Specification for Gray Iron Castings.

.2 ASTM C117, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.

.3 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM C139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

.5 ASTM C478M, Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].

.6 ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-A23.1/A23.2-2014, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.1 CSA-A3001, Cementitious Materials for Use in Concrete.

.2 CSA-A3002, Masonry and Mortar Cement.

.3 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.4 CAN/CSA-G30.18, Billet Steel Bars for Concrete Reinforcement.

.5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

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

2.0 PRODUCTS

2.1 MATERIALS

.1 Cast-in-place concrete:

.1 Cement: to CAN/CSA-A3001, Type GU 50.

.2 Concrete mix design to produce 30 MPa minimum compressive strength at 28 days and containing 25mm maximum size coarse aggregate, with water/cement ratio to CAN/CSA-A23.1.
.1 Air entrainment to CAN/CSA-A23.1.

.2 Precast manhole units: to ASTM C478M, circular or oval.
.1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.

.3 Precast catch basin sections: to ASTM C478M.

.4 Joints: made watertight using rubber rings to ASTM C443 or cement mortar.

.5 Mortar:
.1 Aggregate: to CSA A82.56.
.2 Masonry Cement: to CAN/CSA-A8.

.6 Ladder rungs: to CAN/CSA-G30.18, No.25M billet steel deformed bars, hot dipped galvanized to CAN/CSA-G164.
.1 Rungs to be safety pattern (drop step type).

.7 Adjusting rings: to ASTM C478.

.8 Concrete Brick: to CAN3-A165 Series.

.9 Drop manhole pipe: same as sewer pipe.

.10 Galvanized iron sheet: approximately 2 mm thick.

.11 Steel gratings, I-beams and fasteners: as indicated.

.12 Frames, gratings, covers to dimensions as indicated and following requirements:
.1 Metal gratings and covers to bear evenly on frames.
.1 Frame with grating or cover to constitute one unit.
.2 Assemble and mark unit components before shipment.
.2 Cast iron manhole & catchbasin frames and covers must conform to ASTM A48 and be designed to withstand H2O loading.
.1 Must bear manufacturer identification on castings.

.13 Granular bedding and backfill: in accordance with Section 31 05 16 - Aggregate Materials.

.14 Unshrinkable fill: in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

## 3.0 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 EXCAVATION AND BACKFILL

.1 Excavate and backfill in accordance with Section 31 23 10 - Excavating Trenching and Backfilling and as indicated.

3.3 INSTALLATION

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.2 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.

.3 Set precast concrete base on 100 mm minimum of granular bedding compacted to 95%. Modified proctor density in compliance with ASTM D1557.

.4 Precast units:

.1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.

.2 Make each successive joint watertight with Departmental Representative's approval rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.

.3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.

.4 Plug lifting holes with concrete plugs set in cement mortar or mastic compound.

.5 For sewers:

.1 Place stub outlets and bulkheads at elevations and in positions indicated.

.2 Bench to provide smooth U-shaped channel.

.1 Side height of channel to be 0.75 times diameter of sewer.

.2 Slope adjacent floor at 1 in 20.

.3 Curve channels smoothly.

.4 Slope invert to establish sewer grade.

.5

.6 Compact granular backfill to 95% Modified Proctor Density.

.7 Place unshrinkable backfill in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

.8 Installing units in existing systems:

.1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.

.2 Make joints watertight between new unit and existing pipe.

.3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.

.9 Set frame and cover to required elevation on no more than three courses of brick.

.1 Make brick joints and join brick to frame with cement mortar.

.2 Parge and make smooth and watertight.

.10 Clean units of debris and foreign materials.
- .1 Remove fins and sharp projections.
- .2 Prevent debris from entering system.

.11 Install safety platforms in manholes having depth of 6 m or greater, as indicated.

3.4 ADJUSTING TOPS OF EXISTING UNITS

.1 Remove existing gratings, frames and store for re-use at locations designated by Departmental Representative.

.2 Sectional units:
- .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
- .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.
  - .1 When amount of raise is less than 300mm use standard manhole brick, moduloc or grade rings.

.3 Monolithic units:
- .1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with mortared brick course for 150 mm or less alteration.
- .2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.
- .3 When monolithic units with tapered upper section are lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.
- .4 Install additional manhole ladder rungs in adjusted portion of units as required.
- .5 Re-use existing gratings, frames and I-beams.

3.5 SEALING OVER EXISTING UNITS

.1 Fill with material approved by Departmental Representative.

3.6 FIELD QUALITY CONTROL

.1 Leakage Test:

.2 Install watertight plugs or seals on inlets and outlets of each new sanitary sewer manhole and fill manhole with water.

.3 Leakage not to exceed 0.3% per hour of volume of manhole.

.4 If permissible leakage is exceeded, correct defects.

.5 Repeat until approved by Departmental Representative.

.6 Departmental Representative will issue Test Certificate for each manhole passing test.

3.7 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 33 05 13

## 1.0 GENERAL

### 1.1 SECTION INCLUDES

.1 Materials and installation for storm sewer.

### 1.2 RELATED SECTIONS

.1 Section 31 05 16-Aggregate Materials.

.2 Section 31 23 10-Excavating, Trenching and Backfilling.

.3 Section 33 05 13-Manholes and Catch Basin Structures.

### 1.3 MEASUREMENT PROCEDURES

.1 All work included in this section shall be included in the lump sum bid for all materials, equipment and labour for the scope of work shown on the plans and specifications.

### 1.4 REFERENCES

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

- .1 ASTM C14M, Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
- .2 ASTM C76M, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
- .3 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
- .4 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- .5 ASTM C443M, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
- .6 ASTM C506M, Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.
- .7 ASTM C507M, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe (Metric).
- .8 ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .9 ASTM D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
- .10 ASTM D2680, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- .11 ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .12 ASTM F405, Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.
- .13 ASTM F667, Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings.
- .14 ASTM F794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
- .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

.3 CSA International

- .1 CAN/CSA-A3000-08, Cementitious Materials Compendium.
- .2 CSA A257 Series-M92(R2009), Standards for Concrete Pipe.

.3 CAN/CSA-B1800-06, Thermoplastic Non-pressure Pipe Compendium - B1800 Series.
.4 CSA G401-07, Corrugated Steel Pipe Products.

1.5 SCHEDULING
.1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.

.2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

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

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certification to be marked on pipe.

1.7 DELIVERY, STORAGE, AND HANDLING
.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials in accordance with manufacturer's recommendations.
.2 Store and protect pipes from damage.
.3 Replace defective or damaged materials with new.

2.0 PRODUCTS

2.1 CONCRETE PIPE
.1 Non-reinforced circular concrete pipe and fittings: to ASTM C14M as indicated, designed for flexible rubber gasket joints to ASTM C443M.

.2 Reinforced circular concrete pipe and fittings: to ASTM C76M as indicated, designed for flexible rubber gasket joints to ASTM C443M.

.3 Reinforced concrete arch pipe: to ASTM C506M.

.4 Reinforced concrete elliptical pipe: to ASTM C507M.

.5 Lifting holes:
.1 Pipe 900mm and less diameter: no lift holes.
.2 Pipe greater than 900mm diameter: lift holes not to exceed two in piece of pipe.
.3 Provide pre-fabricated plugs to effectively seal lift holes after installation of pipe.

2.2 PLASTIC PIPE
.1 Type PSM Poly Vinyl Chloride (PVC): to ASTM D 3034 CSA-B182.2.
.1 Standard Dimensional Ratio (SDR): 35.
.2 Separate gasket and integral bell system.
.3 Nominal lengths: 4 m.

.2 Large diameter, ribbed PVC sewer pipe and fittings: to CSA B182.4 ASTM F 794.

2.3 PIPE BEDDING AND SURROUND MATERIAL

.1 Granular material in accordance with Section 31 05 16 - Aggregate Materials.

.2 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Cast-in-Place Concrete.

2.4 BACKFILL MATERIAL

.1 As indicated.

2.5 JOINT MORTAR

.1 Portland cement: to CAN/CSA-A5.

.2 Mortar: one part Portland cement to two parts clean sharp sand mixed with minimum amount of water to obtain optimum consistency for use intended. Do not use additives.

3.0 EXECUTION

3.1 PREPARATION

.1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.

3.2 TRENCHING

.1 Do trenching Work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

.2 Do not allow contents of sewer or sewer connection to flow into trench.

.3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete work in accordance with Cast-in-Place Concrete. Place concrete to details as indicated.

.2 Position pipe on concrete blocks to facilitate placing of concrete.

.1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.3 Do not backfill over concrete within 24 h after placing.

3.4 GRANULAR BEDDING

.1 Place bedding in unfrozen condition.

.2 Place granular bedding material in uniform layer[s] not exceeding 150mm compacted thickness to depth as indicated.

.3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.

.4 Shape transverse depressions as required to suit joints.

.5 Compact each layer full width of bed to at least 95% Modified Proctor Density in compliance with ASTM D1557.

.6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

3.5 INSTALLATION

.1 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.

.2 Handle pipe using methods approved by Departmental Representative.
- .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

.3 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.
- .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

.5 Do not exceed maximum joint deflection recommended by pipe manufacturer.

.6 Do not allow water to flow through pipes during construction except as may be permitted by Departmental Representative.

.7 Whenever work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.8 Install plastic pipe and fittings in accordance with CSA B182.11.

.9 Joints:
- .1 Install gaskets as recommended by manufacturer.
- .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 other foreign material.
- .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace 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 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

.10 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.

.11 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.

.12 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.13 Make watertight connections to manholes and catch basins.
.1 Use shrinkage compensating grout when suitable gaskets are not available.

.14 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.
.1 Joint to be structurally sound and watertight

.15 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.6 PIPE SURROUND

.1 Place surround material in unfrozen condition.

.2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
.1 Leave joints and fittings exposed until field testing is completed.

.3 Hand place surround material in uniform layers not exceeding 150mm compacted thickness as indicated.

.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% Modified Proctor Density.

.6 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround, in uniform layers not exceeding 150mm compacted thickness up to grades as indicated.

.3 Under paving and walks, compact backfill to at least 95% Modified Proctor Density.

3.8 FIELD TESTING

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

.2 When directed by Departmental Representative, 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 Television and photographic inspections:
.1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.
.2 Provide means of access to permit Departmental Representative to do inspections.

END OF SECTION 33 41 00

# BELMONT BATTERY REHABILITATION PROJECT

# FORT RODD HILL, BC

# PROJECT NO. R.075097.001

## APPENDIX 1

## HAZMAT REPORT

# Hazardous Building Materials Assessment

31 Buildings/Structures at the Fort Rodd Hill National Historic Site, BC

Prepared for:
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March 24, 2016

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# Executive Summary

Stantec Consulting Ltd. (Stantec) was retained by Public Works and Government Services Canada (PWGSC) to conduct hazardous building materials assessments within 31 buildings/structures (subject buildings) throughout the Fort Rodd Hill National Historic Site, BC. A list of the buildings assessed is included in Appendix A.

The purpose of the assessment was to check for potential hazardous building materials that may require special attention in accordance with the requirements of the *Canada Labour Code, Part II* (Canada Labour Code), the current version of British Columbia's *Occupational Health & Safety Regulation* (BC Reg. 296/97), as well as the Parks Canada Asbestos Management Guide (January 2014) and the Parks Canada Asbestos Management Standard (January 2014).

The hazardous building materials considered included asbestos-containing materials (ACMs), lead-containing materials including lead-containing paints (LCPs), polychlorinated biphenyls (PCBs), mercury-containing items, ozone-depleting substances (ODSs), mould or moisture affected building materials, and silica.

Based on Stantec's visual assessment and on the laboratory analyses performed on samples collected, hazardous building materials were identified within many of the subject buildings.

A summary of our findings and recommendations is presented below. It should be noted that this summary is subject to the same restrictions and limitations as presented in Section 3.0 (Assessment Limitations) and Section 6.0 (Closure). The information provided is to be read in conjunction with the remainder of this report.

NOTE: Where particular hazardous building materials are not listed in the following table, they were not identified in that particular building.

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Admin Garage and Admin Apartment | **Lead**<br>• Yellow coloured paint on interior walls of the admin apartment kitchen is lead-containing.<br>• White coloured paint on the interior trims of the admin apartment is lead-containing.<br>• Yellow coloured paint on the exterior stucco is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes, solder used in electrical equipment and vent and pipe flashings.<br>**PCBs**<br>• Fluorescent light fixtures of older vintage (one observed) may have PCB-containing ballasts.<br>**Mercury**<br>• Mercury vapour is expected to be present in the light tubes within the five fluorescent light fixtures observed.<br>• Mercury may also be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in stucco, player, gypsum and the concrete foundation of the subject building. |
| Casemate Barracks | **Lead**<br>• Red coloured paint on the wood pillars and trims of the barracks are lead containing.<br>• Grey coloured paint on the coal store and the oil store door and trim is lead containing.<br>• Yellow coloured paint on window frames of the barracks is lead containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes, and vent and pipe flashings.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Mould/Moisture**<br>• Moisture-staining on walls adjacent to gutter ends was observed on the side of the roof of the Provisional Store. If gutters are not functioning or draining properly, adjacent building materials may become wet, creating conditions conducive to mould growth.<br>• As the structure is exposed to regular rainwater, moss and fungal growth are present on wood elements, which is typical.<br>**Silica**<br>• Silica is presumed to be present in concrete walls, floors and ceilings of the subject buildings. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Battery Command Post | **Lead**<br>• Grey coloured paint on the shutters is lead-containing.<br>• Red coloured paint on the windows is lead-containing.<br>• Black coloured paint on the railing is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing and solder used in electrical equipment.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete walls, floors and ceilings of the subject building. |
| Belmont Battery | **Asbestos**<br>• Black roof mastic on vertical exhaust vent on roof throughout is asbestos-containing.<br>**Lead**<br>• White coloured paint on the exterior trims is lead-containing.<br>• White coloured paint on interior walls of tower upper level is lead-containing.<br>• Orange coloured paint on the exterior walls is lead-containing.<br>• Black coloured paint on the interior trims throughout is lead-containing.<br>• Green coloured paint on the trims throughout is lead-containing.<br>• Grey coloured paint on the floors throughout is lead-containing.<br>• White coloured paint on the interior walls throughout is lead-containing.<br>• Red coloured paint on the floor of generator room on concrete slab is lead-containing.<br>• Yellow coloured paint on the interior walls of lifting lobby is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes, solder used in electrical equipment and vent and pipe flashings.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete walls, floors and ceilings of the subject building. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Canteen | **Lead**<br>• White coloured paint on the interior walls and ceiling is lead-containing.<br>• White coloured paint on the exterior trims is lead-containing.<br>• Yellow coloured paint on the interior wood siding is lead-containing.<br>• Pale brown coloured paint on the interior walls of prep room is lead-containing.<br>• Grey coloured paint on the exterior outhouse door is lead-containing.<br>• Black coloured paint on interior ceiling beams is lead-containing.<br>• Brown coloured paint on exterior window frames is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing, solder used in bell fittings for cast iron pipes, solder used in electrical equipment and vent and pipe flashings.<br>**Mercury**<br>• Mercury may also be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete walls, floors and ceiling of the subject buildings. |
| Collections Building | **Lead**<br>• Lead is expected to be present in older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes, and vent and pipe flashings.<br>**ODSs**<br>• One air conditioning unit located on the exterior east side of the building (R-22).<br>**Mercury**<br>• Mercury vapour is expected to be present in the light tubes within the 20 fluorescent light fixtures observed.<br>• Mercury may also be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete slab of the subject buildings. |
| Defensive Electric Light #1 | **ACMs**<br>• Black roofing material is asbestos-containing.<br>**Lead**<br>• Dark green coloured paint on the steel shutters is lead-containing.<br>• Black coloured paint on the steel cage is lead-containing.<br>**Mercury**<br>• Mercury may be present in adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete of the subject buildings. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Fisgard Lighthouse, Boathouse and Store House | **Lead**<br>• White coloured paint on the exterior window sill of the lighthouse is lead containing.<br>• Black coloured paint on the tower staircase cage of lighthouse is lead-containing<br>• Green coloured paint on tower staircase of lighthouse is lead containing.<br>• White coloured paint on the interior walls of tower staircase in lighthouse is lead containing.<br>• Silver coloured paint on the interior steel panel of upper tower of lighthouse is lead containing.<br>• White coloured paint on exterior window frame throughout lighthouse is lead containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes, solder used in electrical equipment and vent and pipe flashings.<br>**PCBs**<br>• PCBs may be present in the fluorescent light ballasts of the two light fixtures observed within the storehouse.<br>**Mercury**<br>• Mercury vapour is likely to be present in the light tubes within the two fluorescent light fixtures observed in the storehouse.<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete and brick mortar of lighthouse and storehouse. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Journey's End | **Asbestos**<br>• Grey straight air-o-cell pipe insulation throughout the basement computer room ceiling space is asbestos-containing.<br>• 9"x9" vinyl floor tile (tan with brown) in the second level west and east bathroom is asbestos-containing.<br>• Tan vinyl sheet flooring in the second level west bathroom is asbestos-containing.<br>• Tan vinyl sheet flooring on the stairs to basement is asbestos-containing.<br>• Yellow vinyl sheet flooring in basement of laundry room is asbestos-containing.<br>**Lead**<br>• Red coloured paint on the exterior trim is lead-containing.<br>• White coloured paint second level on west bathroom trim is lead-containing.<br>• Yellow coloured paint second level on west bathroom walls is lead-containing.<br>• Grey coloured paint on walls in office #2 is lead-containing.<br>• Tan coloured paint on walls in main lobby is lead-containing.<br>• Pink coloured paint on walls in room #104 is lead-containing.<br>• Green coloured paint on walls in room #105 is lead-containing.<br>• White coloured paint on walls by east stairs and throughout upper level corridor is lead-containing.<br>• Tan coloured paint on walls of office #3 is lead-containing.<br>• Dark yellow coloured paint on walls of office #1 is lead-containing.<br>• Green coloured paint on walls of boiler room is lead-containing.<br>• Lead is expected to be present in lead-acid batteries used in emergency lighting, older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes, solder used in electrical equipment, ceramic tile glaze and vent and pipe flashings.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete and mortar of the subject building. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Lower Battery | **Lead**<br>• General lower battery–white coloured paint on the flag pole is lead-containing.<br>• General lower battery–black coloured paint on the main gate, railings, and gates throughout is lead-containing.<br>• Gun emplacements–black coloured paint on the gun emplacements is lead-containing.<br>• Underground magazine–black coloured paint on the shelves and doors throughout is lead-containing.<br>• Underground magazine–grey coloured paint on the doors throughout is lead-containing.<br>• Artillery and small arms ammunition store–grey coloured paint on the trims throughout is lead-containing.<br>• Guardhouse–white coloured paint on the interior walls throughout is lead-containing.<br>• Guardhouse–grey coloured paint on the interior trims and lower walls throughout is lead-containing.<br>• Guardhouse–yellow coloured paint on the window frames throughout is lead-containing.<br>• Guardhouse–red coloured paint on the exterior trims throughout is lead-containing.<br>• Guardhouse–blue coloured paint on the doors throughout is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing, solder used on domestic water lines and in electrical equipment.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete walls, ceilings, and floors (foundation) of the buildings. |
| Maintenance Facilities | **Lead**<br>• Grey coloured paint on the interior floor throughout FRH2 is lead-containing.<br>• White coloured paint on the exterior doors of FRH2 is lead-containing.<br>• Teal coloured paint on the corrugated siding throughout the exterior of FRH3 is lead-containing.<br>• Green coloured paint on the corrugated siding throughout exterior of FRH4 is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes, solder used in electrical equipment and vent and pipe flashings.<br>**Mercury**<br>• Mercury vapour is expected to be present in fluorescent light bulbs/tubes observed in approximately 20 fluorescent light fixtures present in various locations throughout.<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete foundation of the Paint Shop (FRH2) building, and the slab concrete floor of Garage (FRH3). |
| 5 O'Tentiks | No hazardous materials were identified during the assessment. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Parking Lot Washroom | **Lead**<br>• White coloured paint on the exterior trims is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes, solder used in electrical equipment and vent and pipe flashings.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete slab floor, concrete block walls and brick mortar of the subject building. |
| Plotting Room | **Lead**<br>• Light blue coloured paint on the east wall of the plotting room is lead-containing.<br>• Yellow coloured paint on the east wall of the north office is lead-containing.<br>• Silver coloured paint on the metal door in corridor and on the exterior of the plotting room is lead-containing.<br>• Black coloured paint on the interior trims is lead-containing.<br>• Grey coloured paint on the interior floor at the entrance is lead-containing.<br>• Green coloured paint on the interior walls is lead-containing.<br>• White coloured paint on the exterior trim is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials, solder used in electrical equipment.<br>**PCB**<br>• PCBs may be present in the fluorescent light ballasts of the two light fixtures observed.<br>**Mercury**<br>• Mercury vapour is likely to be present in the light tubes within the two fluorescent light fixtures observed.<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete structure of the subject building. |
| Search Light #6 | **Lead**<br>• Green coloured paint on the exterior is lead-containing.<br>• White coloured paint on the interior is lead-containing.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete structure of the subject building. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Search Light Emplacement #7 | **Lead**<br>• Red coloured paint on exterior walls in lead-containing.<br>• Grey coloured paint on interior walls is lead-containing.<br>• Black coloured paint on steel cage is lead-containing.<br>• Brown coloured paint on wood canopy is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and solder used in electrical equipment.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in concrete structure of the subject building. |
| Search Light Engine Room | **Lead**<br>• Tan coloured paint on the interior wall is lead-containing.<br>• Black coloured paint on the interior trim is lead-containing.<br>• Light grey coloured paint on interior wall is lead-containing.<br>• Grey colored paint on the interior floor is lead-containing.<br>• Orange coloured paint on exterior wall is lead-containing.<br>• Red coloured paint on the floor inside caged engine room is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials, solder used on domestic water lines, solder used in bell fittings for cast iron pipes and solder used in electrical equipment.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in the concrete comprising the entirety of the subject building. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Upper Battery | **Lead**<br>• Black coloured paint on the garbage can outside main gate is lead-containing<br>• Red coloured paint on the wood pillars and window sills throughout the guardhouse is lead-containing.<br>• Brown coloured paint on the exterior window frames throughout the guardhouse is lead-containing.<br>• Green coloured paint on the interior window sills throughout the guardhouse is lead-containing.<br>• Grey coloured paint on the interior baseboards throughout the guardhouse is lead-containing.<br>• Black coloured paint on the door of the guardhouse is lead-containing.<br>• Black coloured paint on the steel stairs around gun emplacement is lead-containing.<br>• Yellow coloured paint on the interior doors of the underground magazine is lead-containing.<br>• Black coloured paint on the exterior window frames throughout the underground magazine is lead-containing.<br>• Brown coloured paint on the door frames throughout the underground magazine is lead-containing.<br>• Green coloured paint on the interior ceiling trims throughout the underground magazine is lead-containing.<br>• Tan coloured paint on the interior walls throughout the underground magazine is lead-containing.<br>• Green coloured paint on the steel window frame of the defensive electrical directing station is lead containing.<br>• Light blue coloured paint on the interior walls of defensive electrical directing station is lead-containing.<br>• Grey coloured paint on the exterior door of the electrical directing station is lead-containing.<br>• White coloured paint on the flag pole is lead-containing.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in concrete throughout the Upper Battery. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| Visitors Centre/Entrance Kiosk | **ACMs**<br>• Grey window frame caulking throughout is asbestos-containing.<br>• Grey caulking on base of wood columns throughout is asbestos-containing.<br>• Black window pane caulking throughout is asbestos-containing.<br>**Lead**<br>• Red coloured paint on the exterior trims and columns is lead-containing.<br>• Red coloured paint on the steel fencing is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing and solder used in electrical equipment.<br>**PCBs**<br>• PCBs may be present in the fluorescent light ballasts of the approximately 10 light fixtures observed. As the ballasts were energized, they could not be inspected at the time of the assessment for health and safety reasons.<br>**Mercury**<br>• Mercury vapour is expected to be present in the light tubes within the approximately 10 fluorescent light fixtures observed.<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is presumed to be present in concrete foundation within the subject building. |
| Warrants Officer's Quarter | **Asbestos**<br>• Black mastic on the base of one roof vent on northwest side of the building is asbestos-containing.<br>**Lead**<br>• Tan coloured paint on the interior trim throughout is lead-containing.<br>• Yellow coloured paint on base boards throughout is lead-containing.<br>• White coloured paint on the walls of outhouse is lead-containing.<br>• Grey coloured paint on the concrete floors throughout is lead-containing.<br>• White coloured paint on the exterior window sills is lead-containing.<br>• Tan coloured paint on the exterior window frames is lead-containing.<br>• Red coloured paint on the exterior downspouts is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials and sheathing and solder used in electrical equipment.<br>**Mercury**<br>• Mercury may be present in paints and adhesives.<br>**Mould**<br>• Mould was observed on localized spots in the upstairs of the southeast bedroom ceiling. The suspected source of moisture is roof leaks.<br>**Silica**<br>• Silica is expected to be present in concrete foundation, brick siding and brick mortar of the subject building. |

| Summary of Identified Hazardous Building Materials | |
|---|---|
| **Building Name** | **Identified Hazardous Building Materials** |
| WWII Hut/Visitors Orientation Centre | **Lead**<br>• Green coloured paint on exterior trim and doors is lead-containing.<br>• Yellow coloured paint on exterior window frame trim is lead-containing.<br>• White coloured paint on exterior wood paneling/siding is lead-containing.<br>• Lead is expected to be present in older electrical wiring materials, solder used on domestic water lines, solder used in bell fittings for cast iron pipes and solder used in electrical equipment.<br>**PCBs**<br>• PCBs may be present in the fluorescent light ballasts of the approximately 10 light fixtures observed.<br>**Mercury**<br>• Mercury vapour is expected to be present in the light tubes within the approximately 10 fluorescent light fixtures observed.<br>• Mercury may be present in paints and adhesives.<br>**Silica**<br>• Silica is expected to be present in concrete foundation of the subject building. |

Building-by-building summaries of the identified hazardous building materials are provided in Appendix B through Appendix PP. General findings and recommendations pertaining to hazardous building materials within the subject buildings are provided in Section 4 and Section 5 of this report.

# 1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Public Works and Government Services Canada (PWGSC) to conduct hazardous building materials assessments within the buildings associated with the following National Park sites in British Columbia:

- Fort Langley National Historic Site in Langley, BC (24 buildings)
- Gulf of Georgia Cannery in Richmond, BC(5 buildings)
- Fort Rodd Hill National Historic Site in Victoria, BC (31 buildings)
- Gulf Islands National Park on Vancouver, Saturna, Prevost, Pender, Russell, Mayne and Tumbo Island, BC (45 buildings)
- Pacific Rim National Park in and between Tofino, Ucluelet and Port Renfrew, BC (39 buildings)

The general locations of the National Park sites are indicated on Drawing A1 in Appendix A.

This report presents the findings of assessment activities within 31 buildings (subject buildings) throughout Fort Rodd Hill National Historic Site in Victoria, BC. An overall plan of Fort Rodd Hill National Historic Site which shows the locations of the buildings assessed is presented in drawings in Appendix A. In addition, a list of the buildings included in this assessment is also provided in Appendix A.

The purpose of the assessment was to check for potential hazardous building materials that may require special attention in accordance with the requirements of the *Canada Labour Code, Part II* (Canada Labour Code), the current version of British Columbia's *Occupational Health & Safety Regulation* (BC Reg. 296/97) as well as the Parks Canada Asbestos Management Guide (January 2014) and the Parks Canada Asbestos Management Standard (January 2014).

The hazardous building materials considered included asbestos-containing materials (ACMs), lead-containing materials including lead-containing paints (LCPs), polychlorinated biphenyls (PCBs), mercury-containing items, ozone-depleting substances (ODSs), mould or moisture affected building materials, and silica.

The site work was conducted by David Siemens and Steve Chou of Stantec from June 22 to June 26, 2015.

## 1.1 UNDERSTANDING OF THE PROJECT

Stantec understands that the subject buildings were constructed during time periods when hazardous building materials were commonly used in construction, and that information pertaining to the identity, location and approximate extent of hazardous building materials (if any) within the subject buildings is either not on-file or outdated. As such, and in accordance with the Parks Canada Asbestos Management Guide (January 2014), the Parks Canada Asbestos Management Directive (January 2014), the Canada Labour Code and BC Reg. 296/97

pertaining to identifying hazards associated with hazardous building materials in the workplace, PWGSC commissioned this assessment on behalf of Parks Canada.

A list of the buildings included in this assessment is included in Appendix A.

# 2.0 SCOPE AND METHODOLOGY

David Siemens and Steve Chou of Stantec conducted visual assessments within the subject buildings from June 22 to June 26, 2015. Site work was conducted in general compliance with the requirements of the Canada Labour Code, BC Reg. 296/97 and Stantec's Safe Work Practices (SWPs).

Mechanical systems, structures and finishes of the subject buildings were visually examined to determine the suspected presence of ACMs, lead including LCPs, PCBs, mercury, ODSs, mould, and silica. Where building materials were suspected but not confirmed to contain asbestos or lead (in paint) samples were collected for analysis to confirm or deny the presence of these hazardous materials. Based on analytical results, visually similar materials were referenced to specific analyzed samples to reduce the number of samples collected.

Additional background information and the methodology used for the determination of presence or absence of each specific hazardous material considered in this assessment are outlined in the following sections.

## 2.1 ASBESTOS

The common use of friable (materials which, when dry, can be easily crumbled or powdered by hand pressure) ACMs in construction generally ceased voluntarily in the mid-1970s but was only banned through legislation by the late 1980s. Friable asbestos was used in many building products, primarily high temperature insulations, spray-applied structural fireproofing, and a material known as vermiculite that was commonly used as block wall insulation and may be contaminated with asbestos fibres. Asbestos was also used in many non-friable manufactured products such as floor tiles, ceiling tiles, Transite cement products, and various other construction materials. Some cement products currently used in the construction of buildings may still contain asbestos.

The presence of asbestos in federal workplaces, and pertaining to federally regulated workers is governed by the Canada Labour Code. The presence of asbestos in the workplace in British Columbia pertaining to provincially regulated workers is governed by BC Reg. 296/97. As both federally regulated workers and provincially regulated workers (e.g., contractors) are expected to carry out work activities within the subject buildings, and as the provincial regulations are generally more prescriptive pertaining to asbestos (and generally include the requirements noted in the Canada Labour Code), this assessment was conducted to meet the requirements of BC Reg. 296/97.

According to the current version of BC Reg. 296/97, asbestos-containing material (ACM) means any material containing at least 0.5% asbestos, or vermiculite insulation with any asbestos.

Based on these criteria, a visual assessment of accessible areas was undertaken in order to check for the presence of materials suspected of containing asbestos. Locations to collect discrete bulk asbestos samples of suspect building materials were identified. Samples of representative materials were then collected at these locations.

Multiple samples were collected from each "homogenous application" of observed suspected ACMs (materials suspected to contain asbestos that are uniform in material type, colour, texture application and estimated installation date) and submitted to EMSL Canada Inc. (EMSL) in Mississauga, Ontario for analysis of asbestos content using polarized light microscopy (PLM) with dispersion staining, in accordance with the United States Environmental Protection Agency (EPA) 600/R-93/116 method.

The number of samples to be collected for each homogenous application of a suspected ACM was based on accepted occupational hygiene standards and protocols, along with the assessor's experience and understanding of the consistency of that building material's application.

EMSL's analytical laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

### 2.1.1 Sample Results Interpretation

When asbestos is detected in concentrations greater than 0.5% in one of the samples within a set that was collected to represent a "homogenous application" of a particular material (or detected in any concentration, in a set of samples collected for applications of vermiculite), the entire sample set and the entire application of that material was then considered to be an ACM.

In addition to the above, a "positive stop" option was used during the laboratory analysis of the building material samples submitted for asbestos analysis. The "positive stop" option is utilized by the laboratory when asbestos is detected at a concentration of greater than 1% in one of the samples within a set that was collected to represent a "homogenous application" of that material. At this point, further analysis of subsequent samples within the set is deemed to be unnecessary (as the entire set will be considered an ACM, per above), and the remainder of the samples within the set are not analyzed.

### 2.1.2 Potential Asbestos-Containing Vermiculite Insulation

As part of the assessment, Stantec assessed the subject buildings for areas where vermiculite insulation, a potential ACM, would likely be present. This included making note of and assessing attic spaces, floor cavities and masonry or brick walls, which are typical areas where vermiculite is found. Regarding this portion of the assessment, the following should be noted:

- Where masonry or brick walls were observed, destructive assessment (drilling) was not conducted to assess the cavity for the presence of vermiculite.
- Where non-vermiculite attic insulation (e.g., fiberglass) was observed, inspection for the presence of vermiculite under the other insulation was conducted only at the attic access point (not throughout the attic).

### 2.1.3 Asbestos Sampling Quality Assurance/Quality Control

Sampling activities pertaining to asbestos were conducted in accordance with Stantec's SWPs, which take into account current provincial regulations pertaining to such work (i.e., sampling procedures, required number of samples, and laboratory analytical procedures).

Representative bulk samples were collected of accessible suspect ACMs in sufficient quantities for laboratory analyses. Suspect ACM samples were sealed in polyethylene zip-lock bags labeled with the sample number, suspect material description, and sample location. As part of sampling procedures, sampling tools were cleaned between sample collection events to avoid the potential for cross-contamination of samples.

Sample bags were compiled in order and placed into a single container accompanied with a Chain of Custody form outlining the project information, date, building location, number of samples, and sample description. Samples were submitted to the analytical laboratory in a sealed container via courier.

## 2.2 LEAD

Lead may be used in its pure metallic form or combined chemically with other elements to form lead compounds. Metallic lead is used to make products such as electric storage batteries, ammunition, lead solder, radiation shields, pipes, and sheaths for electric cables. Metallic lead is sometimes combined with other metals such as copper, tin, and antimony as lead alloys for use in the manufacture of a variety of metal products. Lead is commonly found in buildings in the solder used on copper domestic pipes, in the caulking on bell fittings of cast iron drainage pipes and in electrical equipment.

The presence of lead-containing materials (other than paint) was assessed through visual means.

With respect to paint, the lead content of interior paint was limited to 0.5% by weight (equivalent to 5,000 mg/kg or ppm) in 1976 under the Federal *Hazardous Products Act,* which governs the import, export and distribution of hazardous products in Canada. In 2005, the *Hazardous Products Act* had reduced the criteria for surface coatings (including paint) to 600 mg/kg (600 ppm) to define them as "lead-containing". This criterion has since (2010) been reduced to 90 ppm.

However, with respect to potential lead exposures associated with disturbance to surfaces coated with lead-containing products, WorkSafeBC has compiled a manual titled *Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry*, (Lead Guideline) which defines a "lead-containing surface coating material" and indicates that "…the improper removal of lead paint containing 600 mg/kg lead results in airborne lead concentrations that exceed half of the exposure limit". As such, Stantec will reference this value (600 ppm) in defining paints as "lead-containing".

Based on this criterion, samples of suspected LCPs were collected from major paint applications, and were collected to substrate, where possible, in sufficient quantity to conduct analyses for total lead content. Samples collected were placed into separate, sealed, and labeled polyethylene bags, and submitted to EMSL for analyses of total lead content using Flame Atomic Absorption Spectrometry AAS (SW 846 3050B*/7000B).

EMSL's analytical laboratory is also accredited by the American Industrial Hygiene Association (AIHA) Environmental Lead Laboratory Approval Program.

## 2.3 POLYCHLORINATED BIPHENYLS

PCBs were used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. In fluorescent fixtures, PCBs were usually found within the small capacitors inside the ballast that controls the lamp. The Federal Chlorobiphenyls Regulation, SOR/91-152, prohibited the use of PCBs in electrical equipment manufactured after July 1, 1980.

The presence of PCB-containing equipment was assessed through visual means. With respect to fluorescent lamp ballasts, due to the risk of electrical shock associated with dismantling operating fixtures, fluorescent lamp ballasts were not removed to view identification numbers/information.

The total number of fluorescent lamp fixtures that may have ballasts that contain PCBs was approximated for each building assessed.

Suspected PCB-containing electrical equipment can be visually inspected and compared to the Environment Canada reference guide entitled *Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2*, dated August 1991 (PCB Guide).

## 2.4 MERCURY

Mercury is commonly found in buildings as mercury vapour lighting, thermostats/thermometers with mercury-containing glass ampoules, electrical switches and can also be found in minor amounts in fluorescent lamp tubes and vapour bulbs and may be present in stable forms in adhesives. Exposure to mercury in federal workplaces is governed by the Canada Labour Code, while provincially it is governed by BC Reg. 296/97.

The presence of mercury and mercury-containing equipment was assessed through visual means.

## 2.5 MOULD

Moist building materials may provide suitable conditions for mould growth, and the removal of building materials impacted by mould growth may require workers with specific training and experience using work procedures that have been developed to protect workers and work areas from exposure to elevated concentrations of airborne mould.

The presence of suspect visible mould was assessed through visual means and sampling. Material observed with dark-coloured staining and/or a textured and discoloured appearance is described as "suspect mould". Mould identified visually is defined as "suspect mould" unless it is confirmed as mould by laboratory analysis.

### 2.5.1 Mould Reference Guidelines

With respect to mould and/or moisture, the visual assessment procedures utilized during this project were based on the recommendations provided in the documents listed below:

- Standard Construction Document CCA 82 *Mould Guidelines for the Canadian Construction Industry*, Canadian Construction Association, 2004 (referred to as CCA 82)
- *Guidelines on Assessment and Remediation of Fungi in Indoor Environment*, New York City Department of Health, Bureau of Environmental and Occupational Disease Epidemiology, April 2000 (referred to as the NYC Guidelines)
- *Fungal Contamination in Public Buildings: Heath Effects and Investigation Methods*, Federal-Provincial Committee on Environmental and Occupational Health, 2004 (referred to as the Health Canada Guide)
- *Indoor Air Quality in Office Buildings: A Technical Guide*, Report of the Federal-Provincial Advisory Committee on Environmental and Occupational Health, 1995 (referred to as the IAQ Guide)
- *Bioaerosols: Assessment and Control*, American Conference of Governmental Industrial Hygienists (ACGIH), 1999 (referred to as the ACGIH Report)

## 2.6 OZONE-DEPLETING SUBSTANCES

Chlorofluorocarbons (CFCs) and other ODSs are often found in refrigeration units associated with air-conditioning or other refrigeration equipment. In September 1987, 47 countries agreed to the Montreal Protocol on Substances that Deplete the Ozone Layer. ODSs are regulated in BC by the *British Columbia Waste Management Act—Ozone Depleting Substances and Other Halocarbons Regulation* (BC Reg. 387/99 as amended by BC Reg. 109/2002) and the Federal Halocarbon Regulations, 2003 (FHR 2003).

The presence of ODSs and equipment containing these materials was assessed through visual means.

## 2.7 SILICA

Silica, also referred to as free crystalline silica, is found in concrete, cement, mortar, ceramic wall and floor tiles, stucco finishes and acoustic ceiling tiles. Prolonged exposure to, and inhalation of free crystalline silica, may result in respiratory disease known as silicosis, which is characterized by progressive fibrosis of the inner lung tissue and marked shortness of breath or impaired lung function.

Exposure to silica dust is governed by BC Reg. 296/97 According to both legislative instruments, the time-weighted average exposure limit for airborne silica dust is 0.025 mg/m³.

The presence of silica was assessed through visual means.

# 3.0 ASSESSMENT LIMITATIONS

In preparation of this report, Stantec used professional judgment based on experience. The work was conducted in accordance with generally accepted professional standards. Stantec relied on information gathered during the site investigation and laboratory analytical reports.

This report reflects the observations made within accessed areas of the subject buildings and the results of analyses performed on specific materials sampled during the assessment. Analytical results reflect the sampled materials at the specific sample locations.

Sampling was conducted pertaining to suspected ACMs and suspected LCPs only. The assessment for the presence of other hazardous building materials was visual in nature, and was conducted pertaining to readily visible surfaces within accessible spaces only. Concealed spaces were inspected via existing access panels, where present. Interior and exterior finishes, solid ceilings, walls, flooring and structural elements were not removed to access concealed areas.

It should be noted that the following building locations, although included in the proposed scope of work, were not accessed during the project due to security restrictions or the lack of keys required to provide access. As such, limited comments, if any, will be made regarding the presence, extent and/or condition of hazardous building materials in the following areas:

- Belmont Battery Lower Tower Level (door sealed from heat expansion)
- Search Light Engine Room: Oil Storage Room on west side of the building and South East Storage room (no keys provided)

In addition to the above, and due to limitations on the agreed to scope of work for this project as well as physical limitations in accessing concealed areas and limitations associated with working in occupied/operational spaces, there are specific limitations to the information that can be provided to each hazardous building material considered in this assessment, as outlined in the following sub-sections.

## 3.1 ASBESTOS

Suspected ACMs that were not sampled include, but are not limited to, the following (where present, based on building construction or as otherwise noted):

- Roofing materials associated with buildings where the roof could not be accessed safely with the equipment present on-site
- Sub-grade materials
- Interior components of mechanical equipment (e.g., inner linings or gaskets in boilers)
- Interior components of heating, ventilation and air conditioning (HVAC) units
- Heat protection materials inside mechanical installations (e.g., gaskets) and light fixtures (e.g., paper backing in sealed incandescent fixtures)
- Flooring material concealed beneath ceramic tile, brickwork, hardwood flooring, and/or concealed beneath existing sub-floors
- Drywall and/or wall plaster and associated finish materials concealed behind new and/or additional walls or ceilings
- Woven tape inside duct connection joints or inner ducting insulation
- Materials within wall cavities, hard ceiling cavities or crawlspaces
- Insulation materials inside fire doors

If encountered during renovation, demolition or other activities, any suspected ACMs not identified within this report should be presumed to contain asbestos and handled as such until otherwise proven, through analytical testing.

## 3.2 LEAD

Assessment for the presence of lead or lead-containing materials was visual in nature, and was conducted pertaining to readily visible surfaces within accessible spaces of the subject buildings only. The presence of lead or lead-containing materials in inaccessible areas not assessed included, but was not limited to: ceiling spaces, wall cavities, crawlspaces, and buried materials.

With respect to paint, samples of suspected LCPs were collected within the subject buildings only from surfaces of major paint applications where visually different paint colours and/or types were identified. Although the surfaces where samples were collected may be covered with more than one coat of paint, the paint samples are described by the surface (visible) colour only.

Attempts were made to represent all layers of paint in the samples collected. As analytical results are referenced to the surface paint colour only, the lead content of all painted surfaces similar to that represented by the surface paint colour will be presumed to be the same, regardless of differing sub surface paints, if any.

## 3.3 POLYCHLORINATED BIPHENYLS

Due to height restrictions and the risk of electrical shock in handling operational light fixtures, the ballasts present in the fixtures observed within the subject buildings were not removed for comparison to the PCB Guide. The visible labels of ballasts in several fixtures were inspected for comparison to the PCB Guide.

Conclusions and recommendations regarding the presence of PCBs within the subject buildings are based on Stantec's limited observations in combination with information provided by staff regarding lighting renovations (where requested by Stantec based on observations) and is presented to provide guidance regarding the likelihood that PCB-containing equipment is or is not present within the subject buildings. The exact extent and/or number of fluorescent lamp ballasts containing PCBs, if any, within the subject buildings will not be commented on.

## 3.4 MERCURY

Visual assessment for the presence of mercury-containing equipment within the subject buildings was conducted in accessible areas only. The presence of mercury or mercury-containing equipment in inaccessible areas includes, but is not limited to: ceiling spaces, wall cavities, and crawlspaces, or as internal parts of HVAC mechanisms.

## 3.5 MOULD

Visual assessment for the presence of suspected visible mould and/or suitable conditions for mould growth (e.g., moist and/or water-stained building materials) were conducted in accessed portions of the subject buildings only. The assessment was not intrusive in nature and included visual assessment of exposed surfaces and closer inspection of known problem areas.

The conclusions made in this report provide description(s) of the potential source(s) of moisture within the subject buildings that may have led to suitable conditions for mould growth, only in those cases where potential source(s) of moisture were identified. These conclusions will not necessarily identify all sources of moisture leading to suitable conditions for mould growth within the subject buildings or within the impacted area(s).

This assessment does not constitute a building envelope/building systems assessment, which would include an intrusive investigation to assess the internal condition, potential moisture sources, and expected remaining service life of the various components and systems comprising the envelope of a building.

## 3.6 OZONE DEPLETING SUBSTANCES

Visual assessment for the presence of ODSs within the subject buildings was conducted in accessible areas only. The presence of ODS-containing equipment in inaccessible areas including, but not limited to, ceiling spaces, wall cavities and crawlspaces, was not assessed. In addition, portable equipment that may contain ODSs (refrigerators, drink coolers, etc.) was not considered as part of this assessment.

## 3.7 SILICA

Visual assessment for the presence of silica-containing materials within the subject building was conducted in accessible areas only. The presence of potential silica-containing materials in inaccessible areas including, but not limited to, ceiling spaces and wall cavities was not assessed.

# 4.0 FINDINGS

The results of our assessment are provided on a building-by-building basis in Appendices B through V. Each Appendix contains the following (where applicable):

- Separate sections with written summaries of findings pertaining to each hazardous building material, including the following:
  - Information regarding the building including the reported intent for that particular building (e.g., continued operations and maintenance)
  - A listing of suspect materials observed
  - Tables that provide summaries of the sample types, locations, and analytical results
  - Interpretations of observations and/or sample analytical results
- Photographs of identified hazardous building materials, where available
- Information pertaining to condition evaluation of identified hazardous building materials
- Recommendations for identified hazardous building materials found to be in "non-compliant" condition (e.g. damaged ACMs, mould-impacted materials, etc.)

- Floor plan drawings for the subject building, which include locations of the samples collected during this assessment, and locations of identified hazardous building materials (where practical)
- Copies of the analytical certificates for all suspected ACM samples collected
- Copies of the analytical certificates for all suspected LCP samples collected

It should be noted that evaluation of condition of identified ACMs was conducted using terminology and classifications as outlined in the Parks *Canada Asbestos Management Directive* (2012), and considered the friability of the material (terminology relating to how easily fibres can be released), condition (good, fair and poor) and accessibility of the material.

# 5.0 GENERAL RECOMMENDATIONS

Building-specific recommendations pertaining to the identified hazardous building materials that require action are provided in Appendices B through V. General recommendations pertaining to management of identified hazardous building materials in good condition are provided below.

## 5.1 ASBESTOS

For buildings/structures with identified ACMs, Stantec recommends the following with regards to meeting the requirements of the Canada Labour Code), BC Reg. 296/97, the Parks Canada *Asbestos Management Guide* (January 2014) and the Parks Canada *Asbestos Management Standard* (January 2014) as they pertain to managing asbestos in the workplace and/or managing asbestos during renovation/demolition projects:

- Asbestos-containing materials that may be impacted during renovations and/or demolition activities should be removed prior to the renovation and/or demolition activities.
- Prior to renovation and/or demolition activities that would disturb them, undertake testing of presumed ACMs (materials that were previously un-tested, but are presumed to contain asbestos based on application and vintage) that may be impacted to determine their asbestos content. Confirmed asbestos materials should be handled accordingly.
- Identified ACMs in good condition can be managed in place in accordance with the requirements of the Parks Canada Asbestos Management Guide (January 2014) and the Parks Canada Asbestos Management Standard (January 2014).
- Should a material suspected to contain asbestos fibres become uncovered during renovation and/or demolition activities, all work in the areas that may disturb the material should be stopped. Samples of the suspect material should be submitted for laboratory analysis to determine if asbestos fibres are present. Confirmed asbestos materials should be handled in accordance with applicable guidelines and regulations.
- Suspected ACMs deemed visually similar to the ACMs identified in this report (on a building-by-building basis) should be considered asbestos-containing and handled as such, unless proven otherwise, through analytical testing.

- Asbestos-containing cement pipe may be present below ground—caution should be used if excavation is required.
- If masonry block walls are to be impacted by renovation and/or demolition work, and these walls have not been checked for the presence of vermiculite insulation, intrusive assessments for vermiculite should be undertaken prior to renovation/or demolition work. If vermiculite insulation is suspected to be present, this material should be treated as an ACM until testing can show otherwise.
- Ensure asbestos containing waste is handled, stored, and disposed of in accordance with the requirements of the Federal Transportation of Dangerous Goods Regulation and the British Columbia Hazardous Waste Regulation (BC Reg. 63/88).

## 5.2 LEAD

Lead-containing materials, including paints, can be managed in place, where in good condition.

If LCPs or other lead-containing equipment/materials within the subject buildings are to be disturbed and/or removed, ensure compliance with the following:

- Exposure protection requirements of the BC Reg. 296/97
- Disposal requirements of the British Columbia Hazardous Waste Regulation (BC Reg. 63/88)
- Transportation requirements of the Federal Transportation of Dangerous Goods Regulation

Corrective action or remedial work on paint applications containing any concentration of lead should be undertaken in a manner so as to avoid generating fine particulate matter or dust (i.e., avoid sanding). Airborne lead dust or fumes should not exceed the BC Reg. 296/97 8-hour Occupational Exposure Limit (OEL) of 0.05 milligram per cubic metre ($mg/m^3$) during the removal of paints and products containing any concentration of lead. The use of personal protective equipment is recommended to reduce the potential for over-exposure to lead dust. This can be achieved by:

- Providing workers with protective clothing and PPE or devices as necessary to protect the worker against the hazards to which the worker may be exposed
- Providing workers with adequate and training in the care and use of clothing, equipment or device before wearing or using it
- Wetting the surface of the materials to prevent dust emissions
- Providing workers with washing facilities with clean water, soap and individual towels to properly wash prior to exiting the work area

To avoid the inhalation of lead, it is essential to have the following control methods in place:

- Engineering controls
- Work practices and hygiene practices
- Respirators and personal protective equipment
- Training

The work tasks required and the ways in which lead-containing materials (including paints) will be impacted will determine the appropriate respirators, measures and procedures that should be followed to protect workers from lead exposure.

## 5.3 POLYCHLORINATED BIPHENYLS

Fluorescent lamp ballasts that may contain PCBs can be managed in place, where these items are operating and in good condition. No further action is currently required until such time that renovation or demolition activities are to be conducted, or until 2025, when PCB-containing ballasts will require removal and disposal.

When decommissioned, verify the PCB content of fluorescent lamp ballasts as per the Environment and Climate Change Canada publication *Identification of Lamp Ballasts Containing PCBs*, 1991. PCB-containing items identified for removal and disposal should be handled, transported, stored and disposed of in accordance with the following:

- Disposal requirements of the British Columbia Hazardous Waste Regulation (BC Reg. 63/88)
- Transportation requirements of the Federal Transportation of Dangerous Goods Regulation
- Federal PCB Regulations (SOR/2008-273)

Should a material suspected to contain PCBs become uncovered during renovation activities (i.e., dielectric fluids, hydraulic fluids), all work in the areas that may disturb the material should be stopped. Samples of the suspect material should be submitted for laboratory analysis to determine if PCBs are present. Confirmed PCBs should be handled in accordance with Federal Regulation SOR/2008-273 and BC Reg. 63/88.

## 5.4 MERCURY

Identified mercury-containing items can be managed in place, therefore no further action is recommended at this time. Mercury vapour within light fixtures and liquid mercury in thermostat switches pose no risk to workers or occupants provided the mercury containers remain intact and undisturbed.

Complete removal of mercury-containing equipment is required prior to renovation or demolition activities that may disturb the equipment. When mercury-containing items (e.g., fluorescent light bulbs/tubes, thermostats) are removed, ensure all mercury waste is handled, stored and disposed of in accordance with the disposal requirements of the following:

- Disposal requirements of the British Columbia Hazardous Waste Regulation (BC Reg. 63/88)
- Transportation requirements of the Federal Transportation of Dangerous Goods Regulation

Precautions should be taken if workers may potentially be exposed to mercury or mercury vapours to ensure that workers exposure levels do not exceed the occupational exposure limit of 0.025 mg/m$^3$ as per the BC Reg. 296/97 This can be achieved by providing respiratory and skin protection applicable to the hazard and task to be completed.

## 5.5 MOULD

In general, mould-impacted building materials will require action (e.g. abatement/removal or cleaning). Recommendations pertaining to mould are provided in the building-by-building information included in Appendices B through V.

## 5.6 OZONE DEPLETING SUBSTANCES

ODS-containing/ODS-Containing identified can be managed in place and must be serviced by licensed refrigeration technicians (as defined in the Federal Halocarbon Regulations).

When refrigeration equipment that is suspect or confirmed ODS-containing is decommissioned, it should be emptied and inspected by licensed refrigeration technician (as defined in the Federal Halocarbon Regulations).

If ODS-containing equipment is identified (e.g., pad-mounted air conditioning units associated with the main building) and is to be removed during demolition activities, ODSs must be handled, recycled, stored, and/or disposed of in accordance with the requirements of the following:

- British Columbia *Waste Management Act*—Ozone Depleting Substances and Other Halocarbons Regulation (BC Reg. 387/99 as amended by BC Reg. 109/2002)
- Transportation requirements of the Federal Transportation of Dangerous Goods Regulation
- Federal Halocarbons Regulations

## 5.7 SILICA

When silica-containing materials are to be removed during demolition activities, ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by BC Reg. 296/97 (0.025 mg/m$^3$). This would include, but not be limited to, the following:

- Providing workers with respiratory protection
- Wetting the surface of the materials to prevent dust emissions
- Providing workers with facilities to properly wash prior to exiting the work area
- Providing dust control to mitigate the potential for demolition dust to escape from the work area into public and/or adjacent areas

# 6.0 CLOSURE

This report has been prepared by Stantec Consulting Ltd. for the sole benefit of Public Works and Government Services Canada. Any use that a third party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The conclusions presented represent the best judgment of the assessor based on current environmental, health and safety standards and the site conditions observed on the dates cited within this report. This report is based on, and limited by, circumstances and conditions stated herein, and on information available at the time of preparation of the report. Due to the limited nature of the investigation and the limited data available, Stantec Consulting Ltd. cannot warrant against undiscovered environmental, health and/or safety liabilities. It is possible that additional, concealed hazardous materials may become evident during renovation and/or demolition activities within the subject buildings.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

We trust that the report meets your current requirements. Should you have any questions or concerns regarding the above, please do not hesitate to contact the undersigned.

Respectfully submitted,

**STANTEC CONSULTING LTD.**

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# Appendix E FINDINGS AND RECOMMENDATIONS—BELMONT BATTERY

The Belmont Battery was reportedly constructed in 1898 and is a two story concrete building with a steel tower on the North West side of the building. There is also the remains of a former building that reportedly burnt down on the south west side of the Belmont Battery.

The results of the assessment for each of the considered hazardous materials within the building are provided in the following sub-sections.

Floor plan drawings, which include locations of the samples collected during this assessment and locations of identified hazardous building materials (where practical), are attached to this Appendix.

The following areas were not accessed, for the reasons indicated:

- Lower tower level (door sealed)

As such, limited comments, if any, will be provided regarding the presence, quantity or condition of hazardous building materials within the above-noted areas.

## E.1 ASBESTOS

Stantec identified and sampled the following suspected ACMs:

- Roofing material
- Textured flooring
- Mastics, sealants and caulkings
- Vinyl sheet flooring

Twenty-eight samples of the above-noted suspected ACMs were collected and submitted to EMSL for analysis of asbestos content and nature.

A summary of the sample types, locations and analytical results is presented in Table E-1, below. A copy of the certificate of analysis provided by EMSL for the suspected ACM samples submitted is attached at to this Appendix.

## Table E-1 Suspected ACM Sample Collection and Analysis Summary Belmont Battery, Fort Rodd Hill National Historic Site, BC

| Sample Number | Material Description | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| **Belmont Battery** | | | |
| BB-RT-01A | Roofing tar | Roof flashing of artillery store | 0.30% |
| BB-RT-01B | Roofing tar | Roof flashing of artillery store | Not analyzed |
| BB-RT-01C | Roofing tar | Roof flashing of artillery store | Not analyzed |
| BB-RT-02A | Roofing tar | East side of lifting lobby roof under concrete | None detected |
| BB-RT-02B | Roofing tar | East side of lifting lobby roof under concrete | None detected |
| BB-RT-02C | Roofing tar | East side of lifting lobby roof under concrete | None detected |
| BB-RS-01A | Roofing shingle | Roof of artillery store | None detected |
| BB-RS-01B | Roofing shingle | Roof of artillery store | None detected |
| BB-RS-01C | Roofing shingle | Roof of crew shelter room | None detected |
| BB-NSF-01A | No-slip textured flooring | By stairs leading to main artillery | None detected |
| BB-NSF-01B | No-slip textured flooring | By stairs leading to main artillery | None detected |
| BB-NSF-01C | No-slip textured flooring | By stairs leading to main artillery | None detected |
| **BB-RM-01A** | **Black roof mastic** | **Vertical exhaust vent on roof of crew shelter room** | **None detected** |
| **BB-RM-01B** | **Black roof mastic** | **Vertical exhaust vent on roof of crew shelter room** | **None detected** |
| **BB-RM-01C** | **Black roof mastic** | **Vertical exhaust vent on roof of crew shelter room** | **5% Chrysotile** |
| BB-CS-01A | Grey concrete sealant | West exterior wall of paint store | None detected |
| BB-CS-01B | Grey concrete sealant | West exterior wall of paint store | None detected |
| BB-CS-01C | Grey concrete sealant | West exterior wall of paint store | None detected |
| BB-VSF-01 | Brown vinyl sheet flooring | Floor of crew shelter room | None detected |
| BB-CC-01A | White caulking | Ceiling between steel panels | None detected |
| BB-CC-01B | White caulking | Ceiling between steel panels | None detected |
| BB-CC-01C | White caulking | Ceiling between steel panels | None detected |
| **Remains from Burnt Building** | | | |
| BuB-BS-01A | Burnt building shingle | North west of Belmont Battery | None detected |
| BuB-BS-01B | Burnt building shingle | North west of Belmont Battery | None detected |
| BuB-BS-01C | Burnt building shingle | North west of Belmont Battery | None detected |
| BuB-SOIL-01A | Soil sample collected from the burnt building | North west of Belmont Battery | None detected |

**Table E-1 Suspected ACM Sample Collection and Analysis Summary Belmont Battery, Fort Rodd Hill National Historic Site, BC**

| Sample Number | Material Description | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| BuB-SOIL-01B | Soil sample collected from the burnt building | North west of Belmont Battery | None detected |
| BuB-SOIL-01C | Soil sample collected from the burnt building | North west of Belmont Battery | None detected |

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of suspected ACM sample analytical results, the material presented in Table E-2, below were identified as ACMs.

**Table E-2 Summary of Identified ACMs Belmont Battery, Fort Rodd Hill National Historic Site, BC**

| Identified ACM Description and Condition Information | | Photo |
|---|---|---|
| Black roof mastic on vertical exhaust vents on roof | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Content | 5% Chrysotile | |

### E.1.1 Materials with less than 0.5% Asbestos

It should be noted that one sample of black tar on roof flashings was identified to contain asbestos in a concentration less than 0.5%. Although the subsequent two samples were erroneously not analyzed by the lab, applicable regulations and guidance documents in BC (e.g., the BC Asbestos Guide) indicate that one sample of each distinct type of roofing material is sufficient to appropriately characterize it. Based on this result (asbestos content less than 0.5%) and the limited extent of the material, the black tar on roof flashings is not considered to be an ACM.

## E.2 LEAD

Lead is expected to be present in the following:

- Older electrical wiring materials and sheathing
- Solder used on domestic water lines
- Solder used in bell fittings for cast iron pipes
- Solder used in electrical equipment
- Vent and pipe flashings

With respect to paint, 11 paint chip samples were obtained from the predominant suspected LCP applications within the building. A summary of the sample types, locations and analytical results is presented in Table E-3, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is attached to this Appendix.

**Table E-3 Suspected LCP Sample Collection and Analysis Summary Belmont Battery, Fort Rodd Hill National Historic Site, BC**

| Sample No. | Sample Colour | Sample Location | Lab Result (ppm) | Lead Containing (Yes/No) |
|---|---|---|---|---|
| **BB-PB-01** | **White** | **West exterior trims** | **70,000** | **Yes** |
| **BB-PB-02** | **White** | **Interior wall of tower upper level** | **20,000** | **Yes** |
| **BB-PB-03** | **Orange** | **West exterior trims of paint store** | **22,000** | **Yes** |
| **BB-PB-04** | **Black** | **Interior trims of lifting lobby** | **2,000** | **Yes** |
| **BB-PB-05** | **Green** | **Steel structure of tower** | **28,000** | **Yes** |
| **BB-PB-06** | **Green** | **Door trim of paint store** | **15,000** | **Yes** |
| BB-PB-07 | Dark green | Interior walls of paint store | 410 | No |
| **BB-PB-08** | **Grey** | **Floor of paint store** | **42,000** | **Yes** |
| **BB-PB-09** | **White** | **Interior walls of paint store** | **20,000** | **Yes** |
| **BB-PB-10** | **Red** | **Floor of generator room on concrete slab** | **63,000** | **Yes** |
| **BB-PB-11** | **Yellow** | **Interior walls of lifting lobby** | **45,000** | **Yes** |

Based on our observations and on our interpretations of suspected LCP sample analytical results, the materials presented in Table E-4, below were identified as LCPs.

## Table E-4 Summary of Identified LCPs Belmont Battery, Fort Rodd Hill National Historic Site, BC

| Identified LCP Description | Photo |
|---|---|
| White coloured paint on the exterior trims (lower arrow).<br>This paint was observed to be in good condition (not bubbling, flaking or peeling).<br><br>Green colored paint on steel structure of the tower (upper arrow).<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| White coloured paint on the interior walls of the tower upper level.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Orange colored paint on the exterior walls.<br>Although worn from the surface in many locations, this paint was observed to generally be in good condition, (not bubbling, flaking or peeling). |  |

| Identified LCP Description | Photo |
|---|---|
| Black colored paint on the interior trims throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Green colored paint on trim throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Grey colored paint on floors throughout.<br>This paint was observed to be in poor condition (bubbling, flaking or peeling). |  |

| Identified LCP Description | Photo |
|---|---|
| White colored paint on interior walls throughout<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Red colored paint on the floor of generator room on concrete slab.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Yellow colored paint on interior walls of lifting lobby.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |

## E.3 POLYCHLORINATED BIPHENYLS

No suspected PCB-containing electrical equipment was observed.

## E.4 MERCURY

Equipment and/or items that contain mercury were not observed.

Mercury may also be present in paints and adhesives.

## E.5 MOULD

Suspect mould or moisture-impacted building materials were not observed at the time of the assessment.

## E.6 OZONE-DEPLETING SUBSTANCES

Building related cooling and refrigeration equipment suspected to be ODS-containing was not observed.

## E.7 SILICA

Silica is presumed to be present in the concrete walls, floors and ceiling of the subject building.

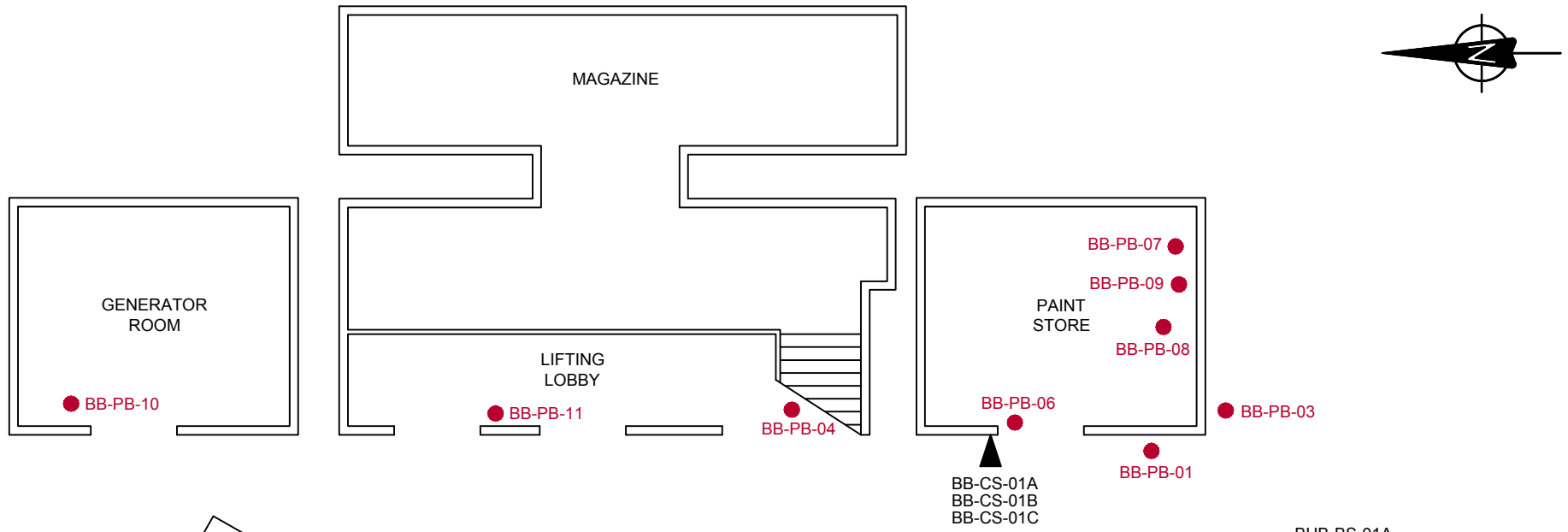
## E.8 RECOMMENDATIONS

In general, identified hazardous building materials were observed to be in good condition and do not appear to require specific action to maintain compliance with applicable regulations for continued operations and maintenance. Refer to Section 5.0 of the main body of this report for applicable material-by-material general recommendations.

### E.8.1 Lead

Lead-containing paint observed in poor condition on the grey floors throughout should be cleaned-up and/or addressed to mitigate potential for additional deterioration and dispersal of lead-containing paint chips/dust. Consideration should be given to re-painting surfaces to mitigate the potential for additional deterioration and hazards associated with the lead-containing paint chips/dust that may be created. If re-painting is completed, appropriate precautions to protect workers and work areas from exposure to lead will be required during painting preparation activities.

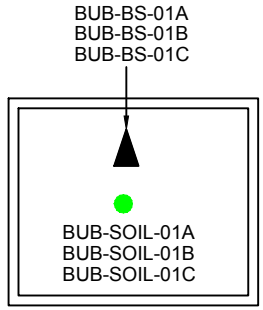
Provisions for worker protection and waste disposal related to the above are included in Section 5.2 of the main body of this report.




BELMONT BATTERY
(GROUND LEVEL)

TOWER

NO ACCESS TO TOWER LOWER LEVEL




BURNT BUILDING

**LEGEND**

- BULK SAMPLE LOCATION
- PAINT CHIP SAMPLE LOCATION
- TEM SAMPLE LOCATION

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

# FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

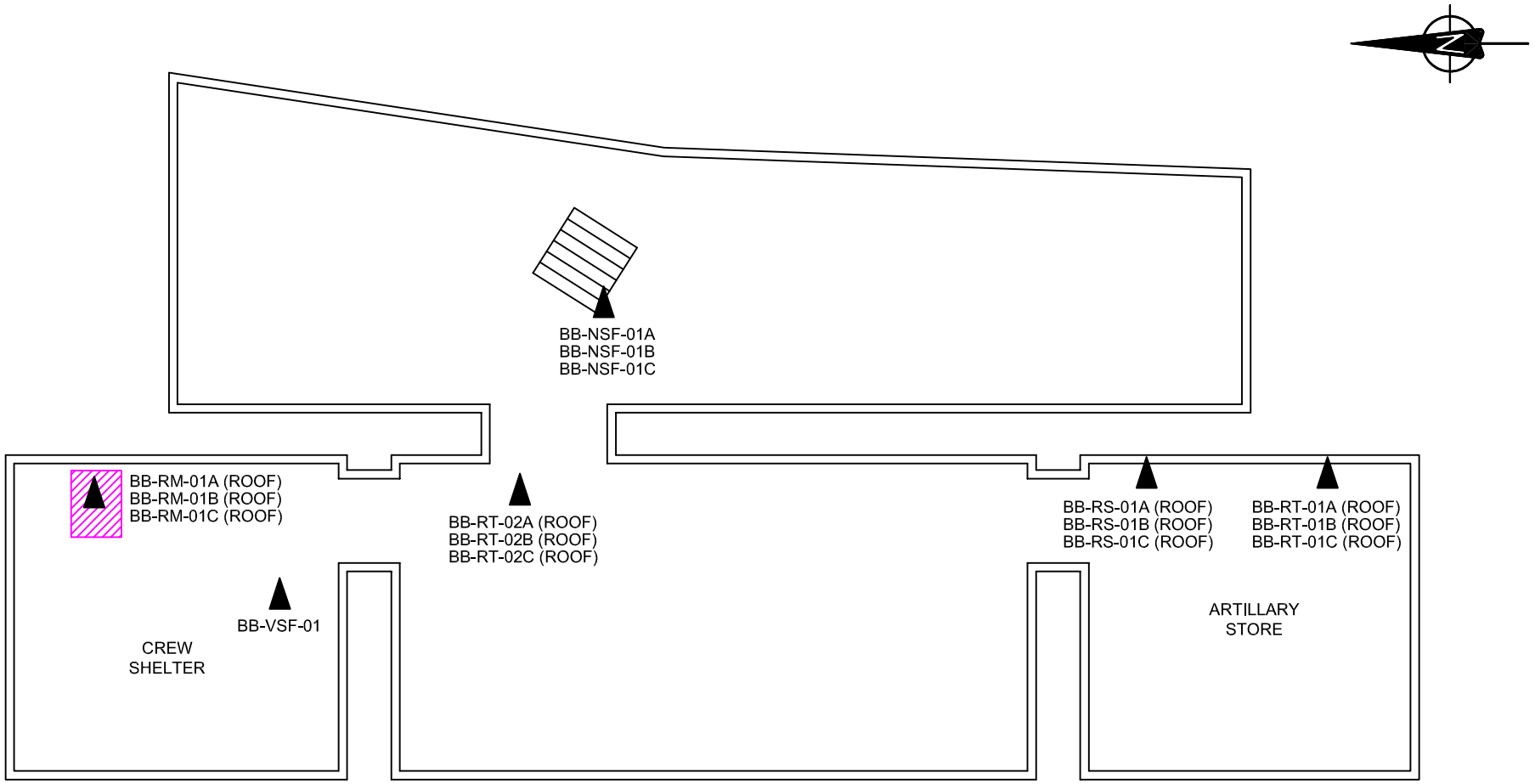
FORT RODD HILL AND FISGARD LIGHTHOUSE NATIONAL HISTORIC SITES, VICTORIA
603 FORT RODD HILL ROAD, VICTORIA, BC

**Client:** PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

| | |
|---|---|
| **Project No.:** | 123220330.400 |
| **Scale:** | N.T.S. |
| **Date:** | 16/03/23 |
| **Dwn. By:** | CD SL2016030300 VM/DM |
| **App'd By:** | TW |

**Dwg. No.:** 2

Stantec




# BELMONT BATTERY (UPPER LEVEL)

**LEGEND**

- BULK SAMPLE LOCATION
- ASBESTOS-CONTAINING MASTIC ON VERTICAL EXHAUST VENT

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

## FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

FORT RODD HILL AND FISGARD LIGHTHOUSE NATIONAL HISTORIC SITES, VICTORIA
603 FORT RODD HILL ROAD, VICTORIA, BC

**Client:** PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

| | |
|---|---|
| **Project No.:** | 123220330.400 |
| **Scale:** | N.T.S. |
| **Date:** | 15/08/28 |
| **Dwn. By:** | CD VM SL2015080185 |
| **App'd By:** | TW |

**Dwg. No.:** 1

Stantec

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http://www.EMSL.com / torontolab@emsl.com


EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

**Attn:** Steve Chou
Stantec Consulting, Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 7/20/2015
Analyzed: 7/28/2015

**Proj:** 123220330.400.100/Fort Rodd Hill

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** BB-RT-01A ***Lab Sample ID:*** **551507781-0062**
***Sample Description:*** Roof flashing of artillery store/Roof Tar

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 99.7% | **0.30% Chrysotile** | |

***Client Sample ID:*** BB-RT-01B ***Lab Sample ID:*** **551507781-0063**
***Sample Description:*** Roof flashing of artillery store/Roof Tar

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/28/2015 | | | | Stop Positive (Not Analyzed) | |

***Client Sample ID:*** BB-RT-01C ***Lab Sample ID:*** **551507781-0064**
***Sample Description:*** Roof flashing of artillery store/Roof Tar

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/28/2015 | | | | Stop Positive (Not Analyzed) | |

***Client Sample ID:*** BB-RT-02A ***Lab Sample ID:*** **551507781-0065**
***Sample Description:*** East side of lifting lobby roof under concrete/Roof Tar

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-RT-02B ***Lab Sample ID:*** **551507781-0066**
***Sample Description:*** East side of lifting lobby roof under concrete/Roof Tar

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-RT-02C ***Lab Sample ID:*** **551507781-0067**
***Sample Description:*** East side of lifting lobby roof under concrete/Roof Tar

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-RS-01A ***Lab Sample ID:*** **551507781-0068**
***Sample Description:*** Roof of artillery store/Roof shingle

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

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http://www.EMSL.com / torontolab@emsl.com


EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** BB-RS-01B **Lab Sample ID:** **551507781-0069**
***Sample Description:*** Roof of artillery store/Roof shingle

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-RS-01C **Lab Sample ID:** **551507781-0070**
***Sample Description:*** Roof of crew shelter room/Roof shingle

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-NSF-01A **Lab Sample ID:** **551507781-0071**
***Sample Description:*** By stairs leading to main artillery /No-slip textured floor

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-NSF-01B **Lab Sample ID:** **551507781-0072**
***Sample Description:*** By stairs leading to main artillery/No-slip textured floor

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-NSF-01C **Lab Sample ID:** **551507781-0073**
***Sample Description:*** By stairs leading to main artillery/No-slip textured floor

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-RM-01A **Lab Sample ID:** **551507781-0074**
***Sample Description:*** Vertical exhaust vent on roof of crew shelter room/Black roof mastic

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-RM-01B **Lab Sample ID:** **551507781-0075**
***Sample Description:*** Vertical exhaust vent on roof of crew shelter room/Black roof mastic

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-RM-01C **Lab Sample ID:** **551507781-0076**
***Sample Description:*** Vertical exhaust vent on roof of crew shelter room/Black roof mastic

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/28/2015 | Black | 0% | 95% | **5% Chrysotile** | |

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http://www.EMSL.com / torontolab@emsl.com


EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** BB-CS-01A **Lab Sample ID:** **551507781-0077**

***Sample Description:*** West exterior wall of paint store/Grey concrete sealant

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-CS-01B **Lab Sample ID:** **551507781-0078**

***Sample Description:*** West exterior wall of paint store/Grey concrete sealant

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-CS-01C **Lab Sample ID:** **551507781-0079**

***Sample Description:*** West exterior wall of paint store/Grey concrete sealant

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-VSF-01 **Lab Sample ID:** **551507781-0080**

***Sample Description:*** Floor of crew shelter room/Brown vinyl sheet flooring

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Brown | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-CC-01A **Lab Sample ID:** **551507781-0081**

***Sample Description:*** Ceiling between steel panels/White caulking

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray/White/Red | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-CC-01B **Lab Sample ID:** **551507781-0082**

***Sample Description:*** Ceiling between steel panels/White caulking

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray/White/Red | 0.0% | 100% | None Detected | |

***Client Sample ID:*** BB-CC-01C **Lab Sample ID:** **551507781-0083**

***Sample Description:*** Ceiling between steel panels/White caulking

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray/White/Red | 0.0% | 100% | None Detected | |

**EMSL Canada Inc.**

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http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

# Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

**Analyst(s):**

| | |
|---|---|
| Jon Delos Santos | PLM (1)<br>PLM Grav. Reduction (3) |
| Nicole Dimou | PLM Grav. Reduction (8) |
| Nicole Yeo | PLM Grav. Reduction (2) |
| Romeo Samson | PLM Grav. Reduction (6) |

**Reviewed and approved by:**

Matthew Davis
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 07/28/201521:57:46

**EMSL Canada Inc.**
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Phone/Fax: 289-997-4602 / (289) 997-4607
http://www.EMSL.com torontolab@emsl.com

| | |
|---|---|
| EMSL Canada Or | 551507850 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123220330 |
| ProjectID: | |

Attn: **Steve Chou**
**Stantec Consulting, Ltd.**
**500 - 4730 Kingsway**
**Burnaby, BC V5H 0C6**

| | |
|---|---|
| Phone: | (604) 412-3004 |
| Fax: | |
| Received: | 07/21/15 11:18 AM |
| Analysis Date: | 7/28/2015 |
| Collected: | |

Project: **123220330.400.100, FORT RODD HILL**

# Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via EPA 600/R-93/116 section 2.3

| SAMPLE ID | DESCRIPTION | APPEARANCE | % MATRIX MATERIAL | % NON-ASBESTOS FIBERS | ASBESTOS TYPES |
|---|---|---|---|---|---|
| BuB-BS-01A<br>*551507850-0001* | NORTH WEST OF BELMONT BATTERY - BURNT BUILDING SHINGLE | Brown/Black<br>Non-Fibrous<br>Heterogeneous | 100 | None | No Asbestos Detected |
| BuB-BS-01B<br>*551507850-0002* | NORTH WEST OF BELMONT BATTERY - BURNT BUILDING SHINGLE | Brown/Black<br>Non-Fibrous<br>Heterogeneous | 100 | None | No Asbestos Detected |
| BuB-BS-01C<br>*551507850-0003* | NORTH WEST OF BELMONT BATTERY - BURNT BUILDING SHINGLE | Brown/Black<br>Non-Fibrous<br>Heterogeneous | 100 | None | No Asbestos Detected |

Analyst(s)

*Matthew Greco (3)*

Matthew Davis
or other approved signatory



Initial report from 07/28/2015 18:00:40

**EMSL Analytical, Inc.**
10 Falconer Drive, Unit 3 Mississauga, ON L5N 3L8
Phone: (289) 997-4602 Fax: (289) 997-4607
Email: TorontoLab@emsl.com

**Attn:** *STEVE CHOU*
STANTEC CONSULTING, LTD.
500-4730 KINGSWAY
BURNABY, BC, V5H 0C6
**Phone:** 604-396-6791
**Fax:** 0
**Project:** **123220330.400.100 FORT RODD HILL**

**Customer ID:** 55JACQ30L
**Customer PO:** Unavailable
**Received:** 8/4/15 12:00 AM
**EMSL Order:** 551507851
**Analysis Date:** 8/18/2015
**Report Date:** **8/18/2015**

# TEM Mass Analysis- Reporting Limit 0.1 %

*Asbestos Analysis in Soil Samples via Modified EPA 600/R-93/ 116 Method Utilizing Analytical Electron Microscopy (Section 2.5.5.2) with Milling*

| *Client Sample ID* / ***EMSL Sample ID*** | *Location* | *Mineral Type(s)* | *# of Structures Detected* | *Analytical Sensitivity %* | *Asbestos Weight %* | *Comments* |
|---|---|---|---|---|---|---|
| *BUB-SOIL-01A* / ***551507851-0001*** | *North West Of Belmont Battery* | No Asbestos Detected | | 0.1 | < 0.1 | |
| *BUB-SOIL-01B* / ***551507851-0002*** | *North West Of Belmont Battery* | No Asbestos Detected | | 0.1 | < 0.1 | |
| *BUB-SOIL-01C* / ***551507851-0003*** | *North West Of Belmont Battery* | No Asbestos Detected | | 0.1 | < 0.1 | |

***0.25***
Analyst

Approved Signatory



*TEM CARB Spreadsheet Version: 4.4*

**This is the Last Page of the Report**

**EMSL Analytical, Inc.**
10 Falconer Drive, Unit 3 Mississauga, ON L5N 3L8
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Email: TorontoLab@emsl.com

**Attn:** *STEVE CHOU*
STANTEC CONSULTING, LTD.
500-4730 KINGSWAY
BURNABY, BC, V5H 0C6
**Phone:** 604-396-6791
**Fax:** 0

**Project:** **123220330.400.100 FORT RODD HILL**

**Customer ID:** 55JACQ30L
**Customer PO:** Unavailable
**Received:** 8/4/15 12:00 AM
**EMSL Order:** 551507851
**Analysis Date:** 8/18/2015

**Report Date:** **8/18/2015**

# TEM Mass Analysis- Reporting Limit 0.1 %

*Asbestos Analysis in Soil Samples via Modified EPA 600/R-93/ 116 Method Utilizing Analytical Electron Microscopy (Section 2.5.5.2) with Milling*

| *Client Sample ID* / ***EMSL Sample ID*** | *Location* | *Mineral Type(s)* | *# of Structures Detected* | *Analytical Sensitivity %* | *Asbestos Weight %* | *Comments* |
|---|---|---|---|---|---|---|
| ***0.25*** | | | | | | |

Analyst

Approved



*TEM CARB Spreadsheet Version: 4.4*

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BURNABY, BC, V5H 0C6
**Phone:** 604-396-6791
**Fax:** 0
**Project:** **123220330.400.100 FORT RODD HILL**

**Customer ID:** 55JACQ30L
**Customer PO:** Unavailable
**Received:** 8/4/15 12:00 AM
**EMSL Order:** 551507851
**Analysis Date:** 8/18/2015

**Report Date:** **8/18/2015**

# TEM Mass Analysis- Reporting Limit 0.1 %

*Asbestos Analysis in Soil Samples via Modified EPA 600/R-93/ 116 Method Utilizing Analytical Electron Microscopy (Section 2.5.5.2) with Milling*

| *Client Sample ID* / ***EMSL Sample ID*** | *Location* | *Mineral Type(s)* | *# of Structures Detected* | *Analytical Sensitivity %* | *Asbestos Weight %* | *Comments* |
|---|---|---|---|---|---|---|

***0.25***

Analyst

Approved Signatory



*TEM CARB Spreadsheet Version: 4.4*

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|---|---|
| EMSL Canada Or | 551507777 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123220330 |
| ProjectID: | |

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**Stantec Consulting, Ltd.**
**500 - 4730 Kingsway**
**Burnaby, BC V5H 0C6**

Phone: (604) 412-3004
Fax:
Received: 07/20/15 11:06 AM
Collected:

Project: **FORT ROD HILL/123220330.400.100**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| BB-PB-01 | *551507777-0067* | | 7/23/2015 | 70000 ppm |
| | Site: WEST EXTERIOR TRIM<br>Desc: WHITE | | | |
| BB-PB-02 | *551507777-0068* | | 7/23/2015 | 20000 ppm |
| | Site: INTERIOR WALL OF TOWER UPPER LEVEL<br>Desc: WHITE | | | |
| BB-PB-03 | *551507777-0069* | | 7/23/2015 | 22000 ppm |
| | Site: WEST EXTERIOR TRIM OF PAINT STORE<br>Desc: ORANGE | | | |
| BB-PB-04 | *551507777-0070* | | 7/23/2015 | 2000 ppm |
| | Site: INTERIOR TRIM OF LIFTING LOBBY<br>Desc: BLACK | | | |
| BB-PB-05 | *551507777-0071* | | 7/23/2015 | 28000 ppm |
| | Site: STEEL STRUCTURE OF TOWER<br>Desc: GREEN | | | |
| BB-PB-06 | *551507777-0072* | | 7/23/2015 | 15000 ppm |
| | Site: DOOR TRIM OF PAINT STORE<br>Desc: GREEN | | | |
| BB-PB-07 | *551507777-0073* | | 7/23/2015 | 410 ppm |
| | Site: INTERIOR WALL OF PAINT STORE<br>Desc: DARK GREEN | | | |
| BB-PB-08 | *551507777-0074* | | 7/23/2015 | 42000 ppm |
| | Site: FLOOR OF PAINT STORE<br>Desc: GREY | | | |
| BB-PB-09 | *551507777-0075* | | 7/23/2015 | 20000 ppm |
| | Site: INTERIOR WALL OF PAINT STORE<br>Desc: WHITE | | | |
| BB-PB-10 | *551507777-0076* | | 7/23/2015 | 63000 ppm |
| | Site: FLOOR OF GENERATOR ROOM ON CONCRETE SLAB<br>Desc: RED | | | |

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/27/2015 09:49:06

**EMSL Canada Inc.**
**2756 Slough Street, Mississauga, ON L4T 1G3**
Phone/Fax: 289-997-4602 / (289) 997-4607
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| | |
|---|---|
| EMSL Canada Or | 551507777 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123220330 |
| ProjectID: | |

Attn: **Steve Chou**
**Stantec Consulting, Ltd.**
**500 - 4730 Kingsway**
**Burnaby, BC V5H 0C6**

Phone: (604) 412-3004
Fax:
Received: 07/20/15 11:06 AM
Collected:

Project: **FORT ROD HILL/123220330.400.100**

## Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| BB-PB-11 | *551507777-0077* | | 7/23/2015 | 45000 ppm |
| | Site: INTERIOR WALL OF LIFTING LOBBY<br>Desc: YELLOW<br>MS outside UCL. | | | |

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/27/2015 09:49:06

# Appendix H FINDINGS AND RECOMMENDATIONS—DEFENSIVE ELECTRIC LIGHT #1

Defensive Electrical Light #1 was reportedly constructed in 1903 and is an outdoor concrete structure.

The results of the assessment for each of the considered hazardous materials within the building are provided in the following sub-sections.

Floor plan drawings, which include locations of the samples collected during this assessment and locations of identified hazardous building materials (where practical), are attached to this Appendix.

## H.1 ASBESTOS

Stantec identified and sampled the following suspected ACM:

- Roofing material

Three samples of the above-noted suspected ACM were collected and submitted to EMSL for analysis of asbestos content and nature.

A summary of the sample types, location sand analytical results is presented in Table H-4, below. A copy of the certificate of analysis provided by EMSL for the suspected ACM samples submitted is attached to this Appendix.

**Table H-1 Suspected ACM Sample Collection and Analysis Summary Defensive Electric Light #1, Fort Rodd Hill National Historic Site, BC**

| Sample Number | Material Description | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| DEL1-RM-01A | Black roofing material | Roof | 4.3% Chrysotile |
| DEL1-RM-01B | Black roofing material | Roof | Positive Stop (Not Analyzed) |
| DEL1-RM-01C | Black roofing material | Roof | Positive Stop (Not Analyzed) |

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of suspected ACM sample analytical results, the material presented in Table H-2, below were identified as an ACM.

**Table H-2 Summary of Identified ACMs**
**Defensive Electric Light #1, Fort Rodd Hill National Historic Site, BC**

| Identified ACM Description and Condition Information | | Photo |
|---|---|---|
| Black roofing material | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Content | 4.3% Chrysotile | |

## H.2 LEAD

Lead-containing items (other than paint) were not observed.

With respect to paint, two paint chip samples were obtained from the predominant suspected LCP applications within the building. A summary of the sample types, locations and analytical results is presented in Table H-3, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is attached to this Appendix.

**Table H-3 Suspected LCP Sample Collection and Analysis Summary**
**Defensive Electric Light #1, Fort Rodd Hill National Historic Site, BC**

| Sample No. | Sample Colour | Sample Location | Lab Result (ppm) | Lead Containing (Yes/No) |
|---|---|---|---|---|
| **DEL1-PB-01** | **Dark Green** | **Steel shutters** | **8,300** | **Yes** |
| **DEL1-PB-02** | **Black** | **Steel cage** | **920** | **Yes** |

Based on our observations and on our interpretations of suspected LCP sample analytical results, the materials presented in Table H-4, below were identified as LCPs.

**Table H-4 Summary of Identified LCPs**
**Defensive Electric Light #1, Fort Rodd Hill National Historic Site, BC**

| Identified LCP Description | Photo |
|---|---|
| Dark green coloured paint on the steel shutters.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Black coloured paint on the steel cage.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). | No picture is available |

## H.3 POLYCHLORINATED BIPHENYLS

No suspected PCB-containing electrical equipment was observed.

## H.4 MERCURY

Equipment and/or items that contain mercury were not observed. Mercury may also be present in paints and adhesives.

## H.5 MOULD

Suspect mould or moisture-impacted building materials were not observed at the time of the assessment.

## H.6 OZONE-DEPLETING SUBSTANCES

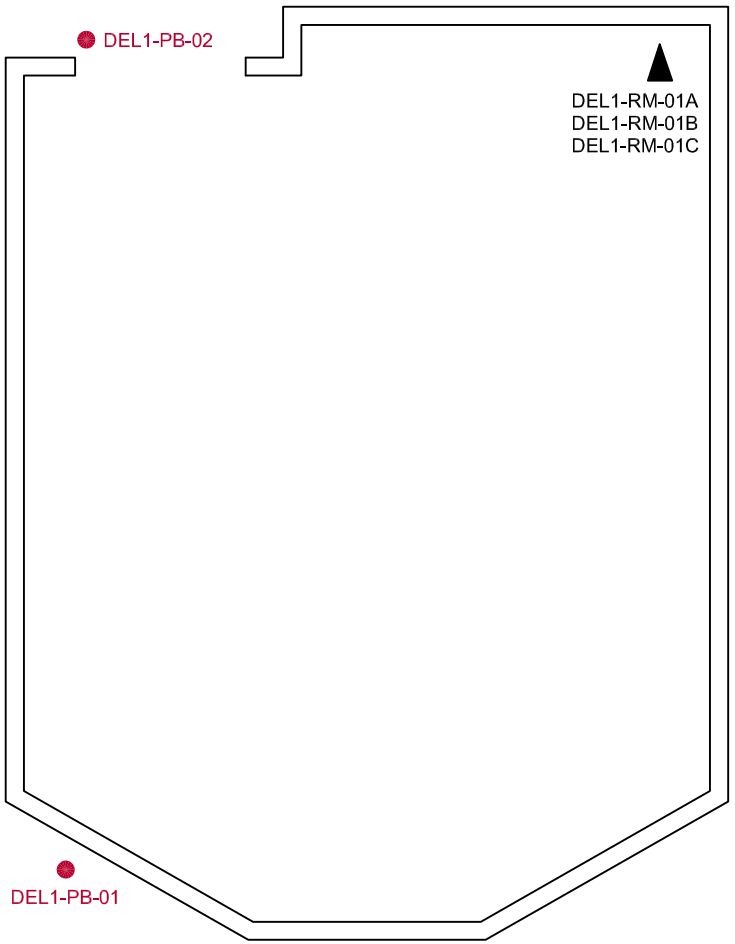
Building related cooling and refrigeration equipment suspected to be ODS-containing was not observed.

## H.7 SILICA

Silica is presumed to be present in the concrete comprising the entirety of the subject building.

## H.8 RECOMMENDATIONS

In general, identified hazardous building materials were observed to be in good condition and do not appear to require specific action to maintain compliance with applicable regulations for continued operations and maintenance. Refer to Section 5.0 of the main body of this report for applicable material-by-material general recommendations.




# DEFENSIVE ELECTRICAL LIGHT 1 (DEL1)

**LEGEND**

- BULK SAMPLE LOCATION
- PAINT CHIP SAMPLE LOCATION

**NOTES:** **1. THE BLACK ROOFING MATERIAL IS ASBESTOS-CONTAINING.**

2. THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

## FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

FORT RODD HILL AND FISGARD LIGHTHOUSE NATIONAL HISTORIC SITES, VICTORIA
603 FORT RODD HILL ROAD, VICTORIA, BC

**Client:** PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

| | |
|---|---|
| **Project No.:** | 123220330.400 |
| **Scale:** | N.T.S. |
| **Date:** | 15/10/29 |
| **Dwn. By:** | CD VM/DM SL2015100185 |
| **App'd By:** | TW |

**Dwg. No.:** 20

Stantec

# EMSL Canada Inc.

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http://www.EMSL.com / torontolab@emsl.com


EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

**Attn:** Steve Chou
Stantec Consulting, Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 7/20/2015
Analyzed: 7/27/2015

**Proj:** 123220330.400.100/Fort Rodd Hill

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** DEL1-RM-01A ***Lab Sample ID:*** **551507781-0084**

***Sample Description:*** Roof/Black roofing material

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 95.7% | **4.3% Chrysotile** | |

***Client Sample ID:*** DEL1-RM-01B ***Lab Sample ID:*** **551507781-0085**

***Sample Description:*** Roof/Black roofing material

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | | | Positive Stop (Not Analyzed) | | |

***Client Sample ID:*** DEL1-RM-01C ***Lab Sample ID:*** **551507781-0086**

***Sample Description:*** Roof/Black roofing material

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | | | Positive Stop (Not Analyzed) | | |

**Analyst(s):**

Nicole Dimou PLM Grav. Reduction (1)

**Reviewed and approved by:**

Matthew Davis
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 07/28/201521:57:46

**EMSL Canada Inc.**
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| | |
|---|---|
| EMSL Canada Or | 551507777 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123220330 |
| ProjectID: | |

Attn: **Steve Chou**
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**Burnaby, BC V5H 0C6**

Phone: (604) 412-3004
Fax:
Received: 07/20/15 11:06 AM
Collected:

Project: **FORT ROD HILL/123220330.400.100**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| DEL1-PB-01 | *551507777-0081* | | 7/24/2015 | 8300 ppm |
| | Site: STEEL SHUTTERS<br>Desc: DARK GREEN | | | |
| DEL1-PB-02 | *551507777-0082* | | 7/23/2015 | 920 ppm |
| | Site: STEEL CAGE<br>Desc: BLACK<br>MS outside UCL. | | | |

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/27/2015 09:52:41

# Appendix K FINDINGS AND RECOMMENDATIONS—LOWER BATTERY

The Lower Battery was reportedly constructed in 1898 and consists of a Guardhouse, Artillery Store, Small Arms Ammunition Store, Oil Store, Water Tank, two Gun Emplacements, and an Underground Magazine. The area is enclosed by concrete perimeter walls.

The typical structural components and finishes associated with these buildings and structures consist of concrete walls, ceilings and floors (except the Guardhouse, which has plaster interior walls and a wood canopy).

The results of the assessment for each of the considered hazardous materials within the buildings are provided in the following sub-sections.

Floor plan drawings, which include locations of the samples collected during this assessment and locations of identified hazardous building materials (where practical), are attached to this Appendix.

The following area was not accessed, for the reason indicated:

- Inside of Oil Store (no access)

## K.1 ASBESTOS

Suspected ACMs were not observed pertaining to the small arms ammunition store, oil store, water tank, the two gun emplacements or the underground magazine.

Stantec identified and sampled the following suspected ACMs in the artillery store and the guard house:

- Caulking and sealant
- Roofing material
- Plaster

Fourteen samples (some containing multiple layers) of the above-noted suspected ACMs were collected and submitted to EMSL for analysis of asbestos content and nature.

A summary of the sample types, locations and analytical results is presented in Table K-1, below. A copy of the certificate of analysis provided by EMSL for the suspected ACM samples submitted is attached at to this Appendix.

## Table K-1 Suspected ACM Sample Collection and Analysis Summary Lower Battery, Fort Rodd Hill National Historic Site, BC

| Sample Number | Material Description | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| **Artillery Store** | | | |
| LBAS-Roof-01A | Black roofing material | Roof of Artillery Store | None detected |
| LBAS-Roof-01B | Black roofing material | Roof of Artillery Store | None detected |
| LBAS-Roof-01C | Black roofing material | Roof of Artillery Store | None detected |
| **Guard House** | | | |
| LBGH-WPC-01A | White window pane caulking | East window of guard house under canopy between frame and pane | None detected |
| LBGH-WPC-01B | White window pane caulking | Central window of guard house under canopy between frame and pane | None detected |
| LBGH-WPC-01C | White window pane caulking | West window of guard house under canopy between frame and pane | None detected |
| LBGH-Roof-01A | Black roofing material | Roof of guard house | None detected |
| LBGH-Roof-01B | Black roofing material | Roof of guard house | None detected |
| LBGH-Roof-01C | Black roofing material | Roof of guard house | None detected |
| LBGH-PL-01A-Skim Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of guard house common room | None detected |
| LBGH-PL-01A-Rough Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of guard house common room | None detected |
| LBGH-PL-01B-Skim Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of guard house common room | None detected |
| LBGH-PL-01B-Rough Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of guard house common room | None detected |
| LBGH-PL-01C-Skim Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of guard house common room | None detected |
| LBGH-PL-01C-Rough Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of guard house common room | None detected |
| LBGH-PL-01D-Skim Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of guard house common room | None detected |
| LBGH-PL-01D-Rough Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of guard house common room | None detected |
| LBGH-PL-01E-Skim Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of guard house common room | None detected |
| LBGH-PL-01E-Rough Coat | Plaster in poor condition (cracked, flaking and peeling) | North west wall of common room | None detected |

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of suspected ACM sample analytical results, no ACMS were identified.

## K.2 LEAD

Lead is expected to be present in the following:

- Older electrical wiring materials and sheathing
- Solder used on domestic water lines
- Solder used in bell fittings for cast iron pipes

With respect to paint, 14 paint chip samples were obtained from the predominant suspected LCP applications within the buildings. A summary of the sample types, locations and analytical results is presented in Table K-2, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is attached to this Appendix.

**Table K-2 Suspected LCP Sample Collection and Analysis Summary Lower Battery, Fort Rodd Hill National Historic Site, BC**

| Sample No. | Sample Colour | Sample Location | Lab Result (ppm) | Lead Containing (Yes/No) |
|---|---|---|---|---|
| **Lower Battery (General)** | | | | |
| **LB-PB-02** | **White** | **Flag pole between east and west gun emplacement** | **1,300** | **Yes** |
| **LB-PB-03** | **Black** | **Main gate** | **50,000** | **Yes** |
| **Gun Emplacements** | | | | |
| **LB-PB-01** | **Black** | **West gun emplacement** | **31,000** | **Yes** |
| **Underground Magazine** | | | | |
| **LBUM-PB-01** | **Black** | **Shelf on south wall** | **3,200** | **Yes** |
| **LBUM-PB-02** | **Grey** | **Door** | **280,000** | **Yes** |
| LBUM-PB-03 | White | Interior wall | 190 | No |
| **Small Arms Ammunition Store/Artillery Store** | | | | |
| **LBGH-PB-01** | **Grey** | **Interior Trim** | **1,000** | **Yes** |
| **Guardhouse** | | | | |
| LBGH-PB-02 | Black | Interior trim | 390 | No |
| **LBGH-PB-03** | **White** | **Interior wall** | **3,400** | **Yes** |

## Table K-2 Suspected LCP Sample Collection and Analysis Summary Lower Battery, Fort Rodd Hill National Historic Site, BC

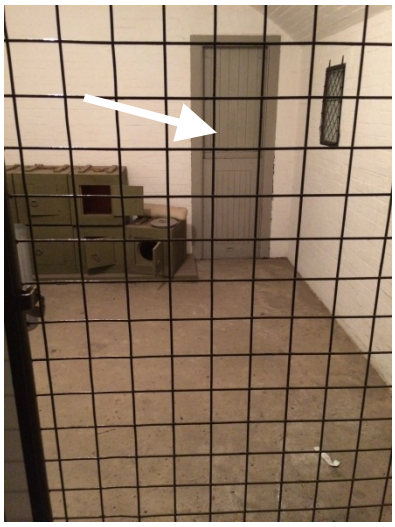
| Sample No. | Sample Colour | Sample Location | Lab Result (ppm) | Lead Containing (Yes/No) |
|---|---|---|---|---|
| **LBGH-PB-04** | **Grey** | **Interior wall** | **3,900** | **Yes** |
| **LBGH-PB-05** | **Yellow** | **Window frame** | **2,800** | **Yes** |
| LBGH-PB-06 | White | Window sill | <90 | No |
| **LBGH-PB-07** | **Red** | **Exterior red trim** | **9,700** | **Yes** |
| **LBGH-PB-08** | **Blue** | **Exterior west door** | **3,000** | **Yes** |

Based on our observations and on our interpretations of suspected LCP sample analytical results, the materials presented in Table K-3, below were identified as an LCP.

## Table K-3 Summary of Identified LCPs Lower Battery, Fort Rodd Hill National Historic Site, BC

| Identified LCP Description | Photo |
|---|---|
| General Lower Battery - white coloured paint on the flag pole.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| General Lower Battery - black coloured paint on the main gate, railings, and gates throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |

## Table K-3 Summary of Identified LCPs Lower Battery, Fort Rodd Hill National Historic Site, BC

| Identified LCP Description | Photo |
|---|---|
| Gun Emplacements - black colored paint on the gun emplacements.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Underground Magazine - black coloured paint on the shelves and doors throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Underground Magazine - grey colored paint on the doors throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |

## Table K-3 Summary of Identified LCPs Lower Battery, Fort Rodd Hill National Historic Site, BC

| Identified LCP Description | Photo |
|---|---|
| Artillery and Small Arms Ammunition Store - grey colored paint on the trims throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Guardhouse - white colored paint on the interior walls throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Guardhouse - grey coloured paint on the lower walls throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |

**Table K-3 Summary of Identified LCPs**
**Lower Battery, Fort Rodd Hill National Historic Site, BC**

| Identified LCP Description | Photo |
|---|---|
| Guardhouse - yellow coloured paint on the window frames throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Guardhouse - red coloured paint on the exterior trim throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Guardhouse - blue coloured paint on the doors throughout.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |

## K.3 POLYCHLORINATED BIPHENYLS

No suspected PCB-containing electrical equipment was observed.

## K.4 MERCURY

Equipment and/or items that contain mercury were not observed. Mercury may also be present in paints and adhesives.

## K.5 MOULD

No mould or moisture-impacted building materials were observed during the assessment.

## K.6 OZONE-DEPLETING SUBSTANCES

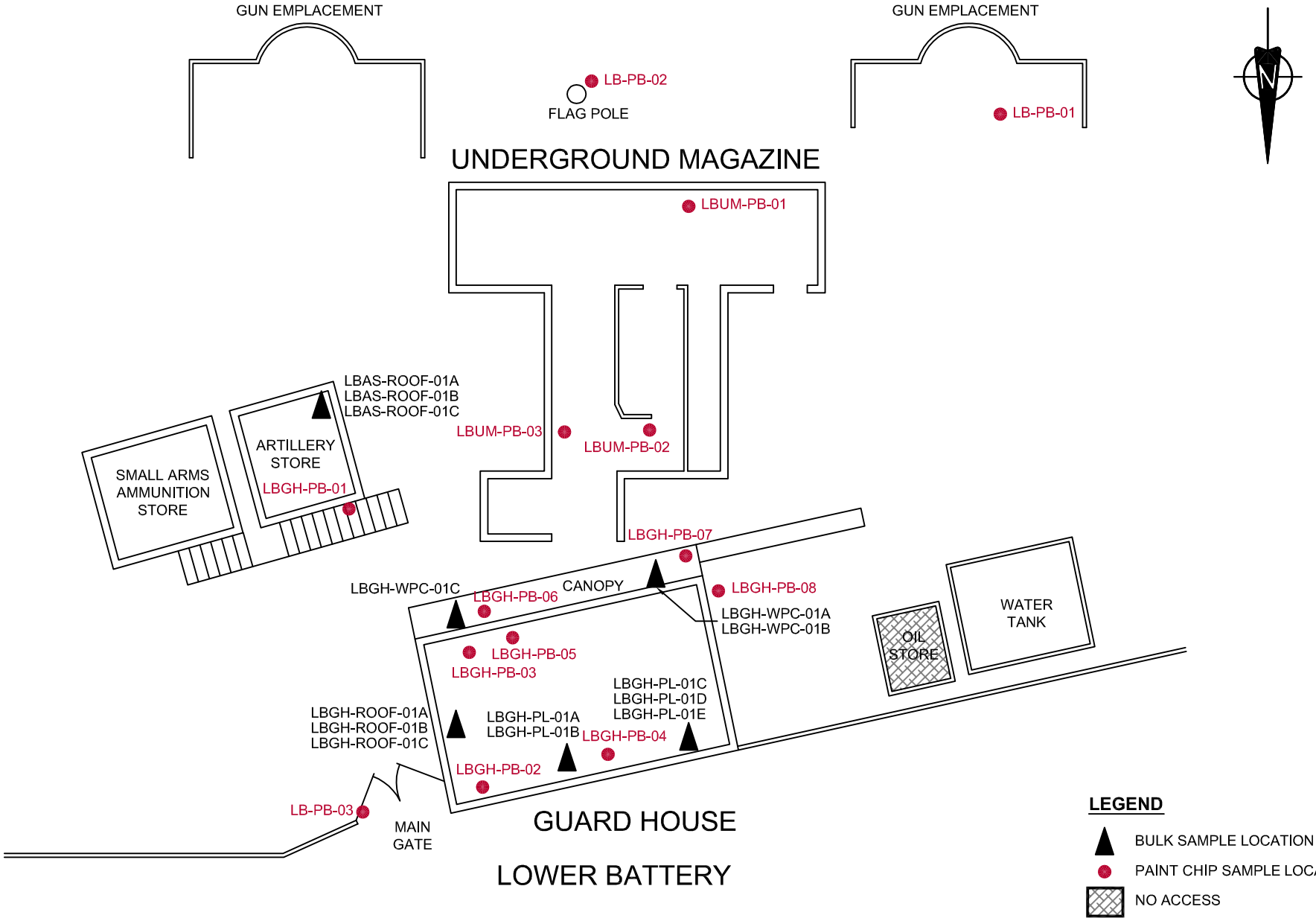
Building related cooling and refrigeration equipment suspected to be ODS-containing was not observed.

## K.7 SILICA

Silica is presumed to be present in the concrete walls, ceilings and floors (foundations) of the buildings.

## K.8 RECOMMENDATIONS

In general, identified hazardous building materials were observed to be in good condition and do not appear to require specific action to maintain compliance with applicable regulations for continued operations and maintenance. Refer to Section 5.0 of the main body of this report for applicable material-by-material general recommendations.




NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

# FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

FORT RODD HILL AND FISGARD LIGHTHOUSE NATIONAL HISTORIC SITES, VICTORIA
603 FORT RODD HILL ROAD, VICTORIA, BC

**Client:** PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

| | |
|---|---|
| **Project No.:** | 123220330.400 |
| **Scale:** | N.T.S. |
| **Date:** | 16/03/12 |
| **Dwn. By:** | CD SL2016030201 VM/DM |
| **App'd By:** | TW |

**Dwg. No.:** 3

Stantec

# EMSL Canada Inc.

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http://www.EMSL.com / torontolab@emsl.com


EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

**Attn:** Steve Chou
Stantec Consulting, Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 7/20/2015
Analyzed: 7/28/2015

**Proj:** 123220330.400.100/Fort Rodd Hill

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** LBAS-Roof-01A **Lab Sample ID:** **551507781-0030**
***Sample Description:*** Roof of building/Black roofing material

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Gray/Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** LBAS-Roof-01B **Lab Sample ID:** **551507781-0031**
***Sample Description:*** Roof of building/Black roofing material

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Gray/Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** LBAS-Roof-01C **Lab Sample ID:** **551507781-0032**
***Sample Description:*** Roof of building/Black roofing material

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray/Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-WPC-01A **Lab Sample ID:** **551507781-0033**
***Sample Description:*** East window under canopy between frame and pane/White window pane caulking

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray/White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-WPC-01B **Lab Sample ID:** **551507781-0034**
***Sample Description:*** Central window under canopy between frame and pane/White window pane caulking

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Gray/White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-WPC-01C **Lab Sample ID:** **551507781-0035**
***Sample Description:*** West window under canopy between frame and pane/White window pane caulking

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray/White | 0.0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-Roof-01A **Lab Sample ID:** **551507781-0036**
***Sample Description:*** Roof of building/Black roofing material

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

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EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** LBGH-Roof-01B ***Lab Sample ID:*** **551507781-0037**

***Sample Description:*** Roof of building/Black roofing material

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-Roof-01C ***Lab Sample ID:*** **551507781-0038**

***Sample Description:*** Roof of building/Black roofing material

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-PL-01A-Skim Coat ***Lab Sample ID:*** **551507781-0039**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/24/2015 | White | 0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-PL-01A-Rough Coat ***Lab Sample ID:*** **551507781-0039A**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/24/2015 | Gray | 0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-PL-01B-Skim Coat ***Lab Sample ID:*** **551507781-0040**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/24/2015 | White | 0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-PL-01B-Rough Coat ***Lab Sample ID:*** **551507781-0040A**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/24/2015 | Gray | 0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-PL-01C-Skim Coat ***Lab Sample ID:*** **551507781-0041**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/24/2015 | White | 0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-PL-01C-Rough Coat ***Lab Sample ID:*** **551507781-0041A**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/24/2015 | Gray | 0% | 100% | None Detected | |

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EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** LBGH-PL-01D-Skim Coat ***Lab Sample ID:*** **551507781-0042**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/28/2015 | White | 0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-PL-01D-Rough Coat ***Lab Sample ID:*** **551507781-0042A**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/28/2015 | Gray | 0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-PL-01E-Skim Coat ***Lab Sample ID:*** **551507781-0043**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/28/2015 | White | 0% | 100% | None Detected | |

***Client Sample ID:*** LBGH-PL-01E-Rough Coat ***Lab Sample ID:*** **551507781-0043A**

***Sample Description:*** North west wall of common room/Plaster in poor condition (cracked, flaking and peeling)

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Asbestos Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM | 7/28/2015 | Gray | 0% | 100% | None Detected | |

**Analyst(s):**

| | |
|---|---|
| Jon Delos Santos | PLM (4)<br>PLM Grav. Reduction (1) |
| Nicole Dimou | PLM Grav. Reduction (5) |
| Nicole Yeo | PLM Grav. Reduction (2) |
| Romeo Samson | PLM (6)<br>PLM Grav. Reduction (1) |

**Reviewed and approved by:**

Matthew Davis
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Report amended: 10/28/201515:17:12 Replaces initial report from: 07/28/201521:57:46 Reason Code: Data Entry-Change to Sample ID

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| | |
|---|---|
| EMSL Canada Or | 551507777 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123220330 |
| ProjectID: | |

Attn: **Steve Chou**
**Stantec Consulting, Ltd.**
**500 - 4730 Kingsway**
**Burnaby, BC V5H 0C6**

Phone: (604) 412-3004
Fax:
Received: 07/20/15 11:06 AM
Collected:

Project: **FORT ROD HILL/123220330.400.100**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| LBGH-PB-01 | *551507777-0037* | | 7/21/2015 | 1000 ppm |
| | Site: INTERIOR TRIM<br>Desc: GREY | | | |
| LBGH-PB-02 | *551507777-0038* | | 7/21/2015 | 390 ppm |
| | Site: INTERIOR TRIM<br>Desc: BLACK | | | |
| LBGH-PB-03 | *551507777-0039* | | 7/23/2015 | 3400 ppm |
| | Site: INTERIOR WALL<br>Desc: WHITE | | | |
| LBGH-PB-04 | *551507777-0040* | | 7/23/2015 | 3900 ppm |
| | Site: INTERIOR WALL<br>Desc: GREY | | | |
| LBGH-PB-05 | *551507777-0041* | | 7/23/2015 | 2800 ppm |
| | Site: WINDOW FRAME<br>Desc: YELLOW | | | |
| LBGH-PB-06 | *551507777-0042* | | 7/23/2015 | <90 ppm |
| | Site: WINDOW SILL<br>Desc: WHITE | | | |
| LBGH-PB-07 | *551507777-0043* | | 7/23/2015 | 9700 ppm |
| | Site: EXTERIOR WEST TRIM<br>Desc: RED | | | |
| LBGH-PB-08 | *551507777-0044* | | 7/23/2015 | 3000 ppm |
| | Site: EXTERIOR WEST DOOR<br>Desc: BLUE | | | |

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/27/2015 09:41:11

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| | |
|---|---|
| EMSL Canada Or | 551507777 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123220330 |
| ProjectID: | |

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**Stantec Consulting, Ltd.**
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**Burnaby, BC V5H 0C6**

Phone: (604) 412-3004
Fax:
Received: 07/20/15 11:06 AM
Collected:

Project: **FORT ROD HILL/123220330.400.100**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| LB-PB-01 | *551507777-0031* | | 7/21/2015 | 31000 ppm |
| | Site: WEST GUN EMPLACEMENT<br>Desc: BLACK | | | |
| LB-PB-02 | *551507777-0032* | | 7/21/2015 | 1300 ppm |
| | Site: FLAG POLE BETWEEN EAST AND WEST GUN EMPLACEMENT<br>Desc: WHITE | | | |
| LB-PB-03 | *551507777-0033* | | 7/21/2015 | 50000 ppm |
| | Site: MAIN GATE<br>Desc: BLACK | | | |

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/27/2015 09:37:19

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| EMSL Canada Or | 551507777 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123220330 |
| ProjectID: | |

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Phone: (604) 412-3004
Fax:
Received: 07/20/15 11:06 AM
Collected:

Project: **FORT ROD HILL/123220330.400.100**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| LBUM-PB-01 | *551507777-0034* | | 7/21/2015 | 3200 ppm |
| | Site: SHELF ON SOUTH WALL<br>Desc: BLACK | | | |
| LBUM-PB-02 | *551507777-0035* | | 7/21/2015 | 280000 ppm |
| | Site: DOOR<br>Desc: GREY | | | |
| LBUM-PB-03 | *551507777-0036* | | 7/21/2015 | 190 ppm |
| | Site: INTERIOR WALL<br>Desc: WHITE | | | |

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/27/2015 09:39:45

# Appendix P FINDINGS AND RECOMMENDATIONS—SEARCH LIGHT #6

The construction date of the search light #6 is unknown, although it appears to be of a pre-1990 vintage. The building is an outdoor concrete structure with steel shutters.

The results of the assessment for each of the considered hazardous materials within the building are provided in the following sub-sections.

## P.1 ASBESTOS

Suspected ACMs were not observed.

## P.2 LEAD

Lead is expected to be present in the following:

- Older electrical wiring materials and sheathing
- Solder used in electrical equipment

With respect to paint, three paint chip samples were obtained from the predominant suspected LCP applications within the building. A summary of the sample types, locations and analytical results is presented in Table P-1, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is attached to this Appendix.

**Table P-1 Suspected LCP Sample Collection and Analysis Summary Search Light #6, Fort Rodd Hill National Historic Site, BC**

| Sample No. | Sample Colour | Sample Location | Lab Result (ppm) | Lead Containing (Yes/No) |
|---|---|---|---|---|
| **SL6-PB-01** | **Green** | **Exterior wall** | **81,000** | **Yes** |
| SL6-PB-02 | Black | Steel cage | <90 | No |
| **SL6-PB-03** | **White** | **Interior wall** | **23,000** | **Yes** |

Based on our observations and on our interpretations of suspected LCP sample analytical results, the materials presented in Table P-2, below were identified as LCPs.

**Table P-2 Summary of Identified LCPs**
**Search Light #6, Fort Rodd Hill National Historic Site, BC**

| Identified LCP Description | Photo |
|---|---|
| Green coloured paint on the exterior.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| White coloured paint on the interior.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |

## P.3 POLYCHLORINATED BIPHENYLS

No suspected PCB-containing electrical equipment was observed.

## P.4 MERCURY

Equipment and/or items that contain mercury were not observed. Mercury may also be present in paints and adhesives.

## P.5 MOULD

No mould or moisture-impacted building materials were observed during the assessment.

## P.6 OZONE-DEPLETING SUBSTANCES

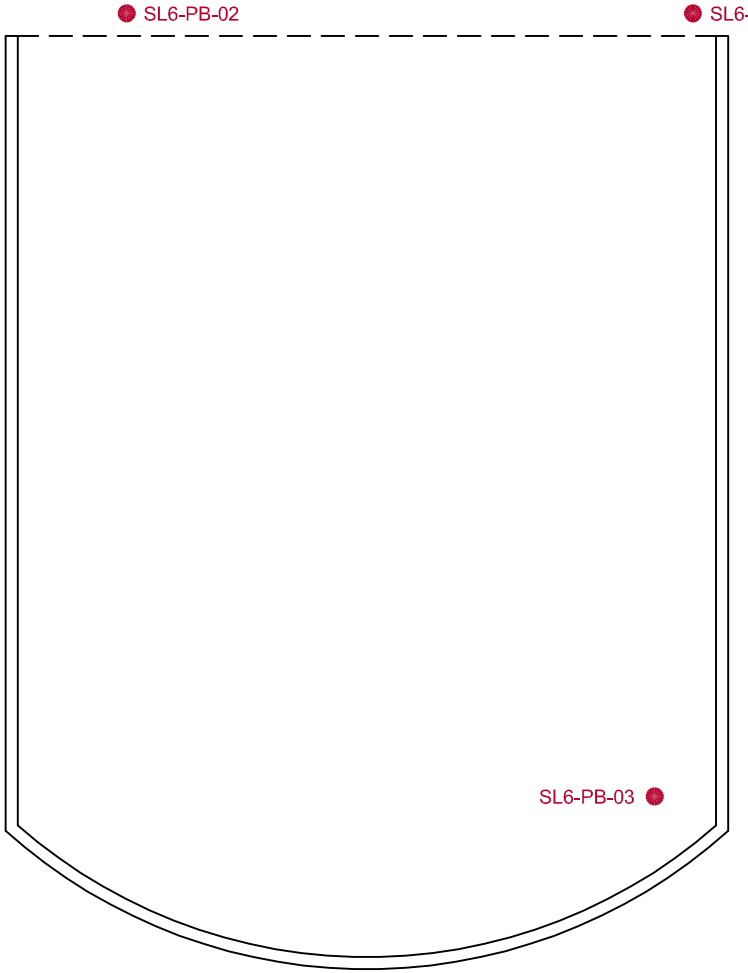
Building related cooling and refrigeration equipment suspected to be ODS-containing was not observed.

## P.7 SILICA

Silica is presumed to be present in the concrete structure of the searchlight.

## P.8 RECOMMENDATIONS

In general, identified hazardous building materials were observed to be in good condition and do not appear to require specific action to maintain compliance with applicable regulations for continued operations and maintenance. Refer to Section 5.0 of the main body of this report for applicable material-by-material general recommendations.




SEARCH LIGHT 6 (SL6)

**LEGEND**

● PAINT CHIP SAMPLE LOCATION

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

# FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

FORT RODD HILL AND FISGARD LIGHTHOUSE NATIONAL HISTORIC SITES, VICTORIA
603 FORT RODD HILL ROAD, VICTORIA, BC

**Client:** PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

| | |
|---|---|
| **Project No.:** | 123220330.400 |
| **Scale:** | N.T.S. |
| **Date:** | 15/08/28 |
| **Dwn. By:** | CD VM SL2015080205 |
| **App'd By:** | TW |

**Dwg. No.:** 21

Stantec

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Phone: (604) 412-3004
Fax:
Received: 07/20/15 11:06 AM
Collected:

Project: **FORT ROD HILL/123220330.400.100**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| SL6-PB-01 | *551507777-0078* | | 7/24/2015 | 81000 ppm |
| | Site: EXTERIOR WALL<br>Desc: GREEN | | | |
| SL6-PB-02 | *551507777-0079* | | 7/24/2015 | <90 ppm |
| | Site: STEEL CAGE<br>Desc: BLACK | | | |
| SL6-PB-03 | *551507777-0080* | | 7/24/2015 | 23000 ppm |
| | Site: INTERIOR WALL<br>Desc: WHITE | | | |

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/27/2015 09:50:57

# Appendix Q FINDINGS AND RECOMMENDATIONS—SEARCH LIGHT EMPLACEMENT #7

Search light emplacement #7 was reportedly constructed in 1940 and is an outdoor camouflaged concrete structure with steel shutters and a wood canopy.

The results of the assessment for each of the considered hazardous materials within the building are provided in the following sub-sections.

Floor plan drawings, which include locations of the samples collected during this assessment and locations of identified hazardous building materials (where practical), are attached to this Appendix.

## Q.1 ASBESTOS

Suspected ACMs were not observed.

## Q.2 LEAD

Lead is expected to be present in the following:

- Older electrical wiring materials and sheathing
- Solder used in electrical equipment

With respect to paint, six paint chip samples were obtained from the predominant suspected LCP applications within the building. A summary of the sample types, locations and analytical results is presented in Table Q-1, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is attached to this Appendix.

**Table Q-1 Suspected LCP Sample Collection and Analysis Summary**
**Search Light Emplacement #7, Fort Rodd Hill National Historic Site, BC**

| Sample No. | Sample Colour | Sample Location | Lab Result (ppm) | Lead Containing (Yes/No) |
|---|---|---|---|---|
| **SE-PB-01** | **Red** | **Exterior** | **1,100** | **Yes** |
| SE-PB-02 | Brown | Exterior | 170 | No |
| **SE-PB-03** | **Grey** | **Interior** | **51,000** | **Yes** |
| **SE-PB-04** | **Black** | **Steel cage** | **1,900** | **Yes** |
| SE-PB-05 | Red | Steel fence | 240 | No |
| **SE-PB-06** | **Brown** | **Wood canopy** | **1,400** | **Yes** |

Based on our observations and on our interpretations of suspected LCP sample analytical results, the materials presented in Table Q-2, below were identified as LCPs.

**Table Q-2 Summary of Identified LCPs**
**Search Light #6, Fort Rodd Hill National Historic Site, BC**

| Identified LCP Description | Photo |
|---|---|
| Red coloured paint on exterior walls.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Grey coloured paint on interior walls.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Black coloured paint on steel cage (left arrow).<br>This paint was observed to be in good condition (not bubbling, flaking or peeling).<br><br>Brown coloured paint on wood canopy (right arrow).<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |

## Q.3 POLYCHLORINATED BIPHENYLS

No suspected PCB-containing electrical equipment was observed.

## Q.4 MERCURY

Equipment and/or items that contain mercury were not observed. Mercury may also be present in paints and adhesives.

## Q.5 MOULD

No mould or moisture-impacted building materials were observed during the assessment.

## Q.6 OZONE-DEPLETING SUBSTANCES

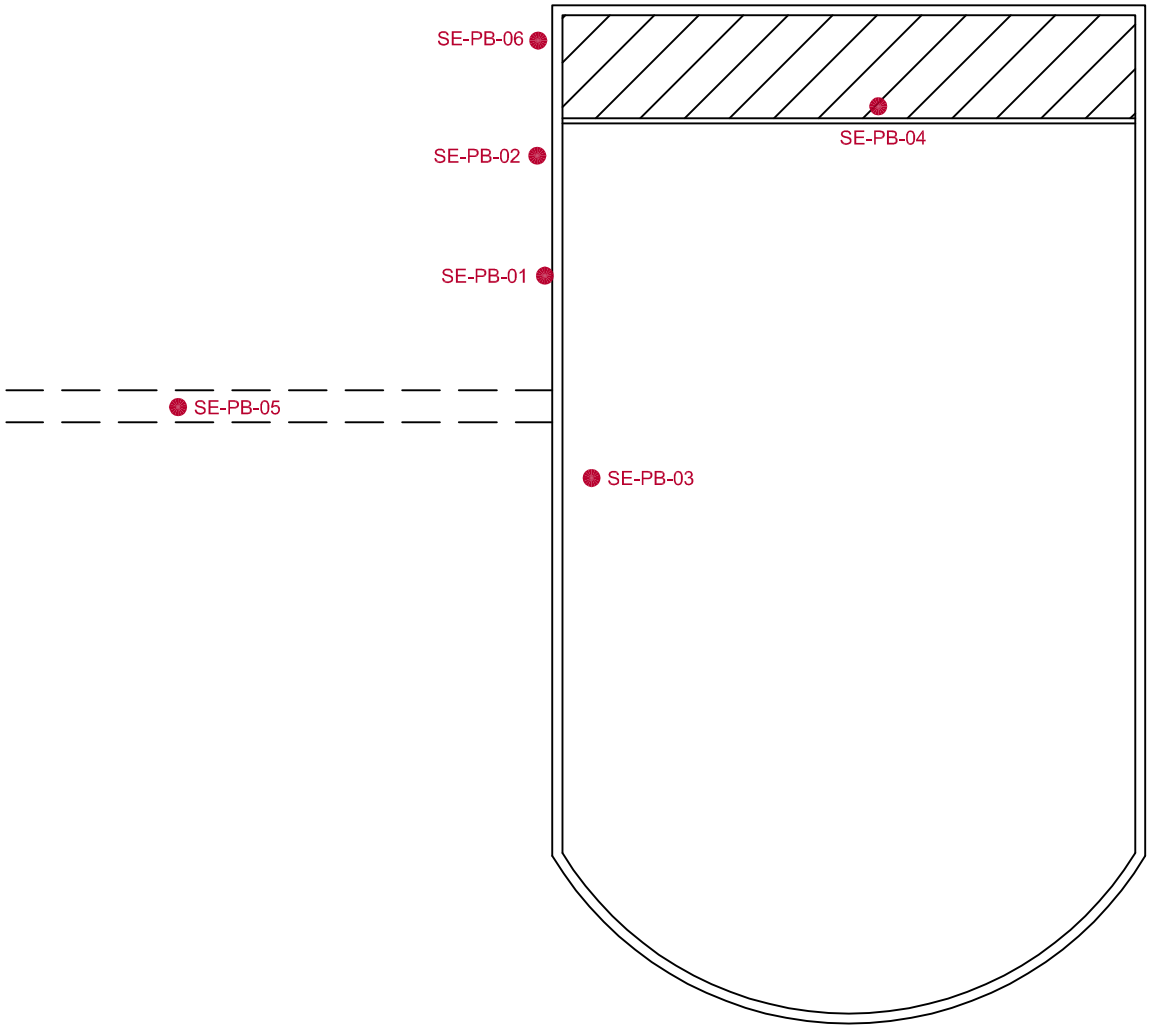
Building related cooling and refrigeration equipment suspected to be ODS-containing was not observed.

## Q.7 SILICA

Silica is presumed to be present in the concrete structure of the searchlight.

## Q.8 RECOMMENDATIONS

In general, identified hazardous building materials were observed to be in good condition and do not appear to require specific action to maintain compliance with applicable regulations for continued operations and maintenance. Refer to Section 5.0 of the main body of this report for applicable material-by-material general recommendations.





## SEARCH LIGHT EMPLACEMENT 7 (SE)

**LEGEND**

● PAINT CHIP SAMPLE LOCATION

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

# FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

FORT RODD HILL AND FISGARD LIGHTHOUSE NATIONAL HISTORIC SITES, VICTORIA
603 FORT RODD HILL ROAD, VICTORIA, BC

**Client:** PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

| | |
|---|---|
| **Project No.:** | 123220330.400 |
| **Scale:** | N.T.S. |
| **Date:** | 15/08/28 |
| **Dwn. By:** | CD VM SL2015080198 |
| **App'd By:** | TW |

**Dwg. No.:** 14

Stantec

**EMSL Canada Inc.**
**2756 Slough Street, Mississauga, ON L4T 1G3**
Phone/Fax: 289-997-4602 / (289) 997-4607
http://www.EMSL.com torontolab@emsl.com

| | |
|---|---|
| EMSL Canada Or | 551507777 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123220330 |
| ProjectID: | |

Attn: **Steve Chou**
**Stantec Consulting, Ltd.**
**500 - 4730 Kingsway**
**Burnaby, BC V5H 0C6**

Phone: (604) 412-3004
Fax:
Received: 07/20/15 11:06 AM
Collected:

Project: **FORT ROD HILL/123220330.400.100**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| SE-PB-01 | *551507777-0091* | | 7/23/2015 | 1100 ppm |
| | Site: EXTERIOR<br>Desc: RED | | | |
| SE-PB-02 | *551507777-0092* | | 7/24/2015 | 170 ppm |
| | Site: EXTERIOR<br>Desc: BROWN | | | |
| SE-PB-03 | *551507777-0093* | | 7/24/2015 | 51000 ppm |
| | Site: INTERIOR<br>Desc: GREY | | | |
| SE-PB-04 | *551507777-0094* | | 7/23/2015 | 1900 ppm |
| | Site: STEEL CAGE<br>Desc: BLACK | | | |
| SE-PB-05 | *551507777-0095* | | 7/24/2015 | 240 ppm |
| | Site: STEEL FENCE<br>Desc: RED | | | |
| SE-PB-06 | *551507777-0096* | | 7/23/2015 | 1400 ppm |
| | Site: WOOD CANOPY<br>Desc: BROWN | | | |

MS outside UCL. Sample#551507777-0091/-0094.

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/27/2015 10:00:18

# Appendix R FINDINGS AND RECOMMENDATIONS—SEARCH LIGHT ENGINE ROOM

The search light engine room was reportedly constructed in the 1900s and is a concrete building used for storage.

The results of the assessment for each of the considered hazardous materials within the building are provided in the following sub-sections.

Floor plan drawings, which include locations of the samples collected during this assessment and locations of identified hazardous building materials (where practical), are attached to this Appendix.

The following areas were not accessed, for the reasons indicated:

- Roof (lack of safe access)
- Search Light Engine Cistern on west side of the building (no access)
- South east storage room (no access)

As such, limited comments, if any, will be provided regarding the presence, quantity or condition of hazardous building materials within the above-noted areas.

## R.1 ASBESTOS

Stantec identified and sampled the following suspected ACMs:

- Textured flooring
- Caulking
- Roof tar

Nine samples of the above-noted suspected ACMs were collected and submitted to EMSL for analysis of asbestos content and nature.

A summary of the sample types, locations and analytical results is presented in Table R-1, below. A copy of the certificate of analysis provided by EMSL for the suspected ACM samples submitted is attached to this Appendix.

**Table R-1 Suspected ACM Sample Collection and Analysis Summary Search Light Engine Room, Fort Rodd Hill National Historic Site, BC**

| Sample Number | Material Description | Sample Location | Result (%/type asbestos) |
|---|---|---|---|
| SER-TF-01A | Black texture flooring | Floor of main corridor | None detected |
| SER-TF-01B | Black texture flooring | Floor of main corridor | None detected |
| SER-TF-01C | Black texture flooring | Floor of main corridor | None detected |
| WPC-01A | Grey window pane caulking | Exterior window | <0.25% Chrysotile |
| WPC-01B | Grey window pane caulking | Exterior window | None detected |
| WPC-01C | Grey window pane caulking | Exterior window | None detected |
| SER-RT-01A | Black roof tar | North side of building wall | None detected |
| SER-RT-01B | Black roof tar | North side of building wall | None detected |
| SER-RT-01C | Black roof tar | North side of building wall | None detected |

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of suspected ACM sample analytical results, no ACMs were identified.

### R.1.1 Materials with less than 0.5% Asbestos

It should be noted that one sample of grey window pane caulking was identified to contain asbestos in a concentration less than the limit of quantification (less than 0.25%), and no asbestos was detected in the other two samples of this material. As the limit of quantification was less than 0.5%, and as the number of samples collected for the homogenous application of this material would be considered sufficient to appropriately characterize it based on published provincial standards published (i.e., the BC Asbestos Guide), the window pane caulking is not considered to be an ACM.

## R.2 LEAD

Lead is expected to be present in the following:

- Older electrical wiring materials and sheathing
- Solder used on domestic water lines
- Solder used in bell fittings for cast iron pipes
- Solder used in electrical equipment

With respect to paint, eight paint chip samples were obtained from the predominant suspected LCP applications within the building. A summary of the sample types, locations and analytical results is presented in Table R-2, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is attached to this Appendix.

## Table R-2 Suspected LCP Sample Collection and Analysis Summary Search Light Engine Room, Fort Rodd Hill National Historic Site, BC

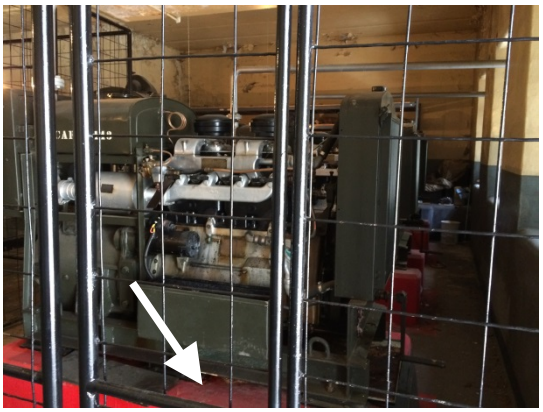
| Sample No. | Sample Colour | Sample Location | Lab Result (ppm) | Lead Containing (Yes/No) |
|---|---|---|---|---|
| SER-PB-01 | White | Exterior trim | <90 | No |
| SER-PB-02 | Dark Grey | Exterior of main door | 310 | No |
| **SER-PB-03** | **Tan** | **Interior wall** | **32,000** | **Yes** |
| **SER-PB-04** | **Black** | **Interior trim** | **24,000** | **Yes** |
| **SER-PB-05** | **Light Grey** | **Interior wall** | **64,000** | **Yes** |
| **SER-PB-06** | **Grey** | **Interior Floor** | **17,000** | **Yes** |
| **SER-PB-07** | **Orange** | **Exterior wall** | **4,500** | **Yes** |
| **SER-PB-08** | **Red** | **Floor inside caged engine room** | **97,000** | **Yes** |

Based on our observations and on our interpretations of suspected LCP sample analytical results, the materials presented in Table R-3, below were identified as LCPs.

## Table R-3 Summary of Identified LCPs Search Light Engine Room, Fort Rodd Hill National Historic Site, BC

| Identified LCP Description | Photo |
|---|---|
| Tan colored paint on the interior walls (right arrow).<br>Black colored paint on the interior trim (left arrow).<br>Light grey colored paint on the interior walls (middle arrow).<br>Grey coloured paint on interior floors (bottom arrow).<br><br>These paints were observed to be in good condition (not bubbling, flaking or peeling). |  |

**Table R-3 Summary of Identified LCPs**
**Search Light Engine Room, Fort Rodd Hill National Historic Site, BC**

| Identified LCP Description | Photo |
|---|---|
| Orange colored paint on the exterior wall.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |
| Red colored paint on the floor inside caged engine room.<br>This paint was observed to be in good condition (not bubbling, flaking or peeling). |  |

## R.3 POLYCHLORINATED BIPHENYLS

No suspected PCB-containing electrical equipment was observed.

## R.4 MERCURY

Equipment and/or items that contain mercury were not observed.

Mercury may also be present in paints and adhesives.

## R.5 MOULD

No mould or moisture-impacted building materials were observed during the assessment.

## R.6 OZONE-DEPLETING SUBSTANCES

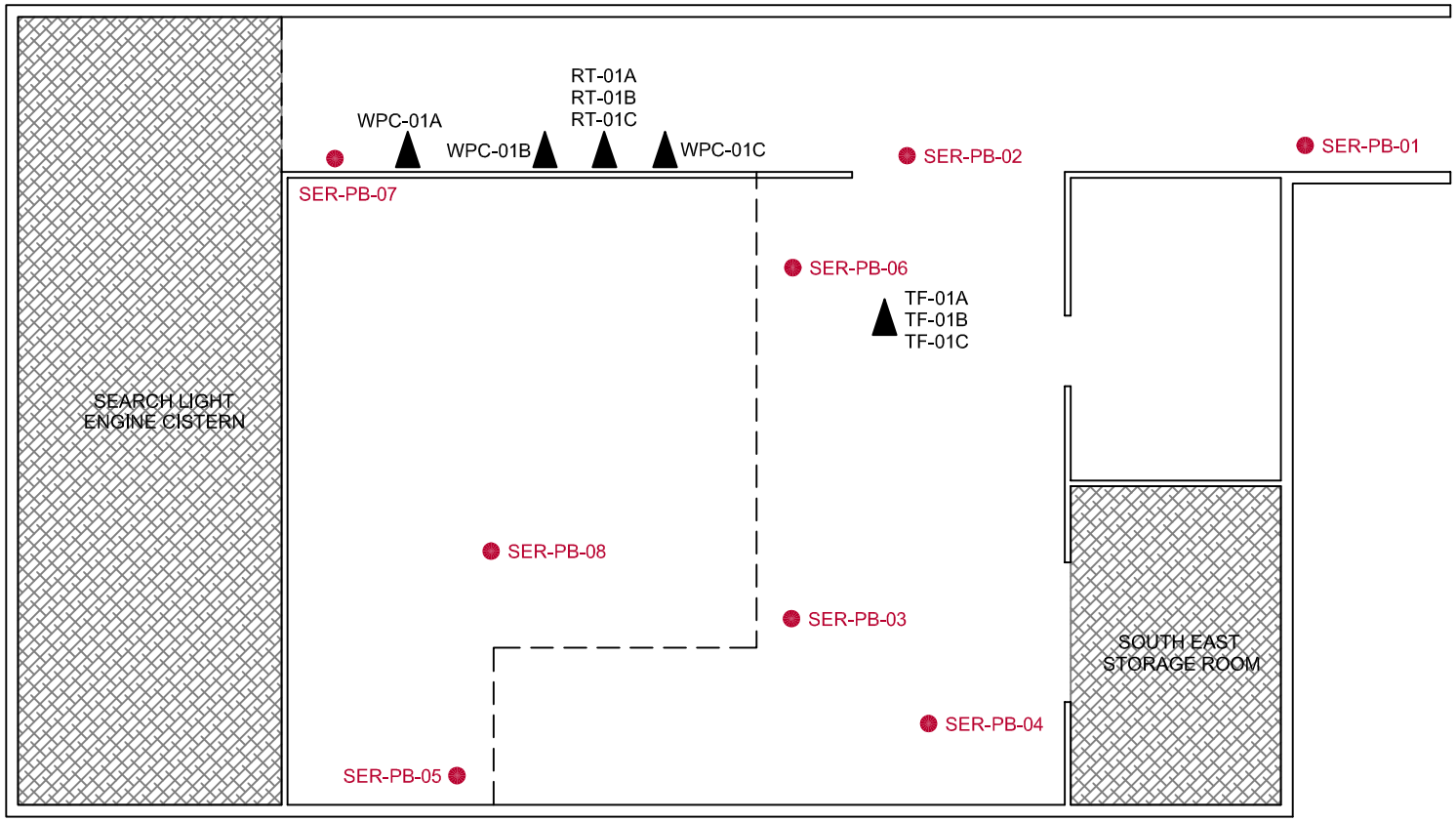
Building related cooling and refrigeration equipment suspected to be ODS-containing was not observed.

## R.7 SILICA

Silica is presumed to be present in the concrete comprising the entirety of the subject building.

## R.8 RECOMMENDATIONS

In general, identified hazardous building materials were observed to be in good condition and do not appear to require specific action to maintain compliance with applicable regulations for continued operations and maintenance. Refer to Section 5.0 of the main body of this report for applicable material-by-material general recommendations.




## SEARCH LIGHT ENGINE ROOM (SER)

**LEGEND**

- BULK SAMPLE LOCATION
- PAINT CHIP SAMPLE LOCATION
- NO ACCESS

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

# FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

FORT RODD HILL AND FISGARD LIGHTHOUSE NATIONAL HISTORIC SITES, VICTORIA
603 FORT RODD HILL ROAD, VICTORIA, BC

**Client:** PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

| | |
|---|---|
| **Project No.:** | 123220330.400 |
| **Scale:** | N.T.S. |
| **Date:** | 16/03/23 |
| **Dwn. By:** | CD SL2016030304 VM/DM |
| **App'd By:** | TW |

**Dwg. No.:** 19

Stantec

# EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3
Phone/Fax: 289-997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com


EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

**Attn:** Steve Chou
Stantec Consulting, Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 7/20/2015
Analyzed: 7/28/2015

**Proj:** 123220330.400.100/Fort Rodd Hill

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** SER-TF-01A **Lab Sample ID:** **551507781-0087**
***Sample Description:*** Floor of main corridor/Black texture flooring

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** SER-TF-01B **Lab Sample ID:** **551507781-0088**
***Sample Description:*** Floor of main corridor/Black texture flooring

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** SER-TF-01C **Lab Sample ID:** **551507781-0089**
***Sample Description:*** Floor of main corridor/Black texture flooring

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** WPC-01A **Lab Sample ID:** **551507781-0090**
***Sample Description:*** Exterior window/Grey window pane caulking

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Gray | 0.0% | 100% | **<0.25% Chrysotile** | |

***Client Sample ID:*** WPC-01B **Lab Sample ID:** **551507781-0091**
***Sample Description:*** Exterior window/Grey window pane caulking

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** WPC-01C **Lab Sample ID:** **551507781-0092**
***Sample Description:*** Exterior window/Grey window pane caulking

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Gray | 0.0% | 100% | None Detected | |

***Client Sample ID:*** SER-RT-01A **Lab Sample ID:** **551507781-0093**
***Sample Description:*** North side of building wall/Black roof tar

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

# EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3
Phone/Fax: 289-997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com


EMSL Canada Order 551507781
Customer ID: 55JACQ30L
Customer PO: 123220330
Project ID:

## Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

***Client Sample ID:*** SER-RT-01B ***Lab Sample ID:*** **551507781-0094**

***Sample Description:*** North side of building wall/Black roof tar

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/27/2015 | Black | 0.0% | 100% | None Detected | |

***Client Sample ID:*** SER-RT-01C ***Lab Sample ID:*** **551507781-0095**

***Sample Description:*** North side of building wall/Black roof tar

| TEST | Analyzed Date | Color | Non-Asbestos Fibrous | Non-Fibrous | Asbestos | Comment |
|---|---|---|---|---|---|---|
| PLM Grav. Reduction | 7/28/2015 | Black | 0.0% | 100% | None Detected | |

**Analyst(s):**

Nicole Dimou PLM Grav. Reduction (6)
Nicole Yeo PLM Grav. Reduction (3)

**Reviewed and approved by:**

Matthew Davis
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 07/28/201521:57:46

**EMSL Canada Inc.**
**2756 Slough Street, Mississauga, ON L4T 1G3**
Phone/Fax: 289-997-4602 / (289) 997-4607
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| | |
|---|---|
| EMSL Canada Or | 551507777 |
| CustomerID: | 55JACQ30L |
| CustomerPO: | 123220330 |
| ProjectID: | |

Attn: **Steve Chou**
**Stantec Consulting, Ltd.**
**500 - 4730 Kingsway**
**Burnaby, BC V5H 0C6**

Phone: (604) 412-3004
Fax:
Received: 07/20/15 11:06 AM
Collected:

Project: **FORT ROD HILL/123220330.400.100**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| SER-PB-01 | *551507777-0083* | | 7/23/2015 | <90 ppm |
| | Site: EXTERIOR TRIM<br>Desc: WHITE | | | |
| SER-PB-02 | *551507777-0084* | | 7/23/2015 | 310 ppm |
| | Site: EXTERIOR OF MAIN DOOR<br>Desc: DARK GREY | | | |
| SER-PB-03 | *551507777-0085* | | 7/24/2015 | 32000 ppm |
| | Site: INTERIOR WALL<br>Desc: TAN | | | |
| SER-PB-04 | *551507777-0086* | | 7/23/2015 | 24000 ppm |
| | Site: INTERIOR TRIM<br>Desc: BLACK | | | |
| SER-PB-05 | *551507777-0087* | | 7/24/2015 | 64000 ppm |
| | Site: INTERIOR WALL<br>Desc: LIGHT GREY | | | |
| SER-PB-06 | *551507777-0088* | | 7/23/2015 | 17000 ppm |
| | Site: INTERIOR FLOOR<br>Desc: GREY | | | |
| SER-PB-07 | *551507777-0089* | | 7/23/2015 | 4500 ppm |
| | Site: EXTERIOR WALL<br>Desc: ORANGE | | | |
| SER-PB-08 | *551507777-0090* | | 7/24/2015 | 97000 ppm |
| | Site: FLOOR INSIDE CAGED ENGINE ROOM<br>Desc: RED | | | |

MS outside UCL. Sample#551507777-0083/-0084/-0086/-0088/-0089.

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 07/27/2015 09:57:07

# BELMONT BATTERY REHABILITATION PROJECT

# FORT RODD HILL, BC

# PROJECT NO. R.075097.001

## APPENDIX 2

## CONCRETE TESTING

Issued: January 19, 2018

File: 171-12824-00

Public Works and Government Services Canada (PWGSC)
641 – 800 Burrard Street
Vancouver, BC V6Z 2V8

**Attention:** **Mr. Tom Dunphy, Project Manager**

**Project:** **Fort Rodd Hill – Belmont Battery**
**Victoria, BC**
**Subject:** **Consulting Engineering Services**

# INTRODUCTION

The Public Works and Government Services Canada (PWGSC) has retained WSP Canada Inc. (WSP) as the materials engineering consultant to provide consulting engineering and material testing services for the above-noted project. The scope of work includes testing for the WWII Concrete structure, testing for the underground "magazine" roof concrete, and testing for WWII concrete reinforcing details. The details regarding the scope of work and methodology are discussed in the following sections.

# TESTING FOR THE WWII CONCRETE STRUCTURE

## COMPRESSIVE STRENGTH

Three core samples were removed from the roof slab and tested for compressive strength in accordance with CSA A23.2-9C. The test results are summarized in Table 1. The test results show that the concrete is of normal density and the compressive strength varies between 15.9 MPa and 16.8 MPa, with an average of 16.3 MPa.

**Table 1: Core samples density and compressive strength summary**

| SAMPLE NO. | COMPRESSIVE STRENGTH (MPa) | DENSITY ($Kg/m^3$) |
|---|---|---|
| 1 | 16.1 | 2348 |
| 2 | 15.9 | 2331 |
| 3 | 16.8 | 2345 |

150-12791 Clarke Place
Richmond, BC, Canada V6V 2H9
Tel.: +1 604 278-1411
Tel.: +1 604 278-1042

wsp.com

## CHLORIDE ION CONCENTRATION

Corrosion of steel reinforcement can initiate by either of two mechanisms: elevated chloride ion concentrations within the concrete pore solution and/or decrease in alkalinity of the pore solution due to carbonation. Both of these mechanisms will allow the initiation of corrosion of the reinforcement when in the presence of moisture and oxygen.

Chloride-induced corrosion in reinforced concrete can occur when the concrete member is exposed to high concentration of chloride ion, such as de-icing salt and sea water. Moisture can carry the external chloride ion to the level of the embedded reinforcing steel in the concrete. Eventually, the concentration of chlorides will reach the threshold above which corrosion will be initiated. The chloride concentration necessary to de-passivate the black steel reinforcement and allow corrosion to initiate is approximately 0.030 to 0.050% by mass of concrete. The threshold value is typically stated as a range as it depends on several factors, such as the cement content, pH, humidity, and temperature of the concrete.

In order to determine the chloride ion content of the concrete at various depths from the surface, WSP extracted and analyzed concrete powder samples from three randomly selected locations of the concrete structures: one on the roof slab top surface, one from the south facing exterior wall, and one from the east facing exterior wall of the WWII structure. The concrete powder samples were collected at three depths per location. The test results are summarized in Table 2.

**Table 2: Concrete powder sample chloride ion content summary**

| SAMPLE LOCATIONS | DEPTH OF CONCRETE SAMPLE (mm) | CHLORIDE ION CONTENT AS PER CSA A23.2-4B (%) |
|---|---|---|
| South Wall Exterior Surface | 0 - 20 | <0.010 |
| | 20 - 40 | <0.010 |
| | 40 – 60 | <0.010 |
| East Wall Exterior Surface | 0 - 20 | 0.024 |
| | 20 - 40 | 0.029 |
| | 40 – 60 | 0.017 |
| Roof Slab Top Surface | 0 - 20 | <0.010 |
| | 20 - 40 | 0.027 |
| | 40 – 60 | <0.010 |

The chloride ion content test results indicate that the chloride concentration at all sample locations and depths are below the typical threshold that is required for reinforcement corrosion to initiate.

### CARBONATION DEPTH

The alkalinity of the concrete pore solution in new concrete is typically greater than 12, which causes the formation of a passive layer on the surface of the steel which essentially prevents the steel from corroding. At pH values less than approximately 10, the steel is no longer passivated and active corrosion may initiate, if sufficient moisture and oxygen are present. Reduction in concrete pH is expected at concrete surfaces exposed to atmospheric carbon dioxide for an extended period of time.

Carbonation depth testing was performed on two concrete core samples from the exterior walls, where the concrete surface is not sealed by membrane and exposed to the environment during regular service conditions (Photo 1). The core samples were fractured in the laboratory and treated with a phenolphthalein indicator. If the concrete surface turns purple after coming in contact with the solution, the pH of the concrete is above 10 (Photo 2). Where the solution remains colorless, it is an indication of carbonation.

The carbonation depths measured in the two cores are 25 mm and 40 mm, with an average of 33 mm. The test results are not uncommon for a concrete structure of this vintage.

### PETROGRAPHIC EXAMINATION

WSP engaged Mark E. Patton Ltd. to conduct a petrographic examination in accordance with ASTM C856-17 "*Standard Practice for Petrographic Examination of Hardened Concrete*" on one concrete core sample removed from the exterior surface of the south wall. The detailed petrographic examination report is presented in Appendix A. The petrographic examination report indicates that there are aggregate particles present in the concrete that have the potential to participate in alkali-silica reactions. However, there are no indications of deleterious reactions other than a few cracked aggregates where no alkali-silica gel is found and the slight discoloration of the paste due to carbonation. The petrographic examination result indicates that the core has a carbonation depth of 45 mm, which is comparable to the phenolphthalein test results for the other two cores extracted from the exterior wall (25 mm and 40 mm). In addition, the report indicates that the core consists of non-air entrained concrete. Although there is no evidence of damage from exposure to freezing and thawing in the core, the concrete at locations susceptible to ponding is at risk of freeze/thaw deterioration.

## TESTING FOR THE UNDERGROUND "MAGAZINE" ROOF CONCRETE

A full-thickness core was extracted from the "magazine" roof at a location designated by CWMM (Photo 3 and Photo 4). The total length of the core is approximately 1300 mm (Photo 5). A concrete topping of approximately 150 mm in thickness is evident in the core sample (Photo 6 to Photo 11). The concrete in the base material consists of approximately 40 mm nominal maximum size coarse aggregate (Photo 12). The concrete appears to be poorly consolidated as

large amounts of voids are generally present in the middle section of the core. The topping layer consists of approximately 25 mm nominal maximum size coarse aggregate, and it appears to be well consolidated.

## TESTING FOR WWII CONCRETE REINFORCING DETAILS

WSP performed a Ground Penetrating RADAR (GPR) survey at select locations of various concrete members, delineated by CWMM, to provide information related to the number of layers and spacing of the embedded steel reinforcement. Shallow exploratory openings were made at localized areas for the verification of bar size.

### DIRECTOR'S TOWER FLOOR BEAM

The GPR survey was performed at the area shown in Photo 13, and the results are summarized in Table 3.

**Table 3: Director's tower GPR survey summary**

| | NUMBER OF BARS DETECTED IN THE SCAN AREA | APPROXIMATE AVERAGE SPACING (mm) | RANGE OF CONCRETE COVER MEASURED (mm) | AVERAGE CONCRETE COVER MEASURED (mm) | DIAMETER OF EXPOSED REINFORCEMENT (mm) |
|---|---|---|---|---|---|
| Horizontal Reinforcement | 3 | 305 | 43 – 145 | 83 | 19 |
| Vertical Reinforcement | 7 | 235 | 62 – 140 | 107 | N/A |

Large variations of concrete cover were noted at the horizontal and vertical reinforcement. It is unclear if the concrete cover variations are resulting from different layers of reinforcement or inconsistency in reinforcement installation at the time of original construction. However, the change in concrete cover for the horizontal and vertical reinforcement did not appear to be in a pattern that is typically observed at reinforcement installed in layers. GPR survey was only performed on the exterior surface of the floor beam as access to the underside and the interior surface was obstructed (Photo 14 and Photo 15). Concrete removal by chipping was performed at a localized area where the concrete cover was relatively low; only the horizontal reinforcement was exposed at this location as the vertical reinforcement at this location was situated significantly deeper (Photo 16).

### CONCRETE ENCASEMENT TO STEEL LEGS

Each of the four concrete encased legs has a dimension of approximately 470 mm x 470 mm. A GPR survey was performed at a localized area on the south face of the southwest leg of the Director's Tower (Photo 17). Based on the result of the GPR survey, it is likely that the concrete encasement for the steel legs are reinforced with one vertical reinforcement at each of the four corners and horizontal reinforcement at approximately 305 mm spacing. The horizontal and

vertical reinforcement size were verified by chipping at a location on the northwest leg where work was being performed by contractors on site (Photo 18 to Photo 20). The results are summarized in Table 4.

**Table 4: Steel leg GPR survey summary**

| | NUMBER OF BARS DETECTED IN THE SCAN AREA | APPROXIMATE AVERAGE SPACING (mm) | RANGE OF CONCRETE COVER MEASURED (mm) | AVERAGE CONCRETE COVER MEASURED (mm) | DIAMETER OF EXPOSED REINFORCEMENT (mm) |
|---|---|---|---|---|---|
| Horizontal Reinforcement | 3 | 305 | 64 – 76 | 69 | 10 |
| Vertical Reinforcement | 2 | 343 | 75 – 84 | 80 | 19 |

## EXISTING ROOF SLAB SUPPORTING THE TOWER LEG

The southeast leg of the Director's Tower is supported by the concrete roof slab. The top surface of the roof slab is generally covered with a roof membrane; however, an opening in the membrane of approximately 1.6 m x 1.6 m was made available to WSP for access to the concrete substrate to conduct the GPR survey (Photo 21). The roof slab soffit is generally covered with wooden ceiling panels. One of the ceiling panels at the northwest corner of the room was removed for WSP's access to the concrete substrate for GPR survey (Photo 22). The size of reinforcement was confirmed by exposing the reinforcement at an intersecting location at the top surface (Photo 23), and no exploratory openings were made in the slab soffit. Results of the GPR survey are summarized in Table 5.

**Table 5: Roof slab supporting tower leg GPR survey summary**

| | NUMBER OF BARS DETECTED IN THE SCAN AREA | APPROXIMATE AVERAGE SPACING (mm) | RANGE OF CONCRETE COVER MEASURED (mm) | AVERAGE CONCRETE COVER MEASURED (mm) | DIAMETER OF EXPOSED REINFORCEMENT (mm) |
|---|---|---|---|---|---|
| Reinforcement in east-west direction (Top Surface) | 4 | 152 | 105 – 125 | 112 | 5 mm mesh and (13 mm bent bar at cut location) |
| Reinforcement in north-south direction (Top Surface) | 4 | 305 | 97 – 115 | 109 | 5 mm mesh |
| Reinforcement in east-west direction (Soffit) | 2 | 305 | 69 | 69 | N/A |
| Reinforcement in north-south direction (Soffit) | 4 | 127 | 73 | 73 | N/A |

A steel reinforcement was cut during the core extraction from the roof slab (Photo 24). This reinforcement runs in the north-south direction and is bent to create a vertical profile (Photo 25). Based on our review of the core hole, the rebar has top surface concrete cover of 97 mm at the north end and it slopes down in the south direction to an unknown depth. The core hole is located at approximate 450 mm east and 950 mm south from the northwest corner of the roof slab, at the perimeter of the roof membrane opening. Tracing of this rebar from the underside and measurement of its corresponding soffit concrete cover could not be performed as the opening in the soffit wood panels does not allow for GPR scanning at this location. The diameter of this cut rebar is approximately 13 mm, which is different than that observed bar size in the other exploratory location on the roof slab.

A GPR scan was performed in the perpendicular direction of the cut rebar along the top end, and a reinforcement spacing of approximately 305 mm, similar to that observed within other areas of the roof membrane opening, was noted; however, WSP was not able to distinguish between the bent rebar and mesh as the concrete cover for the two are comparable. The cut rebar was not identified during the GPR survey likely due to (1) the scanning was performed at the lower end of the bent bar and the depth at the lower end exceeded the detection range of our device and/or (2) the signal of the bar at the lower end was masked by an adjacent rebar.

## WALL PIER ADJACENT TO DOOR

The thickness of the wall pier, measured at the door opening, is approximately 460 mm (Photo 26). The location where the GPR survey was performed is shown in Photo 27. No exploratory openings were made at the wall pier due to the depth of the embedded reinforcement. The results are summarized in Table 6.

**Table 6: Pier wall GPR survey summary**

| | NUMBER OF BARS DETECTED IN THE SCAN AREA | APPROXIMATE AVERAGE SPACING (mm) | RANGE OF CONCRETE COVER MEASURED (mm) | AVERAGE CONCRETE COVER MEASURED (mm) | DIAMETER OF EXPOSED REINFORCEMENT (mm) |
|---|---|---|---|---|---|
| Horizontal Reinforcement | 4 | 305 | 47 – 185 | 134 | N/A |
| Vertical Reinforcement | 3 | 305 | 140 – 157 | 148 | N/A |

The number of layers of reinforcement in the wall pier could not be verified as there is no access to the interior surface for GPR survey due to the existing wood finishing. WSP was able to scan the wall below the window located south of the wall pier through a small opening in the wood interior finishing using the GPR (Photo 28). The concrete cover of a vertical and a horizontal reinforcement was measured on both sides of the wall at this location. The concrete covers are 205 mm and 185 mm for the horizontal reinforcement measured from the exterior and interior, respectively. The concrete covers are 140 mm and 210 mm for the vertical reinforcement measured from the exterior and interior, respectively. As the wall thickness is approximately 460 mm, it is difficult to conclude, based on the results, whether there are two closely spaced layers of reinforcement (each layer consisting of horizontal and vertical reinforcement) or the difference is attributed to the inherent variation of the steel profile of a single reinforcement layer within the wall.

# DURABILITY OF EXISTING ROOF SLAB SUPPORTING THE TOWER LEG- PRELIMINARY CONCLUSION

Based on the limited concrete cover measurements, carbonation depth, and chloride ion content test results presented in previous sections, although the high chloride ion concentration and carbonation of concrete appear to have progressed to a depth of approximately 45 mm from the concrete surface, due to relatively high concrete cover at the measured locations (i.e. more than 69 mm), the current risk of embedded steel reinforcement corrosion due to carbonation and chloride ion contamination of the roof slab appears to be low. Provided that the mechanical loading, existing protections, and exposure condition of the concrete remain unchanged. Considering the existing concrete is more than 72 years old, it is anticipated that the risk of chloride and carbonation induced corrosion of reinforcement at the

areas of the roof slab structure, away from the cracks and localized areas with potential low concrete cover, if any, remains low for the next 10 years. The petrographic examination report indicates that there is no evidence of alkali-silica reaction occurring the tested core. However, petrographic examination results indicate that the concrete in the exterior wall is non-air entrained; therefore, locations such as wall bases where the concrete is susceptible to prolonged moisture exposure should be monitored for the development of freeze/thaw damage. WSP has no information that indicates if the roof slab consists of the same concrete as the exterior wall. If the roof slab also consists of non-air entrained concrete, it is imperative to ensure that the roof waterproofing membrane is well maintained to prevent the roof's exposure to freeze/thaw cycles.

Since no previous inspections have been carried out on these elements, WSP recommends that testing, review, and monitoring of these elements be conducted within five years in order to determine the rate of deterioration and whether or not repairs or preventive maintenance works are required.

Please note that the above conclusions are solely based on the limited testing conducted at localized areas of the slab and shall not be generalized to the other areas or other concrete elements of the structure.

## CLOSURE

We trust this meets your current needs. Please call if you require anything further. Thank you for retaining WSP.

Yours truly,

***[Original signed by E. Liu]***

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Reviewed by:

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**Photo 1: Locations of core samples from the exterior walls**

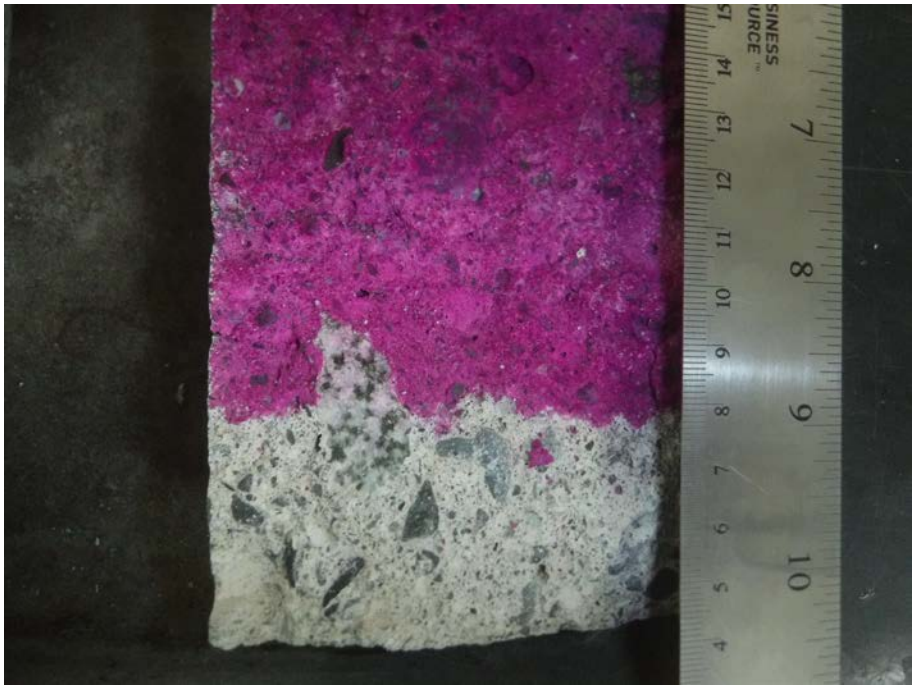


**Photo 2: Core sample fractured surface treated with phenolphthalein**

**Photo 3: Location of full-thickness core from "magazine" roof**

**Photo 4: Underside of the "magazine" roof and core location**

**Photo 5: Full-thickness core from "magazine" roof slab**


**Photo 6: Concrete topping at the top end of full-thickness core**

**Photo 7: Partial view along full-thickness core**

**Photo 8: Partial view along full-thickness core**

**Photo 9: Partial view along full-thickness core**

**Photo 10: Partial view along full-thickness core**

**Photo 11: Partial view along full-thickness core**

**Photo 12: Coarse aggregate from full-thickness core**

**Photo 13: Director's Tower floor beam GPR survey area**

**Photo 14: Door frame limits GPR access to floor beam underside**

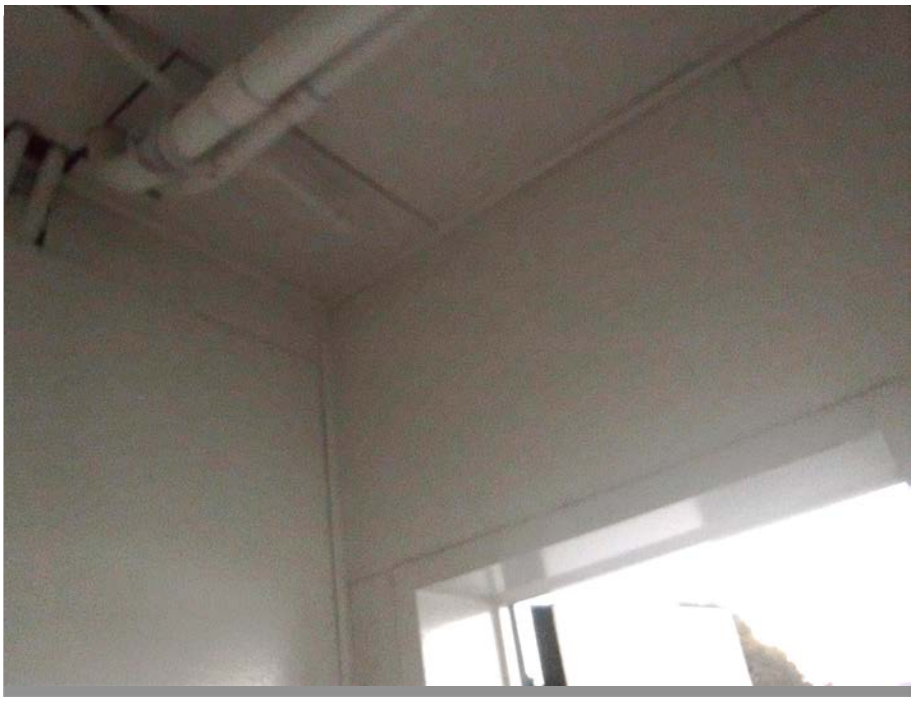


**Photo 15: Interior surface of floor beam covered in wood panels**

**Photo 16: Horizontal reinforcement exposed**

Photo 17: GPR survey on the south face of the southwest leg

Photo 18: Location of reinforcement size review on the northwest leg


**Photo 19: Vertical reinforcement exposed in northwest leg**


**Photo 20: Horizontal reinforcement exposed in northwest leg**


**Photo 21: Roof slab top surface GPR survey area**

**Photo 22: Roof slab soffit GPR survey area**


**Photo 23: Steel reinforcement exposed from roof slab top surface**

**Photo 24: Location of cut rebar**

**Photo 25: Bent bar cut at the upper end**

**Photo 26: Wall pier thickness measured at door opening**

**Photo 27: Area of GPR survey on wall pier**

**Photo 28: Interior surface of wall pier covered in wood panels and exposed concrete below window**

# APPENDIX

# A PETROGRAPHIC EXAMINATION REPORT

Mark E. Patton, Ltd.
Materials Consultant
P.O. Box 31
Murrysville, PA 15668
724 325 1915

November 1, 2017
MP1710926

# PETROGRAPHIC EXAMINATION OF A CONCRETE CORE

**FOR**

**WSP CANADA INC.**
(171-12824-00)

*** * * * * * ***

## INTRODUCTION

Reported herein are the results of a petrographic examination of a concrete core identified as from a structure in Victoria, British Columbia. The core is submitted by the Richmond Office of WSP Canada and is reported to have been placed approximately at the time of World War II and faces the Pacific Ocean. WSP is interested in identifying if there are any indications that alkali-silica reactions are occurring in the concrete.

Accordingly, the core is prepared and examined using applicable methods of ASTM C856, "Petrographic Examination of Hardened Concrete."

## STUDIES

**Samples** – Received for the study is one nominal 94 mm diameter core identified as Core 1 with a nominal length of 210 mm. The top end of the core is a flat, smooth formed surface. The bottom end is a fractured surface. Images of the core are presented in Figure 1.

To prepare a section for the studies, a longitudinal saw cut was made close to the center of the core using a water-cooled saw with a diamond-tipped blade. The saw cut is oriented perpendicular to the arrow on the top surface of the core. One saw cut surface was selected and lapped with progressively finer abrasives to obtain the desired light-reflective smooth surface for the studies. The prepared surface is shown in Figure 2.

**Petrographic Examination** – Coarse aggregate particles in the core are crushed gravel with a nominal maximum size of 37.5 mm. Coarse aggregate particles are mainly diorite, quartz diorite and granodiorite with minor to trace amounts of basalt, gneiss, schist, fine-grained foliated rocks that contain minor to trace amounts of strained and microcrystalline quartz, granitic rocks, and light brown chert. Fine aggregate includes a fine natural sand that is mainly sub rounded quartz particles with minor to trace amounts of feldspar, mafic minerals and mica, and in the coarser fraction sub angular dark particles that include undersized particles of the coarse aggregate and coarse sand size particles that are similar in composition to the coarse aggregate.

Many of the coarse aggregate particles contain fine cracks, but the cracks to do extend into the flanking paste and there is no alkali-silica gel present in the cracks, the aggregate sockets, or voids immediately flanking the cracked aggregate particles. The dark aggregate particles that are cracked contain mainly the amphibole hornblende, a plagioclase feldspar (albite, oligoclase) and a mica with no quartz present. One cracked aggregate particle is shown in Figure 3; the composition of this aggregate is corroborated by powder x-ray diffraction to be mainly hornblende, a plagioclase feldspar and mica

with no quartz detected. The fine-grained foliated aggregates that are cracked contain chlorite, hornblende, feldspar and minor to trace amounts of strained quartz. Cracks in these fine-grained foliated aggregates also do not extend into the flanking paste, and there is no alkali-silica gel found in the cracks, aggregate sockets or voids in the paste immediately flanking the aggregate particles. An example of cracks in a fine-grained foliated particle is shown in Figure 4.

Paste in the core is variable on microscale from mainly light gray to medium gray and to depths that are from 40 to 50 mm is discolored with an orange-beige tint that is more prominent in the top 10 mm of the core. Paste varies on a microscale from mainly moderately hard and firm to hard and firm with small zones of moderately soft, but firm paste present immediately flanking bleed water channels and collections of non-spherical voids flanking coarse aggregate particles. Throughout the core zones that contain numerous voids from trapped bleed water and bleed water channels flank many of the coarse aggregate particles. A magnified view of one prominent bleed water channel that is visible on the image of the prepared cross section in Figure 2 is presented in Figure 5. Another example of zones of collections of voids and bleed water channels is shown in Figure 6.

Fresh fractured surfaces induced in the paste in the laboratory have textures that are mainly finely granular to granular. Supplementary cementitious materials such as fly ash are not present. Hydration of the cement is advanced; relict and residual portland cement particles are abundant. The calcium hydroxide component of the cement hydration products is present in meager amounts below the carbonated zone and it appears the calcium hydroxide has been leached from the paste.

Compositional and textural features of the paste are indicative of a portland cement content estimated to be moderate to moderately high (e.g. 330 to 360 kg/m$^{3)}$ and a water-cement ratio that is estimated to vary on a microscale from mainly moderate to moderately high (e.g. 0.50 to 0.54). In small zones of paste immediately flanking

collections of voids and bleed water channels as described previously, paste has a water-cement ratio is estimated to be moderately high to high (e.g. 0.54 to 0.56).

The air content of the core is estimated to be $2^1/2$ to 3 percent. Air in the core occurs mainly as coarse spherical and non-spherical voids characteristic of entrapped air and as trace amounts of small spherical voids. The concrete is non-air entrained.

The top surface of the core is a formed surface that is weathered but intact with the top surfaces of fine aggregate exposed. Paste at the top surface is carbonated to depths of 40 to 50 mm; the orange-beige tint described previously corresponds to the depth of carbonation of the paste. One fine, tight surface crack is present on the prepared surface that extends from the top surface of the core to depths of 5 mm. The crack is not visible on the top surface of the core.

The surfaces of voids throughout the depth of the core are dull and lined with a light coat of fine secondary deposits. The secondary deposits are identified as mainly fine calcium carbonate. In addition to the calcium carbonate in some of the voids throughout the core there are meager amounts of small collections of fine, white, acicular crystals. In the carbonated zone in the upper 40 to 50 mm of the core the secondary deposits of acicular crystals have refractive indices measured to be the same as those of ettringite, but with a positive sign of elongation; ettringite has a negative sign of elongation. At depths below the zone of carbonation, the fine acicular crystals are present and identified as ettringite with the proper refractive indices and negative sign of elongation.

No reinforcement is present in the core.

## SUMMARY AND DISCUSSION

The core is non-air entrained and made using: (1) siliceous crushed gravel coarse aggregate (2) fine aggregate that is natural fine siliceous sand and coarse sand size particles with a composition similar to the coarse aggregate; (3) a portland cement content estimated to be 330 to 360 kg/m$^3$, and (4) a water-cement ratio that is estimated

to vary mainly from 0.50 to 0.54 and occasionally 0.56. The air content of the core is estimated to be from $2^{1}/_{2}$ to 3 percent.

Although some fine-grained foliated metamorphic rocks present contain microcrystalline quartz and strained quartz and there are chert particles present that are also potentially alkali-silica reactive, no reaction products are found in cracks in these particles or in the aggregate sockets or voids in the paste immediately flanking the suspect particles. Many of these potentially reactive particles contain fine cracks, but the cracks do not extend into the flanking paste and there are no cracks found in the paste.

The variation in the estimated water-cement ratio in the core is due to bleeding and water gain trapped below and alongside coarse aggregate particles. There are numerous bleed water channels and collections of non-spherical voids present immediately flanking aggregate particles. To depths of 45 mm, paste is carbonated and has a light orange-beige tint; the discoloration is more pronounced at depths of 0 to 10 mm.

The concrete is non-air entrained. Overall paste is intact, firm and sound. The orange-beige discoloration is correlated to the depth of carbonation but in some instances, can be an indication of alteration of the paste due to chemical attack, for example by external sulfates. However, there is no other evidence of significant alteration or damage of the paste or concrete components from a deleterious reaction such as an alkali-silica reaction or chemical attack.

In summary, the concrete is in fair condition given the age, exposure, the lack of air entrainment and the presence of numerous bleed water channels and non-spherical voids immediately flanking coarse aggregate particles. The lack of air entrainment and potential exposure to sulfates and chlorides deposited by sea spray are the primary concerns with respect to long term durability. The concrete has been in service for a long time and it is expected that it may have over its long life experienced some alteration of the paste due to potential exposure to sea water spray. There are aggregate particles present that have the potential to participate in an alkali-silica reaction, and some amount of aggregate reaction would not be unexpected in a structure of this age.

However, there are no indications of deleterious reactions other than the slight discoloration of the paste and a few cracked aggregates. There are no cracks in the paste and overall paste is firm and sound. No alkali-silica gel is found associated with any of these cracked aggregates. There are no indications of damage from exposure to freezing and thawing and no significant alteration or damage from chemical attack or deleterious aggregate reactions. If there is a need to confirm that over the long life of this structure that there is has been some slight alteration of paste in the outer regions of the wall or the potential for future alteration of the paste due to a chemical attack, chloride and gravimetric sulfate profiles are required.

Submitted,

Mark E. Patton, PhD, PE (PA-032213)

**Figure 1** – Views of the received Core #1 showing clockwise from the left, the side, the top surface and the bottom end. There are no visible fractures on the top or side surfaces. The slight discoloration of the paste at the top of the core (outer surface of the wall) is visible in the side view. Increments of the scales in the images are millimeters.

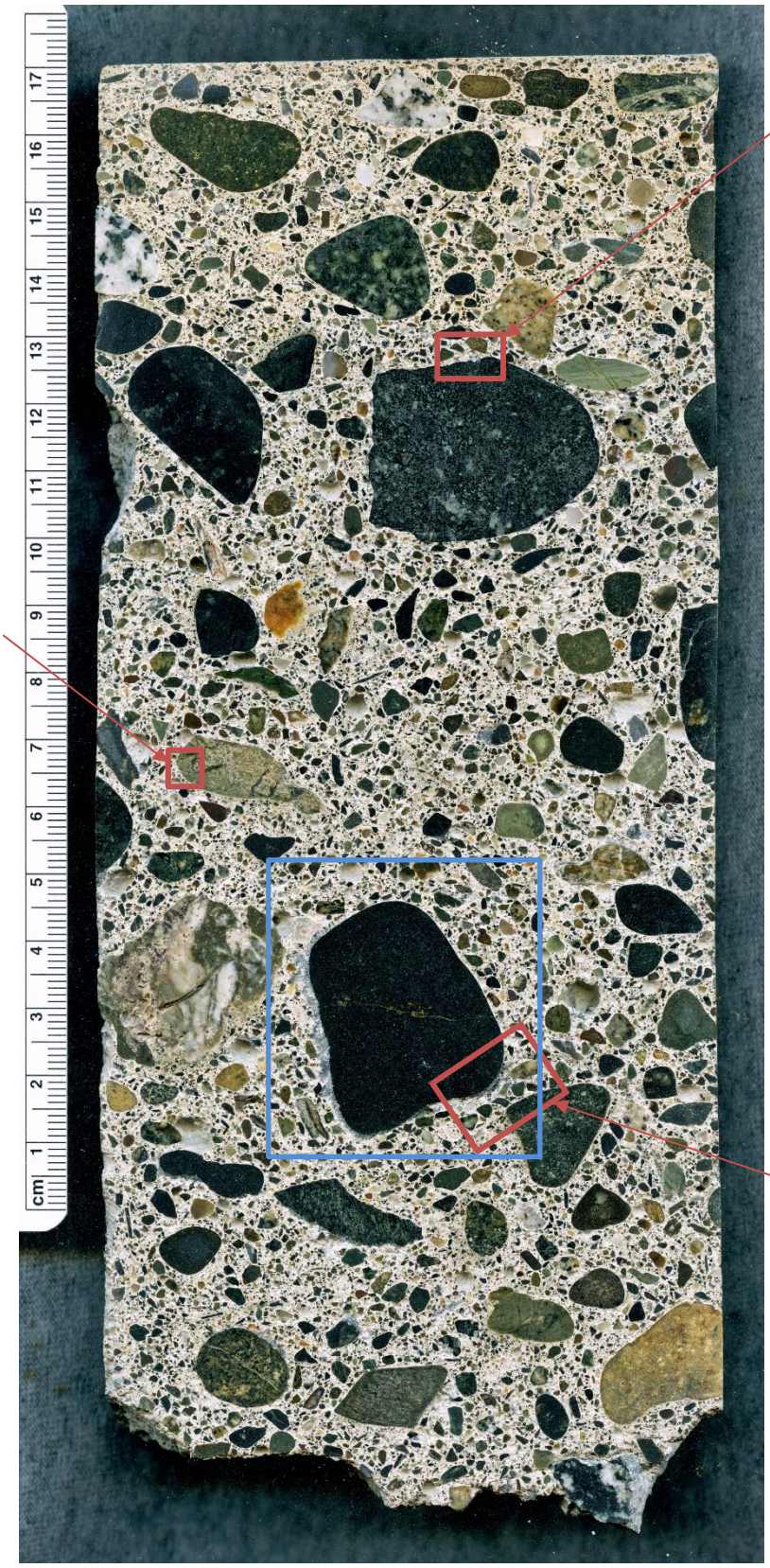



**Figure 2** – View of the prepared cross section of the core. Note the light orange-beige tint of the paste to depths of 40 mm from the top surface. Cracks are visible in some of the coarse aggregate particles (magnified views in Figures 3 and 4). There is no alkali-silica gel found in the cracks and the cracks do not extend into the flanking paste. One of the more prominent collections of voids and bleed water channels immediately flanking a coarse aggregate are readily visible (blue rectangle). An image of a portion of this area is shown in Figure 5.

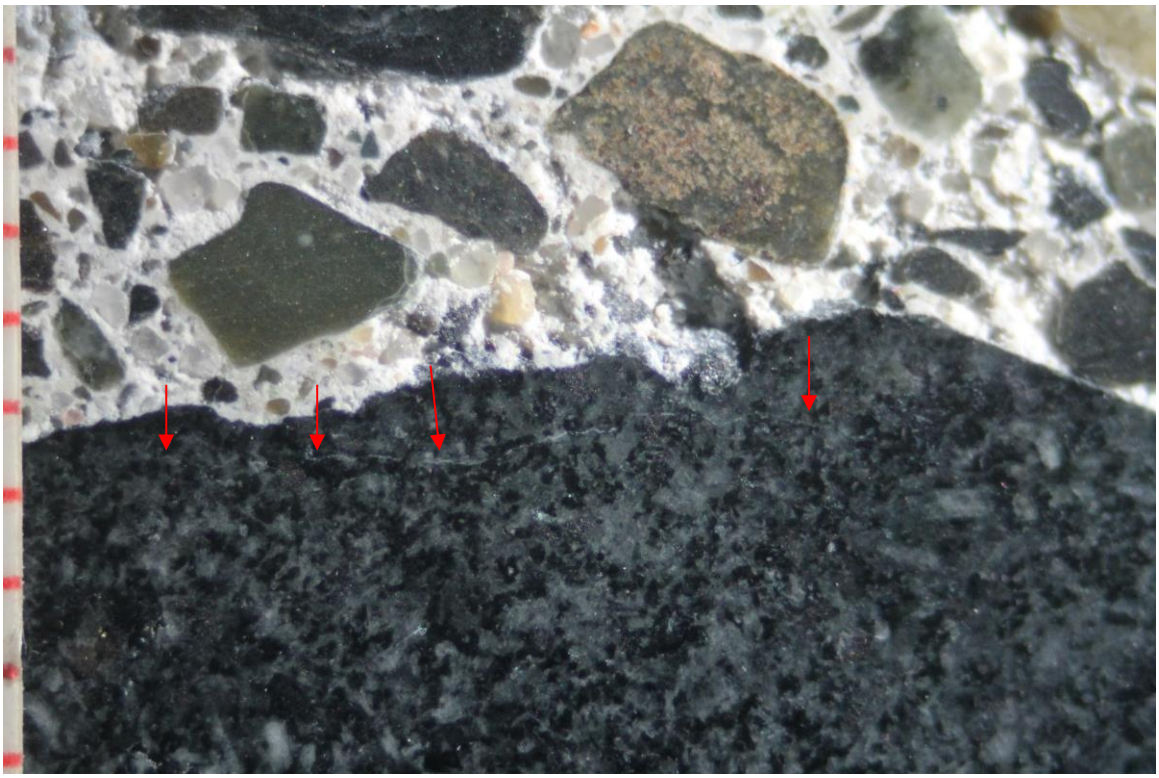


**Figure 3** – An example of a dark aggregate particle showing a fine crack parallel to the surface of the particle. The crack does not extend into the flanking paste. The aggregate contains hornblende, a plagioclase feldspar and mica but no quartz, as confirmed by powder x-ray diffraction. The increments of the scale at the left are 1 mm.

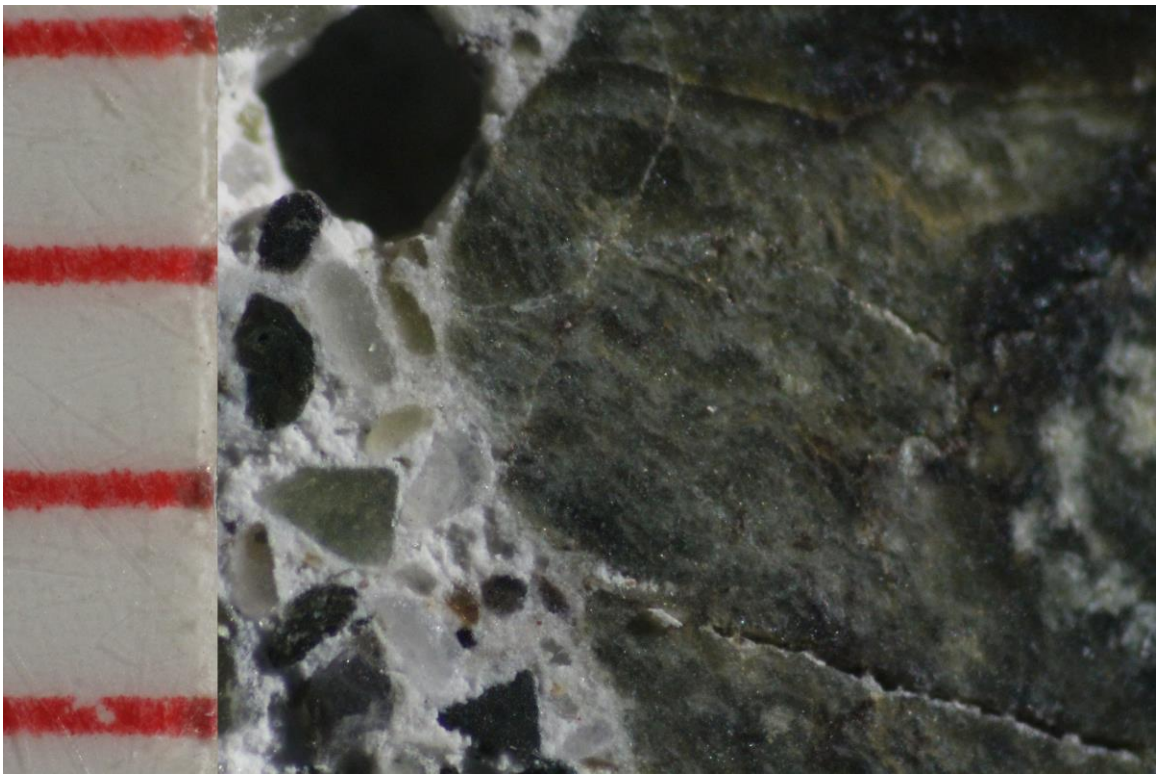


**Figure 4** – View of a fine-grained foliated aggregate that is cracked. The cracks do not extend into the flanking paste. The increments of the scale at the left of the image are 1 mm.

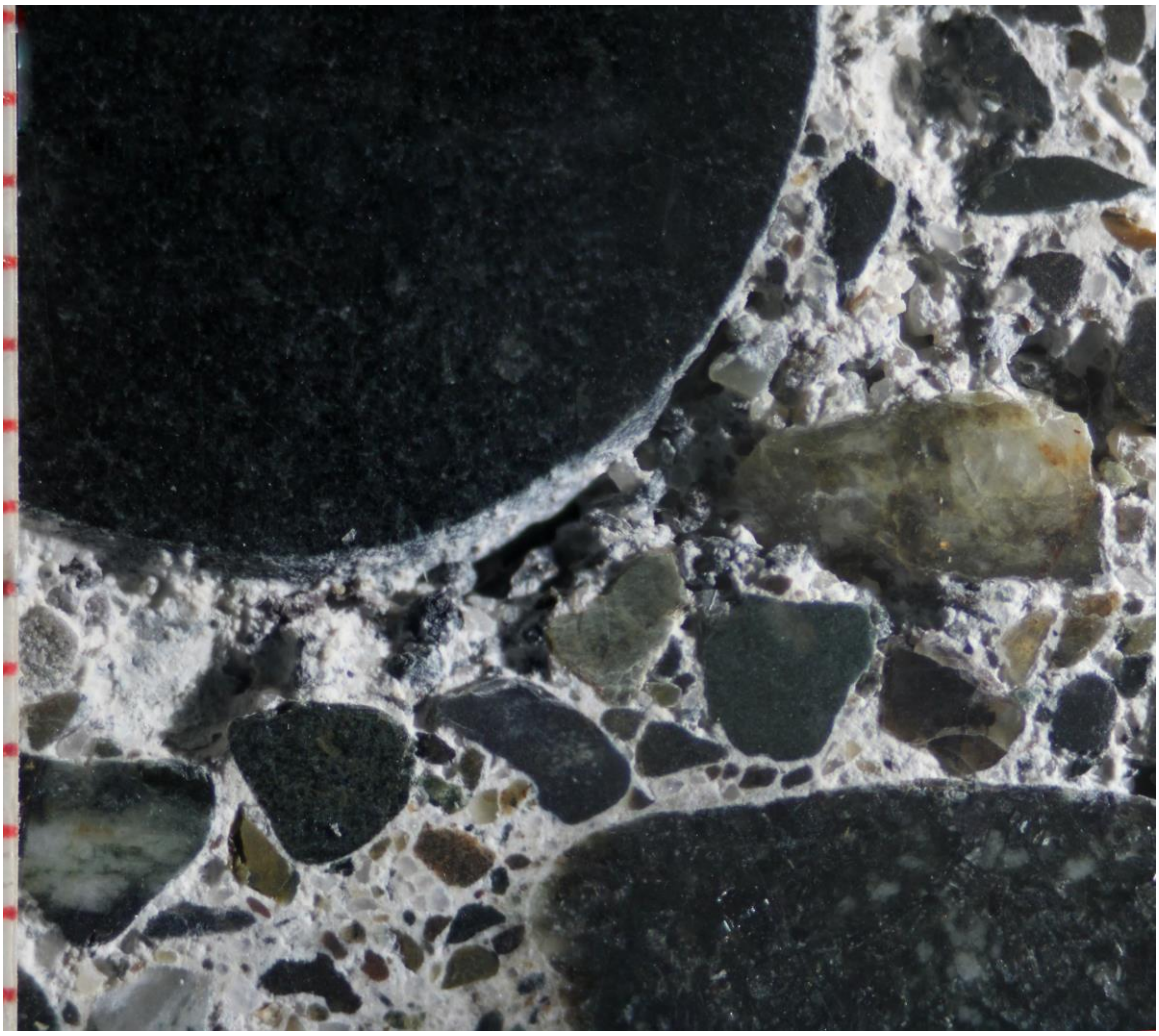


**Figure 5** – A view of a portion of the bleed water channel that flanks the coarse aggregate shown in the middle of the image of the prepared cross section shown in Figure 2. Paste flanking the voids and bleed water channel present at the aggregate socket is variable on a microscale from light gray, moderately soft but firm to medium gray hard and firm. The increments of the scale at the left of the image are 1 mm.

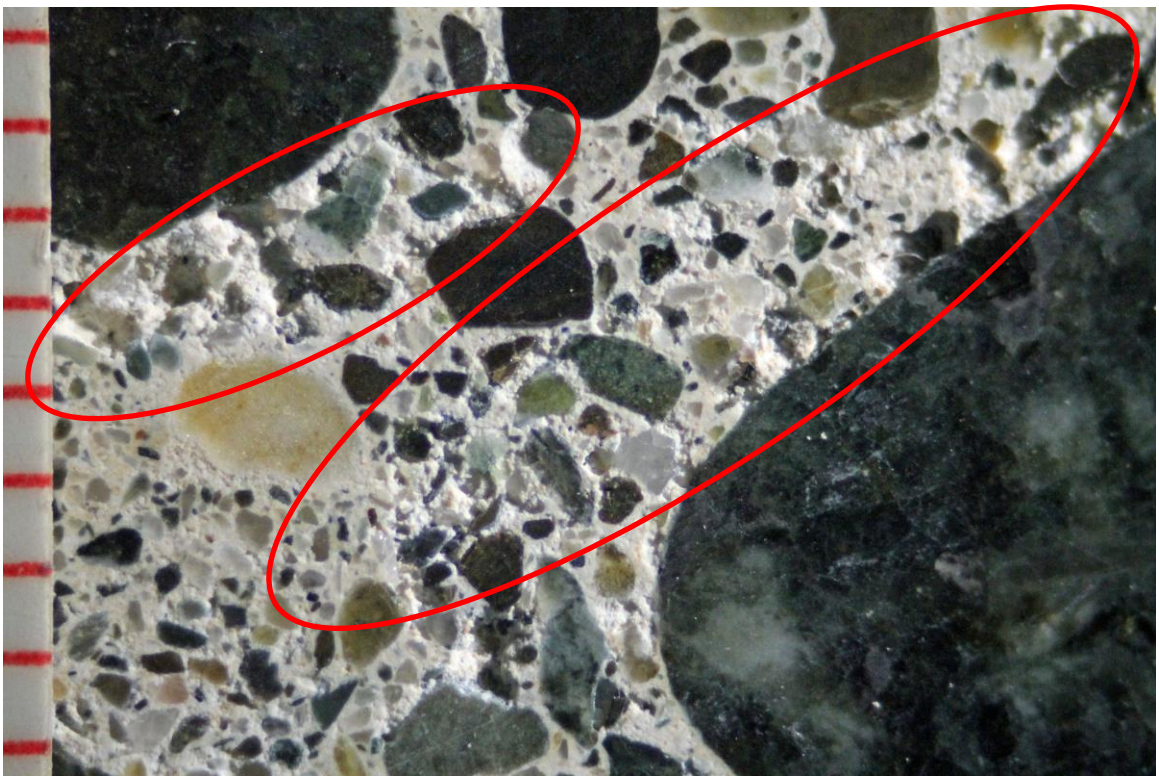


**Figure 6** – This image shows examples of small zones of light gray, moderately soft paste present in zones of water gain that are present frequently throughout the core. The increments of the scale at the left are 1 mm.

# BELMONT BATTERY REHABILITATION PROJECT

# FORT RODD HILL, BC

# PROJECT NO. R.075097.001

## APPENDIX 3

## STEEL TEST REPORT

**WSP CANADA INC.**

150-12791 Clarke Place
Richmond, BC V6V 2H9
T: 604.278.1411 F: 604.278.1042
www.wspgroup.com

# Material Test Certificate - Tensile Test

**Client:** Public Works and Government Services Canada (PWGSC)
**Address:** 641 - 800 Burrard Street
Vancouver, BC V6Z 2V8

**Attention:** Mr. Tom Dunphy, Project Manager

**Report No:** 1
**Report Date:** October 25, 2017
**Test Date:** October 23, 2017
**P.O. Number:** -
**Project No:** 171-12824-00

**Test Representing Material:** 1/4" Thick Steel Offcut
**Specification:** Unknown

| Sample No. | Area ($in^2$) | Yield Load 0.2% Offset ($lb_f$) | Yield Stress 0.2% Offset (ksi) | Ultimate Stress (ksi) | Elongation Gauge 2in (%) | Reduction of Area (%) |
|---|---|---|---|---|---|---|
| 1 | 0.134 | 5,450 | 40.6 | 64.8 | 30.1 | 56.9 |
| **Material Specification:** | Unknown | | - | - | - | - |
| **Test Method:** | ASTM A370 | | **Sample Size:** | Standard 1/2" wide rectangular | | |

**Remarks:**

Tested By: _____ Reviewed by: _____

Norman Chang, B. Tech, AScT Arnold Palmero, AScT

Specimens are retained for 60 days unless otherwise notified.

Baldwin BTE-120 and Tinius Olsen Super 'L-60' test machines are verified annually to the requirements of ASTM E 4.

# BELMONT BATTERY REHABILITATION PROJECT

# FORT RODD HILL, BC

# PROJECT NO. R.075097.001

## APPENDIX 4

## HYDRO SEED APPLICATION GUIDE

Profile®
Solutions for your Environment™

# Application Guide for Profile® HP-FGM™ and ET-FGM™

## Application / Loading Procedures

A. Strictly comply with equipment Manufacturer's installation instructions and recommendations. Use approved hydro-spraying machines with fan-type nozzle (50-degree tip) whenever possible to achieve best soil coverage. Apply from opposing directions to assure 100% soil surface coverage. Slope interruption devices or water diversion techniques are recommended according to the slope interruption limits table on the back.

B. To ensure proper application rates, measure and stake area. For maximum performance, apply in a two-step process*:

1. Apply specified prescriptive agronomic formulations along with 50% of seed with a small amount of HP-FGM™ or ET-FGM™ for visual metering.
2. Mix balance of seed and apply HP-FGM or ET-FGM at a rate of 50 pounds per 125 gallons (see mixing section on the back for details) of water over freshly seeded surfaces. See loading chart on the back and confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.

C. Fill 1/3 of mechanically agitated hydroseeder with water. Turn pump on for 15 seconds and purge and pre-wet lines. Turn pump off.

D. Turn agitator on and load low density materials first (i.e. seed).**

E. Continue slowly filling tank with water while loading fiber matrix into tank.

F. Consult loading chart on the back to determine the number of bags to be added for desired area and application rate.

G. HP-FGM or ET-FGM should be completely loaded before water level reaches 75% of the top of tank.

H. Top off with water and mix until all fiber is fully broken apart and hydrated (minimum of 10 minutes — increase mixing time when applying in cold conditions). This is very important to fully activate the bonding additives and to obtain proper viscosity.

I. Add fertilizer.

J. Shut off recirculation valve to minimize potential for air entrainment within the slurry.

K. Slow down agitator and start applying with a 50-degree fan tip nozzle.

L. Spray in opposing directions for maximum soil coverage.

**Depending on site conditions, HP-FGM or ET-FGM may be applied in a one-step process where all components may be mixed together in single tank loads. Consult with Manufacturer for further details.*

***Do not add tackifiers or polymers.*

## Loading Chart for Profile's HP-FGM and ET-FGM

| Tank Size (gal) | # of 50-lb bales | (lb) | Displacement (gal) | 2,500 lb/acre | | 3,000 lb/acre | | 3,500 lb/acre | | 4,000 lb/acre | | 4,500 lb/acre | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sq ft | Acres | Sq ft | Acres | Sq ft | Acres | Sq ft | Acres | Sq ft | Acres |
| 250 | 2 | 100 | 280 | 1,742 | 0.040 | 1,452 | 0.033 | 1,245 | 0.029 | 1,089 | 0.025 | 968 | 0.022 |
| 500 | 4 | 200 | 560 | 3,485 | 0.080 | 2,904 | 0.067 | 2,489 | 0.057 | 2,178 | 0.050 | 1,936 | 0.044 |
| 750 | 6 | 300 | 840 | 5,227 | 0.120 | 4,356 | 0.100 | 3,734 | 0.086 | 3,267 | 0.075 | 2,904 | 0.067 |
| 1,000 | 8 | 400 | 1,120 | 6,970 | 0.160 | 5,808 | 0.133 | 4,978 | 0.114 | 4,356 | 0.100 | 3,872 | 0.089 |
| 1,500 | 12 | 600 | 1,680 | 10,454 | 0.240 | 8,712 | 0.200 | 7,467 | 0.171 | 6,534 | 0.150 | 5,808 | 0.133 |
| 2,000 | 16 | 800 | 2,240 | 13,939 | 0.320 | 11,616 | 0.267 | 9,957 | 0.229 | 8,712 | 0.200 | 7,744 | 0.178 |
| 2,500 | 20 | 1,000 | 2,800 | 17,424 | 0.400 | 14,520 | 0.333 | 12,446 | 0.286 | 10,890 | 0.250 | 9,680 | 0.222 |
| 3,000 | 24 | 1,200 | 3,360 | 20,909 | 0.480 | 17,424 | 0.400 | 14,935 | 0.343 | 13,068 | 0.300 | 11,616 | 0.267 |
| 3,500 | 28 | 1,400 | 3,920 | 24,394 | 0.560 | 20,328 | 0.467 | 17,424 | 0.400 | 15,246 | 0.350 | 13,552 | 0.311 |
| 4,000 | 32 | 1,600 | 4,480 | 27,878 | 0.640 | 23,232 | 0.533 | 19,913 | 0.457 | 17,424 | 0.400 | 15,488 | 0.356 |

## Additional Notes:

- For hose applications, 35 lb/100 gal is recommended.
- Rough surfaces (rocky terrain, cat tracks, ripped soils, etc.) may require additional product to achieve 100% coverage.
- Be sure to allow for residual material in tank on subsequent applications.

### Application Rates

| Slope Condition | English | SI |
|---|---|---|
| ≤ 4H to 1V | 2500 lb/acre | 2800 kg/hectare |
| > 4H to 1V and ≤ 3H to 1V | 3000 lb/acre | 3400 kg/hectare |
| > 3H to 1V and ≤ 2H to 1V | 3500 lb/acre | 3900 kg/hectare |
| > 2H to 1V and ≤ 1H to 1V | 4000 lb/acre | 4500 kg/hectare |
| > 1H to 1V[1] | 4500 lb/acre | 5100 kg/hectare |
| Below ECB or TRM | 1500 lb/acre | 1700 kg/hectare |
| As infill for TRM[2] | 3500 lb/acre | 3900 kg/hectare |

[1]HP-FGM or ET-FGM recommended for slopes greater than 1H:1V.
[2]Use only approved and tested TRMs to create the GreenArmor System.

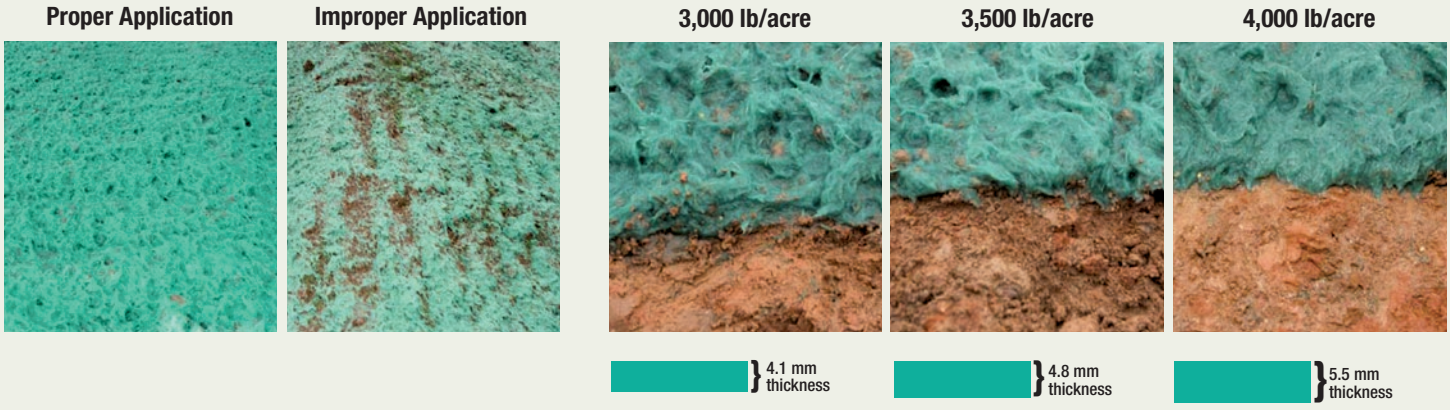
### Slope Interruption Limits*

| Product Category | Length (ft) | Length (m) |
|---|---|---|
| HP-FGM | 100 | 30 |
| ET-FGM | 125 | 38 |

*Listed slope interruption limits are for product applications on a 3H:1V slope. For application on steeper slopes, slope interruption lengths may need to be decreased.

## Visual Key for Proper Application

(Flexterra HP-FGM shown below)




Profile®
Solutions for your Environment™

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Flexterra® HP-FGM™ CocoFlex® ET-FGM

U.S. Patent #'s: 5,942,029; 5,779,782; 5,741,832; 6,360,478; 7,752,804

# BELMONT BATTERY REHABILITATION PROJECT

# FORT RODD HILL, BC

# PROJECT NO. R.075097.001

## APPENDIX 5

## GEOTECHNICAL REPORT

15 January 2018

## FORT RODD HILL NATIONAL HISTORIC SITE

# Conservation of Structures Final Phase Geotechnical Investigation and Remediation Recommendations

**Submitted to:**
Public Services and Procurement Canada
641-800 Burrard St
Vancouver, BC
V6Z 2V8

**Report Number: 1314470497-078-R-Rev0-8100**

**Distribution:**

2 copies - PSPC

REPORT

Golder Associates

# Table of Contents



**FIGURES**

**APPENDICES**

# 1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Public Services and Procurement Canada (PSPC) to carry out a geotechnical subsurface investigation and to provide recommendations for the rehabilitation activities proposed in the Belmont Battery, Searchlight Engine Room and Lower Battery Underground Magazine areas of the Fort Rodd Hill National Historic site (the Site). PSPC is managing the project for Parks Canada who owns and operates the site.

The investigation and assessment were carried out according to Golder's revised scope of work and cost estimate dated August 29, 2017 (Golder file reference 1314470497-070-L-Rev1-8000). The scope of work was based on information provided to us by PSPC via emails dated July 19, 2017 and August 2, 2017, on-site meetings July 20, 2017 and August 10, 2017, and a Terms of Reference (TOR) document from PSPC provided to Golder dated August 28, 2017. The agreed upon scope of work comprised the following:

- Project planning and client liaison, including an on-site pre-investigation meeting with PSPC and Parks Canada.
- Preparation of a site specific subsurface investigation plan indicating the location and methods of advancing geotechnical test holes.
- Preparation of a site-specific health, safety and environment plan (HaSEP) for the proposed geotechnical site investigation.
- Planning and execution of the subsurface investigation comprising drilling boreholes and excavating test pits in the Belmont Battery, Searchlight Engine Room, and Lower Battery Underground Magazine areas to assess foundation and drainage considerations of specific structures and buildings.
- Preparation of a geotechnical investigation report documenting the findings of the geotechnical subsurface investigation, together with our recommendations and comments on potential options for rehabilitation of the discussed structures.

This report should be read in conjunction with the "*Important Information and Limitations of This Report*" (Appendix A). We specifically draw the reader's attention to this information, as it is essential for the proper use and interpretation of this report. Investigation and analytical testing of site soils and groundwater for possible contamination or bio-environmental assessment, were outside our scope of work, but can be provided by Golder if requested.

# 2.0 SITE DESCRIPTION AND PROJECT UNDERSTANDING

The project site is located at Fort Rodd Hill National Historic Site (FRH), in Colwood, BC. FRH was constructed during the late 1800s as a British naval military defense fort on the southern tip of Vancouver Island. FRH is located at the entrance to Esquimalt Harbour on the west shoreline. In 1958, Parks Canada took over management and operations of the FRH area when it was decommissioned as a military base and designated a national historic site. A variety of structures, including bunkers and buildings, are situated within a variety of landscapes including fields, meadows, marine shoreline, forest and rock outcrops. Many of the structures within the site are designated as Federal Heritage Buildings and are currently being evaluated by Parks Canada for structural rehabilitation. The focus of this subsurface investigation was on rehabilitation of structures within the Belmont Battery, Searchlight Engine Room, and Lower Battery Underground Magazine areas, as shown on Figure 1.

Areas currently under consideration for rehabilitation and that required geotechnical assessment are as follows:

- Belmont Battery
  - Belmont Director's Tower: Assessment of foundation conditions and site class; input to structural rehabilitation options.
  - Belmont Retaining Walls: Assessment of soil, bedrock, and groundwater seepage conditions behind walls; input to rehabilitation options to address observed seepage.
- Searchlight Engine Room
  - Searchlight Engine Room Retaining Walls: Assessment of soil, bedrock, and groundwater seepage conditions behind walls; input to rehabilitation options to address observed seepage on face of wall and apparent wall displacement.
  - Searchlight Engine Room: Assessment of soil, bedrock, and groundwater seepage conditions adjacent to south wall of the structure; input to potential drainage improvements and waterproofing to address interior moisture issues.
- Lower Battery Underground Magazine: Assessment of soil, bedrock, and groundwater seepage conditions; input to drainage improvements and waterproofing to address interior moisture issues.

## 3.0 SUBSURFACE INVESTIGATION METHODS

The geotechnical subsurface investigation was conducted on 28 September, and on 18, 19, 23 and 24 October, 2017. The subsurface investigation methods and geotechnical test hole locations were identified in Golder's work plan titled "*Conservation of Structures Final Phase Site Investigation Plan*", dated September 26, 2017. Prior to conducting the subsurface investigation, Golder provided information on the proposed investigation locations and methods to PSPC and Parks Canada for review.

Golder engaged a utility locator to carry out a BC One Call for the area and to assess the proposed test hole locations for potential buried utilities and structures. The utility locator used ground penetrating radar (GPR) and electromagnetic (EM) methods in the assessment. No buried utilities or structures were identified near the test hole locations. The results of the underground utility assessment are provided in Appendix C.

The subsurface investigation comprised 16 test hole locations, including 12 auger boreholes and 4 test pits. A combination of drilling and test-pitting was selected to reduce site disturbance. Soil, bedrock and shallow groundwater seepage conditions were visually assessed and recorded at each test hole location. Soil samples were collected from selected intervals in the test holes and submitted for geotechnical characterization using standard laboratory test methods.

A limited access auger drill rig, supplied and operated by Grassroots Drilling Inc., was used to advance auger boreholes where access constraints were identified. The limited access auger drill rig was used at the Belmont Retaining Walls, Searchlight Engine Room Retaining Walls, and Searchlight Engine Room sites. A track-mounted auger drill rig with rock coring capability, supplied and operated by Drillwell Enterprises Ltd., was used to advance test holes at the Belmont Director's Tower and the Lower Battery Underground Magazine. Oskar Construction Ltd.

supplied a John Deere 35G excavator to excavate the test pits at the Searchlight Engine Room (South) Retaining Wall, and in the foundation area of the Belmont Director's Tower. Photographs of the test holes and the subsurface conditions encountered are provided in Appendix B.

Golder's geotechnical staff were on site full time during the investigation and visually examined and logged the subsurface conditions encountered. The subsurface investigation was monitored by archaeological staff from Millennia Research Ltd. (Millennia) and First Nation's representatives from the Esquimalt and Songhees Nations, who documented and recorded historical and cultural items encountered. We understand that the information collected from this archaeological assessment will be provided to PSPC and Parks Canada by Millennia.

Subsurface conditions were logged and recorded based on visual observations of the sides of the test pits, soils retained on the auger flights, split spoon samples from Standard Penetration Testing (SPT), and rock core. The relative density of soil encountered in the test pits was assessed based on resistance to penetration of the excavator bucket, hand held shovel, or rock hammer. Standard Penetration Testing was used to assess the apparent *in situ* density of the soils encountered during borehole drilling. SPT is carried out using a split barrel sampler, driven 610 mm (24 in) with a 63.5 kg automatic hammer dropped 760 mm. The SPT "N" value was determined based on hammer blow counts recorded over the interval of 150 mm to 450 mm during driving of the SPT split barrel sampler.

Soil cuttings and excavated materials from the test holes were stockpiled on site during drilling and test pit excavation. The boreholes were backfilled with bentonite and soil cuttings consistent with requirements under the BC Groundwater Protection Regulation. The test pits were backfilled with excavated material and compacted using the excavator bucket. When possible, geotextile was placed under material stockpiles to reduce ground surface disturbance. After excavation, Golder personnel assessed the locations of the boreholes using a handheld GPS (accuracy +/-3 m) and measuring tape relative to key site features.

The test hole locations are presented in Figures 2, 3, and 4. Detailed descriptions of the soil and bedrock encountered are provided in the Record of Boreholes and Test Pits in Appendix D.

## 4.0 SUBSURFACE GEOTECHNICAL INVESTIGATION RESULTS

The soil and bedrock descriptions provided in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Groundwater was not encountered in the test holes completed during this investigation. The reported depths of stratigraphic contacts should be considered approximate, given that changes between the different soil types are typically gradational in nature.

Depths within test holes are referenced from the existing ground surface (meters below ground surface (m bgs)). Detailed soil and rock descriptions and SPT blow counts are presented in the Records of Boreholes and Test Pits (Appendix D).

## 4.1 Belmont Battery

### 4.1.1 Belmont Director's Tower

Three test pits, TP17-02 to TP17-04, and two boreholes, BH17-09 and BH17-10, were advanced during the subsurface investigation at the Belmont Director's Tower. The test pits were excavated at the base of each of the three tower foundation pillars to visually assess the footing type and inferred bearing conditions. Rock coring was conducted at BH17-09 to assess general bedrock characteristics adjacent to the existing structure. The test hole locations at the Director's Tower are presented on Figure 2.

The subsurface conditions encountered in this area comprised fill over bedrock. The fill generally consisted of gravelly sand to sandy gravel with trace to some non-plastic fines and local cobbles. The thickness of the fill varied from 0.4 m to 1.4 m among the test holes. The fill was described as brown, non-cohesive, moist, and compact.

Bedrock was encountered underlying the fill in all test holes carried out in this area at depths of 0.4 m to 1.4 m bgs. Concrete footings founded on bedrock were observed in the test pits excavated at the base of each of the three tower foundation pillars. Rock coring was carried out at BH17-09 to a depth of 3.35 m. The bedrock encountered was generally described as granodiorite, light grey to green, very strong, fresh to slightly weathered, with moderately close to closely spaced joints and fractures (Photograph 3, Appendix B). From surface to a depth of about 0.9 m the bedrock was highly fractured and oxidized. A second zone of highly fractured rock was encountered from approximately 3 m bgs to the base of the core hole at 3.35 m. Brown to dark red iron staining was observed along natural joints and fractures in the core, indicating weathering and oxidation processes have affected the bedrock at this location.

### 4.1.2 Belmont Retaining Walls

The subsurface investigation at the Belmont Retaining Walls site was carried out to assess the soil conditions behind the retaining walls. Three boreholes, BH17-02, BH17-03 and BH17-04 were advanced at this location. The subsurface conditions encountered in this area comprised fill over inferred bedrock. The test hole locations are provided on Figure 2.

The fill encountered at the east Retaining Wall comprised silt with varying amounts of gravel overlying sand with trace gravel. The silt was described as brown with rootlets, non-cohesive, and loose. The underlying sand was described as brown, non-cohesive, and compact. Practical refusal was encountered at a depth of 2.7 m at the east Retaining Wall. Refusal was inferred to be within either a zone of cobbles or on bedrock.

The fill encountered at the west Retaining Wall comprised silty sand with varying amounts of gravel. The silty sand was described as brown, non-cohesive, dry, and compact. Practical refusal was encountered at depths of 2.3 m and 2.4 m at the west Retaining Wall. Refusal was inferred to be within either a zone of cobbles or on bedrock.

## 4.2 Searchlight Engine Room

### 4.2.1 Searchlight Engine Room Retaining Walls

The subsurface investigation at the Searchlight Engine Room retaining walls consisted of three boreholes, BH17-06 to BH17-08, and one test pit, TP17-01. The purpose of the investigation at this location was to assess the soil conditions behind the retaining walls. The subsurface conditions encountered in this area comprised topsoil and fill down to refusal on inferred cobbles and boulders adjacent to the north Retaining Wall, and fill overlying hard clayey silt at the south Retaining wall. Test hole locations are provided on Figure 3.

Top soil was observed from ground surface to a depth of up to 0.9 m bgs at the north Retaining Wall. The top soil was described as silt with varying amounts of gravel, dark brown, with rootlets, non-cohesive, and dry to moist. The fill encountered at the north Retaining Wall comprised silty sand with varying amounts of gravel. The silty sand was described as brown to dark brown, non-cohesive, and dry to moist. Refusal, inferred to be on cobbles or bedrock, was encountered in the three boreholes advanced at the north Retaining Wall. Refusal was encountered at depths of 1.0 and 1.5 m.

The fill encountered at the south Retaining Wall comprised gravelly silt and sand with cobbles and boulders, less than approximately 5% by volume, overlying hard clayey silt. The gravelly silt and sand was described as brown, with roots and rootlets in the upper 1.5 m, non-cohesive, and increasing compactness with depth. The hard clayey silt was described as brown, cohesive, with a water content below the Plastic Limit. Sub-angular and sub-rounded cobbles and boulders ranging from 75 mm to 375 mm approximate diameter were observed adjacent to the south Retaining Wall. A PVC perforated pipe running at a 45 degree angle to the south Retaining Wall was observed at a depth of 0.8 m. A clay tile drain running parallel to the foundation of the south Retaining Wall was also observed at a depth of 1.9 m.

### 4.2.2 Searchlight Engine Room

The subsurface investigation at the Searchlight Engine Room consisted of two boreholes, BH17-01 and BH17-05, to assess the soil conditions adjacent to the south wall of the structure. The subsurface conditions encountered in this area comprised fill down to refusal on inferred cobbles or boulders. Test hole locations are provided on Figure 3.

The fill encountered comprised silt and clayey silt with some sand and gravel. The silt and clayey silt was described in general as brown, non-cohesive, and dry to moist. Refusal, inferred to be on cobbles and boulders or bedrock, was encountered in both boreholes advanced in this area at depths of 1.5 and 3.4 m.

## 4.3 Lower Battery Underground Magazine

The subsurface investigation at the Lower Battery Underground Magazine consisted of two boreholes, BH17-11 and BH17-12, to assess the soil conditions adjacent to the gun emplacements. The subsurface conditions encountered in this area comprised topsoil and fill down to refusal on inferred cobbles or bedrock. Test hole locations are provided on Figure 4.

Top soil was observed from ground surface to a depth of up to 0.5 m. The top soil was described as organic silt with trace to some gravel, dark brown, containing shells and rootlets, non-cohesive, moist, and loose. The fill consisted of sand and gravel. The sand and gravel was described as brown, non-cohesive, moist, and loose to dense. Inferred bedrock refusal was encountered in both of the boreholes advanced in this area. Refusal was encountered at depths of 0.6 m and 0.85 m.

# 5.0 DISCUSSION AND GEOTECHNICAL COMMENTS

## 5.1 Belmont Battery

### 5.1.1 Belmont Director's Tower

The results of the test pit investigation indicated that the concrete foundations for the Belmont Director's Tower were founded on the bedrock. Based on the depth to bedrock, observed foundations for the tower foundation on the bedrock, and the condition of the observed bedrock, we recommend that a seismic site classification of Site Class A[1] be used for design of tower remedial measures. Strength testing was not carried out on the bedrock encountered, however, an estimated allowable bearing pressure of 1000 kPa[2] may be considered for foundations bearing directly on the bedrock based on the observed conditions.

### 5.1.2 Belmont Retaining Walls

Evidence of seepage has been observed on the face of both of the retaining walls at the Belmont Battery. Subsurface soils encountered in the boreholes behind the Belmont Retaining Walls generally comprised granular fill over inferred bedrock. It is anticipated that the observed gradation of the granular soils comprising the fill materials would generally promote good drainage. However, the potential bedrock encountered at approximately 2.3 to 2.7 m bgs could be acting as a barrier to precipitation and surface water infiltrating into the soils behind the wall, causing seepage through cracks in the concrete wall. Based on the observed conditions, it is recommended that consideration be given to interception of surface water and directing it around the walls to a suitable discharge location. Consideration could also be given to installation of horizontal relief drains at a level suitable to intercept seepage infiltrating the soils behind the wall and similarly directing it to an appropriate location away from the facility.

## 5.2 Searchlight Engine Room

### 5.2.1 Searchlight Engine Room Retaining Walls

Evidence of seepage has been observed on the face of both of the retaining walls adjacent to the Searchlight Engine Room entrance walkway. Subsurface soils encountered in the boreholes behind the Searchlight Engine Room retaining walls generally comprised granular fills down to the level of refusal of the drill. Refusal in this area was inferred to be within fill containing cobbles and boulders, although shallow bedrock was observed at surface within approximately 5 metres the walls. It is inferred that bedrock was likely excavated from the area to allow construction of the entrance walkway and retaining walls. We understand that any proposed excavation behind the retaining walls may be constrained by the existing trees and concerns regarding the protection of sensitive vegetation and habitat beyond the existing fence.

Based on the observed conditions, it is recommended that the existing fills behind the walls be excavated to the depth practical to allow installation of suitable drainage adjacent to the wall. Well graded granular backfill material,

[1] National Research Council Canada, "National Building code of Canada 2015"

[2] Canadian Geotechnical Society, "Canadian Foundation Engineering Manual, 4th Edition, 2006"

such as 25 mm minus crushed gravel, may be placed and compacted to a suitable level to act as a base or bedding layer for installing a 100 mm to 150 mm diameter perforated PVC drain pipe. The PVC pipe should be surrounded by free draining granular materials following the MMCD specification for Drain Rock (2.7.1; Section 31-05-17). The Drain Rock should be carried vertically up to 100 mm to 150 mm above the top of the PVC pipe, followed by additional 25 mm minus material to within approximately 100 mm to 150 mm of ground surface, with a non-woven geotextile placed over top of the granular fill. A suitable growing medium for restoration of native vegetation may be placed over the geotextile. Consideration may also be given to placement of non-woven geotextile against the excavated slope as a separation barrier to prevent fines from migrating into the drain rock from the adjacent fill and native soils. Consideration could also be given to installation of horizontal relief drains at a level suitable to intercept seepage infiltrating the soils behind the wall and similarly directing it to an appropriate location away from the facility.

Some rotational deformation of the wall has been observed, therefore, consideration may be given to the installation of soil or rock anchors to provide additional structural support to the wall and possibly correct some of the observed deformation. If soil or rock anchors are determined to be required, suitable engineering analyses and input are recommended.

### 5.2.2 Searchlight Engine Room

Moisture has been observed on the interior south wall of the Searchlight Engine Room. The subsurface soils encountered during drilling adjacent to the Searchlight Engine Room were observed to consist of dry to moist, silt and clayey silt with minor sand and gravel. In general, these soils would be considered to have poor drainage characteristics. No drilling or coring of bedrock was carried out to assess potential seepage within the bedrock, given access constraints which prevented mobilization of a suitable rock coring rig at this site. The potential for groundwater seepage to be causing moisture problems in the building is generally considered to be low, given that the soils and bedrock behind the south wall of the building do not appear to be in direct contact with the structure. Seepage through fractures in the bedrock would not be expected to discharge appreciable amounts of groundwater that would contribute to the observed seepage issue in the building.

Further, it was noted during the drilling investigation, that a considerable amount of roof drainage was observed to be discharging between the building and the adjacent ground along the south wall of the structure. Based on our observations of the soil and surface water conditions at the time of the investigation, it is recommended that consideration be given to intercepting roof drainage from the Searchlight Engine Room and adjacent slopes and re-directing it away from the building. Monitoring of moisture levels inside the building should be carried out following thee drainage improvements to assess the potential reduction in the severity of water ingress and whether additional measures may be required to mitigate the moisture issue.

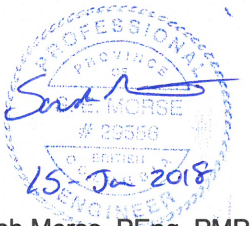
## 5.3 Lower Battery Underground Magazine

Effective refusal on inferred bedrock was encountered at depths of 0.6 m and 0.85 m in the boreholes in this area. We understand that no additional geotechnical input is required for this area at this time.

## 6.0 CLOSURE

We trust that this report meets your current requirements. Please do not hesitate to contact us should you require additional information.

**GOLDER ASSOCIATES LTD.**




Sarah Morse, PEng, PMP
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SM/JF/lih

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**LEGEND**

PROJECT LOCATIONS

ROADS

0 100 200

1:5,000 (APPROX.) METRES

**REFERENCE(S)**

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2. DATUM: NAD83, PROJECTION: UTM ZONE 10

CLIENT
PWGSC

CONSULTANT
Golder Associates

| | |
|---|---|
| YYYY-MM-DD | 2018-01-09 |
| DESIGNED | R. MONTEMAYOR |
| PREPARED | C. FRENAL |
| REVIEWED | R. MONTEMAYOR |
| APPROVED | S. MORSE |

PROJECT
FORT RODD HILL
COLWOOD, BC

TITLE
**KEY PLAN**

| PROJECT NO. | PHASE/TASK | REV. | FIGURE |
|---|---|---|---|
| 13-1447-0497 | 8100/8104 | 0 | 01 |

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**LEGEND**

- APPROXIMATE BOREHOLE LOCATION (GOLDER, 2017)
- APPROXIMATE TEST PIT LOCATION (GOLDER, 2017)

0 20 40
1:800 (APPROX.) METRES

**REFERENCE(S)**

1. BACKGROUND IMAGE © 2017 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. IMAGE DATE: AUGUST 18, 2016. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. DATUM: NAD83, PROJECTION: UTM ZONE 10

**NOTE**

1. ALL MEASUREMENTS ARE IN METRES UNLESS OTHERWISE NOTED.

CLIENT
PWGSC

CONSULTANT
Golder Associates

| | |
|---|---|
| YYYY-MM-DD | 2018-01-09 |
| DESIGNED | R. MONTEMAYOR |
| PREPARED | C. FRENAL |
| REVIEWED | R. MONTEMAYOR |
| APPROVED | S. MORSE |

PROJECT
FORT RODD HILL
COLWOOD, BC

TITLE
**BOREHOLE AND TEST PIT LOCATION PLAN - BELMONT BATTERY AREA**

| PROJECT NO. | PHASE/TASK | REV. | FIGURE |
|---|---|---|---|
| 13-1447-0497 | 8100/8104 | 0 | 02 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
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**LEGEND**

- APPROXIMATE BOREHOLE LOCATION (GOLDER, 2017)
- APPROXIMATE TEST PIT LOCATION (GOLDER, 2017)

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1:1,000 (APPROX.) METRES

**REFERENCE(S)**

1. BACKGROUND IMAGE © 2017 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. IMAGE DATE: AUGUST 18, 2016. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. DATUM: NAD83, PROJECTION: UTM ZONE 10

**NOTE**

1. ALL MEASUREMENTS ARE IN METRES UNLESS OTHERWISE NOTED.

CLIENT
PWGSC

CONSULTANT
Golder Associates

| | |
|---|---|
| YYYY-MM-DD | 2018-01-09 |
| DESIGNED | R. MONTEMAYOR |
| PREPARED | C. FRENAL |
| REVIEWED | R. MONTEMAYOR |
| APPROVED | S. MORSE |

PROJECT
FORT RODD HILL
COLWOOD, BC

TITLE
**BOREHOLE AND TEST PIT LOCATION PLAN - SEARCHLIGHT ENGINE ROOM AREA**

| PROJECT NO. | PHASE/TASK | REV. | FIGURE |
|---|---|---|---|
| 13-1447-0497 | 8100/8104 | 0 | 03 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
25 mm
0

Last Edited By: cfrenal Date: 2018-01-09 Time:2:06:11 PM | Printed By: cfrenal Date: 2018-01-09 Time:2:06:53 PM
Path: \\golder.gds\gal\Kelowna\CAD-GIS\Client\PWGSC\Colwood, BC\99_PROJECTS\13-1447-0497_Fort Rodd Hill\02_PRODUCTION\Phase 8100\Task 8104\DWG\ | File Name: 13-1447-0497_8100_8104-004.dwg


**LEGEND**

⌖ APPROXIMATE BOREHOLE LOCATION (GOLDER, 2017)

0 20 40
1:800 (APPROX.) METRES

**REFERENCE(S)**

1. BACKGROUND IMAGE © 2017 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. IMAGE DATE: AUGUST 18, 2016. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. DATUM: NAD83, PROJECTION: UTM ZONE 10

**NOTE**

1. ALL MEASUREMENTS ARE IN METRES UNLESS OTHERWISE NOTED.

CLIENT
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| | |
|---|---|
| YYYY-MM-DD | 2018-01-09 |
| DESIGNED | R. MONTEMAYOR |
| PREPARED | C. FRENAL |
| REVIEWED | R. MONTEMAYOR |
| APPROVED | S. MORSE |

PROJECT
FORT RODD HILL
COLWOOD, BC

TITLE
**BOREHOLE LOCATION PLAN - LOWER BATTERY UNDERGROUND MAGAZINE AREA**

| PROJECT NO. | PHASE/TASK | REV. | FIGURE |
|---|---|---|---|
| 13-1447-0497 | 8100/8104 | 0 | 04 |

# APPENDIX A

## Important Information and Limitations

**Standard of Care:** Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

**Basis and Use of the Report:** This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

**Soil, Rock and Groundwater Conditions:** Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

**Sample Disposal:** Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

**Follow-Up and Construction Services:** All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

**Changed Conditions and Drainage:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

# APPENDIX B

## Photographic Summary - Subsurface Investigation


*Photograph 1: Approximate locations of boreholes at the Belmont Director's Tower*

*Photograph 2: Track-mounted drill rig used at the Belmont Director's Tower and the Lower Battery Underground Magazine*


*Photograph 3: Rock core recovered from BH17-09 at the Belmont Director's Tower*


*Photograph 4: Approximate locations of test pits at the Belmont Director's Tower*


*Photograph 5: Approximate location of the first borehole at the west Belmont Retaining Wall*


*Photograph 6: Approximate location of the second borehole at the west Belmont Retaining Wall. Photograph also displays the limited access drilling equipment used in this area.*


*Photograph 7: Example of silty sand fill material from BH17-03 at the west Belmont Retaining Wall*


*Photograph 8: Approximate location of borehole at the east Belmont Retaining Wall*


*Photograph 9: Approximate locations of boreholes and test pit at the Searchlight Engine Room Retaining Walls*

*Photograph 10: Test pit at the south Searchlight Engine Room Retaining Wall (TP17-01)*

*Photograph 11: Test pit at the south Searchlight Engine Room Retaining Wall (TP17-01)*


*Photograph 12: Example of a Standard Penetration Test (SPT) – Split Spoon Sample at the north Searchlight Engine Room Retaining Wall (BH17-08)*


*Photograph 13: Approximate locations of boreholes at the Searchlight Engine Room*

*Photograph 14: Example of silt to silty sand fill material at the Searchlight Engine Room (BH17-01)*


*Photograph 15: Approximate locations of boreholes at the Lower Battery Underground Magazine*

# APPENDIX C

## Underground Utility Locate Information

# GeoScan
SUBSURFACE SURVEYS

**Address:** 225 Lake Park Rd., Lake Cowichan, BC, V0R 2GD
**Phone:** 250.891.9364
**Email:** info@geoscan.ca
**Web:** www.geoscan.ca

## WORK ORDER
*Utility Locating*

**GeoScan REF:** J171016-04.

**Customer Information:** GOLDER

**Site Address:** FORT RODD HILL.

**Customer P.O #**

**Date:** OCT 16/2017.

**Time In/Out** 10:00-13:30 **Travel Time:** 4 HRS.

**BC ONE INFORMATION PROVIDED BY:**
GeoScan ☐ Client ☐ ID#

**Technician(s):** D. PALMER.

**Utilities marked with:** Paint ☒ Flag ☐ Stake ☐

**Job Site Contact:** RICARDO **Phone #:** 250-418-5033

**DIGITAL MAP REQUESTED?** ☐ **POST-PROCESSING REQUIRED?** ☐ **CONCRETE SCANNING REQUIRED?** ☐

| # VAPOUR PROBE INSTALLED | | TOTAL TIME CONCRETE SCANNING FOR VAPOUR PROBES | |
|---|---|---|---|

### Utility Locating Drawing Legend

| | | | |
|---|---|---|---|
| --G-- (Yellow) | Gas / Oil / Steam | --S-- (Green) | Radar Lines / Sanitary - Sewer |
| -E- (Red) | Electrical | --?-- | Unknown Utility |
| -C- (Orange) | Communications | --A-- | GPR Anomaly |
| --W-- (Blue) | Water | ⊕ | Client Borehole |

### Located Utilities

| Utility | Drawing Provided? | Located? | Signal Quality | Equipment Used |
|---|---|---|---|---|
| Gas | ☐ | ☐ | | |
| Water | ☐ | ☐ | | |
| Electrical | ☐ | ☐ | | |
| Communications | ☐ | ☐ | | |
| Storm Sewer | ☐ | ☐ | | |
| Sanitary Sewer | ☐ | ☐ | | |

N/A

### NOTES

- SEE ATTACHED MARK-UP.
- CLEARED 10 BORE HOLE LOCATIONS, AND 1 TEST PIT LOCATIONS.
- NO CONFLICTING SIGNALS OR ANOMOLIES FOUND -

SEE ATTACHED MARK-UP.

**Technician's Signature**

**Customer's Signature**

By signing, the customer acknowledges that he/she has read and understands the following terms and conditions, and agrees to be bound by them. The customer is responsible for marking all areas to be scanned and for clearing these areas of all debris before the work is performed. GeoScan Subsurface Surveys Inc. is not responsible for any loss or damage arising out of the use of, or reliance on, the subsurface data collected or the report presented. GPR signal depth penetration varies from site to site depending on the water table and ground material. GPR sweeping around a borehole location will survey an area around that borehole but not the entire site. A utility's material type and depth below the subsurface has an impact on the utility's ability to be successfully located. Some utilities are difficult to potentially impossible to detect by either GPR or Electromagnetic scans. All drawing(s) are not to scale and should not be relied on solely. If on-site markings disappear or if the project has any delays, a new locate is required. Any changes to the project require a new locate. It is recommended that all utilities marked are verified by "daylighting" the utility to confirm its existence and location. It is also recommended that all excavations within two meters of the located utilities are to be done by hydrovac or hand digging. All data collected remains the property of Geoscan Subsurface Surveys Inc. The customer agrees to pay the subsequent invoice for the work performed within 30 calendar days of invoice date. All late payments will be subject to an interest charge of 5% per month.


Fort Rodd Hill
19th-century
coastal artillery fort
- Client Borehole location
- Client Testpit location
Google

# APPENDIX D

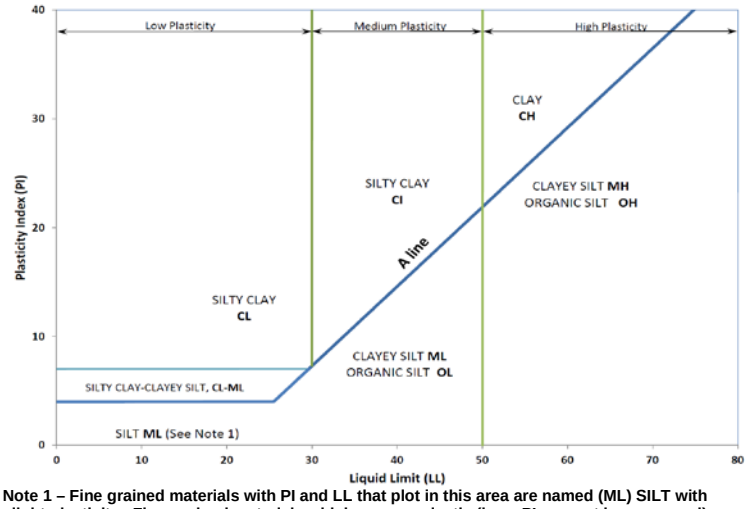
## Record of Boreholes and Test Pits

# METHOD OF SOIL CLASSIFICATION

## The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

| Organic or Inorganic | Soil Group | Type of Soil | | Gradation or Plasticity | $Cu = \frac{D_{60}}{D_{10}}$ | $Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$ | Organic Content | USCS Group Symbol | Group Name |
|---|---|---|---|---|---|---|---|---|---|
| INORGANIC (Organic Content ≤30% by mass) | COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm) | GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm) | Gravels with ≤12% fines (by mass) | Poorly Graded | <4 | ≤1 or ≥3 | ≤30% | GP | GRAVEL |
| | | | | Well Graded | ≥4 | 1 to 3 | | GW | GRAVEL |
| | | | Gravels with >12% fines (by mass) | Below A Line | n/a | | | GM | SILTY GRAVEL |
| | | | | Above A Line | n/a | | | GC | CLAYEY GRAVEL |
| | | SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm) | Sands with ≤12% fines (by mass) | Poorly Graded | <6 | ≤1 or ≥3 | | SP | SAND |
| | | | | Well Graded | ≥6 | 1 to 3 | | SW | SAND |
| | | | Sands with >12% fines (by mass) | Below A Line | n/a | | | SM | SILTY SAND |
| | | | | Above A Line | n/a | | | SC | CLAYEY SAND |

| Organic or Inorganic | Soil Group | Type of Soil | | Laboratory Tests | Field Indicators | | | | | Organic Content | USCS Group Symbol | Primary Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Dilatancy | Dry Strength | Shine Test | Thread Diameter | Toughness (of 3 mm thread) | | | |
| INORGANIC (Organic Content ≤30% by mass) | FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm) | SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below) | | Liquid Limit <50 | Rapid | None | None | >6 mm | N/A (can't roll 3 mm thread) | <5% | ML | SILT |
| | | | | | Slow | None to Low | Dull | 3mm to 6 mm | None to low | <5% | ML | CLAYEY SILT |
| | | | | | Slow to very slow | Low to medium | Dull to slight | 3mm to 6 mm | Low | 5% to 30% | OL | ORGANIC SILT |
| | | | | Liquid Limit ≥50 | Slow to very slow | Low to medium | Slight | 3mm to 6 mm | Low to medium | <5% | MH | CLAYEY SILT |
| | | | | | None | Medium to high | Dull to slight | 1 mm to 3 mm | Medium to high | 5% to 30% | OH | ORGANIC SILT |
| | | CLAYS (PI and LL plot above A-Line on Plasticity Chart below) | | Liquid Limit <30 | None | Low to medium | Slight to shiny | ~ 3 mm | Low to medium | 0% to 30% (see Note 2) | CL | SILTY CLAY |
| | | | | Liquid Limit 30 to 50 | None | Medium to high | Slight to shiny | 1 mm to 3 mm | Medium | | CI | SILTY CLAY |
| | | | | Liquid Limit ≥50 | None | High | Shiny | <1 mm | High | | CH | CLAY |
| HIGHLY ORGANIC SOILS (Organic Content >30% by mass) | | Peat and mineral soil mixtures | | | | | | | | 30% to 75% | PT | SILTY PEAT, SANDY PEAT |
| | | Predominantly peat, may contain some mineral soil, fibrous or amorphous peat | | | | | | | | 75% to 100% | | PEAT |




**Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.**
**Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.**

**Dual Symbol** — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.
For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.
For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

**Borderline Symbol** — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.
A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to ~~or~~ indicate~~s~~ a range of similar soil types within a stratum.

# ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

**PARTICLE SIZES OF CONSTITUENTS**

| Soil Constituent | Particle Size Description | Millimetres | Inches (US Std. Sieve Size) |
|---|---|---|---|
| BOULDERS | Not Applicable | >300 | >12 |
| COBBLES | Not Applicable | 75 to 300 | 3 to 12 |
| GRAVEL | Coarse<br>Fine | 19 to 75<br>4.75 to 19 | 0.75 to 3<br>(4) to 0.75 |
| SAND | Coarse<br>Medium<br>Fine | 2.00 to 4.75<br>0.425 to 2.00<br>0.075 to 0.425 | (10) to (4)<br>(40) to (10)<br>(200) to (40) |
| SILT/CLAY | Classified by plasticity | <0.075 | < (200) |

**MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS**

| Percentage by Mass | Modifier |
|---|---|
| >35 | Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL, SAND and CLAY) |
| > 12 to 35 | Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable |
| > 5 to 12 | some |
| ≤ 5 | trace |

**PENETRATION RESISTANCE**

**Standard Penetration Resistance (SPT), N:**

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.).

**Cone Penetration Test (CPT)**

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 $cm^2$ pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance ($q_t$), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

**Dynamic Cone Penetration Resistance (DCPT); $N_d$:**

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

**PH:** Sampler advanced by hydraulic pressure
**PM:** Sampler advanced by manual pressure
**WH:** Sampler advanced by static weight of hammer
**WR:** Sampler advanced by weight of sampler and rod

**SAMPLES**

| | |
|---|---|
| AS | Auger sample |
| BS | Block sample |
| CS | Chunk sample |
| DO or DP | Seamless open ended, driven or pushed tube sampler – note size |
| DS | Denison type sample |
| FS | Foil sample |
| GS | Grab Sample |
| RC | Rock core |
| SC | Soil core |
| SS | Split spoon sampler – note size |
| ST | Slotted tube |
| TO | Thin-walled, open – note size |
| TP | Thin-walled, piston – note size |
| WS | Wash sample |

**SOIL TESTS**

| | |
|---|---|
| w | water content |
| PL , $w_p$ | plastic limit |
| LL , $w_L$ | liquid limit |
| C | consolidation (oedometer) test |
| CHEM | chemical analysis (refer to text) |
| CID | consolidated isotropically drained triaxial test[1] |
| CIU | consolidated isotropically undrained triaxial test with porewater pressure measurement[1] |
| $D_R$ | relative density (specific gravity, Gs) |
| DS | direct shear test |
| GS | specific gravity |
| M | sieve analysis for particle size |
| MH | combined sieve and hydrometer (H) analysis |
| MPC | Modified Proctor compaction test |
| SPC | Standard Proctor compaction test |
| OC | organic content test |
| $SO_4$ | concentration of water-soluble sulphates |
| UC | unconfined compression test |
| UU | unconsolidated undrained triaxial test |
| V (FV) | field vane (LV-laboratory vane test) |
| γ | unit weight |

1. Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

**NON-COHESIVE (COHESIONLESS) SOILS**

**Compactness[2]**

| Term | SPT 'N' (blows/0.3m)[1] |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 to 10 |
| Compact | 10 to 30 |
| Dense | 30 to 50 |
| Very Dense | >50 |

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects.
2. Definition of compactness descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average $N_{60}$ values.

**Field Moisture Condition**

| Term | Description |
|---|---|
| Dry | Soil flows freely through fingers. |
| Moist | Soils are darker than in the dry condition and may feel cool. |
| Wet | As moist, but with free water forming on hands when handled. |

**COHESIVE SOILS**

**Consistency**

| Term | Undrained Shear Strength (kPa) | SPT 'N'[1] (blows/0.3m) |
|---|---|---|
| Very Soft | <12 | 0 to 2 |
| Soft | 12 to 25 | 2 to 4 |
| Firm | 25 to 50 | 4 to 8 |
| Stiff | 50 to 100 | 8 to 15 |
| Very Stiff | 100 to 200 | 15 to 30 |
| Hard | >200 | >30 |

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.

**Water Content**

| Term | Description |
|---|---|
| w < PL | Material is estimated to be drier than the Plastic Limit. |
| w ~ PL | Material is estimated to be close to the Plastic Limit. |
| w > PL | Material is estimated to be wetter than the Plastic Limit. |

# LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

## I. GENERAL

| | |
|---|---|
| $\pi$ | 3.1416 |
| ln x | natural logarithm of x |
| $\log_{10}$ | x or log x, logarithm of x to base 10 |
| g | acceleration due to gravity |
| t | time |

## II. STRESS AND STRAIN

| | |
|---|---|
| $\gamma$ | shear strain |
| $\Delta$ | change in, e.g. in stress: $\Delta\sigma$ |
| $\varepsilon$ | linear strain |
| $\varepsilon_v$ | volumetric strain |
| $\eta$ | coefficient of viscosity |
| $\upsilon$ | Poisson's ratio |
| $\sigma$ | total stress |
| $\sigma'$ | effective stress ($\sigma' = \sigma - u$) |
| $\sigma'_{vo}$ | initial effective overburden stress |
| $\sigma_1$, $\sigma_2$, $\sigma_3$ | principal stress (major, intermediate, minor) |
| $\sigma_{oct}$ | mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$ |
| $\tau$ | shear stress |
| u | porewater pressure |
| E | modulus of deformation |
| G | shear modulus of deformation |
| K | bulk modulus of compressibility |

## III. SOIL PROPERTIES

### (a) Index Properties

| | |
|---|---|
| $\rho(\gamma)$ | bulk density (bulk unit weight)* |
| $\rho_d(\gamma_d)$ | dry density (dry unit weight) |
| $\rho_w(\gamma_w)$ | density (unit weight) of water |
| $\rho_s(\gamma_s)$ | density (unit weight) of solid particles |
| $\gamma'$ | unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$) |
| $D_R$ | relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly $G_s$) |
| e | void ratio |
| n | porosity |
| S | degree of saturation |

* Density symbol is $\rho$. Unit weight symbol is $\gamma$ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

### (a) Index Properties (continued)

| | |
|---|---|
| w | water content |
| $w_l$ or LL | liquid limit |
| $w_p$ or PL | plastic limit |
| $I_p$ or PI | plasticity index = $(w_l - w_p)$ |
| $w_s$ | shrinkage limit |
| $I_L$ | liquidity index = $(w - w_p) / I_p$ |
| $I_C$ | consistency index = $(w_l - w) / I_p$ |
| $e_{max}$ | void ratio in loosest state |
| $e_{min}$ | void ratio in densest state |
| $I_D$ | density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density) |

### (b) Hydraulic Properties

| | |
|---|---|
| h | hydraulic head or potential |
| q | rate of flow |
| v | velocity of flow |
| i | hydraulic gradient |
| k | hydraulic conductivity (coefficient of permeability) |
| j | seepage force per unit volume |

### (c) Consolidation (one-dimensional)

| | |
|---|---|
| $C_c$ | compression index (normally consolidated range) |
| $C_r$ | recompression index (over-consolidated range) |
| $C_s$ | swelling index |
| $C_\alpha$ | secondary compression index |
| $m_v$ | coefficient of volume change |
| $c_v$ | coefficient of consolidation (vertical direction) |
| $c_h$ | coefficient of consolidation (horizontal direction) |
| $T_v$ | time factor (vertical direction) |
| U | degree of consolidation |
| $\sigma'_p$ | pre-consolidation stress |
| OCR | over-consolidation ratio = $\sigma'_p / \sigma'_{vo}$ |

### (d) Shear Strength

| | |
|---|---|
| $\tau_p$, $\tau_r$ | peak and residual shear strength |
| $\phi'$ | effective angle of internal friction |
| $\delta$ | angle of interface friction |
| $\mu$ | coefficient of friction = tan $\delta$ |
| c′ | effective cohesion |
| $c_u$, $s_u$ | undrained shear strength ($\phi = 0$ analysis) |
| p | mean total stress $(\sigma_1 + \sigma_3)/2$ |
| p′ | mean effective stress $(\sigma'_1 + \sigma'_3)/2$ |
| q | $(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$ |
| $q_u$ | compressive strength $(\sigma_1 - \sigma_3)$ |
| $S_t$ | sensitivity |

**Notes:** 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-01

SHEET 1 OF 1

DATUM: Geodetic

CLIENT: PWGSC
PROJECT: Fort Rodd Hill Geotechnical Investigation
LOCATION: Searchlight Engine Room
N: ~5364359 E: ~466542
*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

DRILLING DATE: October 18, 2017
DRILLING CONTRACTOR: Grassroots

INCLINATION: -90°

SAMPLER HAMMER, 140lbs.; DROP, 30in.

| DEPTH SCALE METRES | DRILLING RIG | DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SAMPLES: BLOWS/0.3m | WATER CONTENT PERCENT (Wp, W, Wl; NP - Non-Plastic) | SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Pocket Pen -; Q -, U -) | GRADATION % CLAY PARTICLE SIZE <= 0.002: GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ground Surface | | | | | | | | | | | | | | | | | |
| 0 | Mole Rat Limited Access Rig | Auger Drilling | FILL - **(ML/SM)** SILT, some gravel; brown; non-cohesive, dry, loose to compact. | | 0.00 | 1 | AS | | | | | | | | | | | | | |
| 1 | | | - organics (rootlets) encountered in upper 1.50 m. | | | 2 | AS | | | | | | | | | | | | | |
| 2 | | | - inferred cobbles below 2.00 m depth. | | | 3 | AS | | | | | | | | | | | | | |
| 3 | | | | | | 4 | AS | | | | | | | | | | | | | |
| | | | End of Borehole. (Refusal) | | 3.35 | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE
1 : 25

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: RM
CHECKED: SEM

Golder Associates

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form:BC_BOREHOLE_GRADATION (AUTO) .dfrenal 7/11/17

PROJECT No.: 13-1447-0497 / 8100

CLIENT: PWGSC

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Belmont Retaining Wall

N: ~5364328 E: ~466598

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

# RECORD OF BOREHOLE: BH17-02

SHEET 1 OF 1

DATUM: Geodetic

DRILLING DATE: October 18, 2017

DRILLING CONTRACTOR: Grassroots

SAMPLER HAMMER, 140lbs.; DROP, 30in.

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG | DRILLING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | RECOVERY % | BLOWS/0.3m | WATER CONTENT PERCENT: Wp W Wl, NP - Non-Plastic; SHEAR STRENGTH Cu, kPa: nat V. + Q - ●, rem V. ⊕ U - ◐, Pocket Pen - ■ | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ground Surface | | | | | | | | | | | | | | | |
| 0 | Mole Rat Limited Access Rig | Auger Drilling | TOPSOIL - **(ML)** SILT, trace gravel; dark brown, with rootlets; non-cohesive, loose. | | 0.00 | 1 | AS | | | | | | | | | | | |
| | | | FILL - **(ML)** SILT, some gravel; brown, with rootlets; non-cohesive, loose. | | 0.30 | 2 | AS | | | | | | | | | | | |
| 1 | | | FILL - **(SW)** SAND, trace gravel; brown, mottled brown-orange; non-cohesive,compact. | | 0.91 | 3 | AS | | | | | | | | | | | |
| | | | | | | 4 | AS | | | | | | | | | | | |
| 2 | | | | | | 5 | AS | | | | | | | | | | | |
| | | | End of Borehole. (Refusal) | | 2.74 | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: RM

CHECKED: SEM

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-03

SHEET 1 OF 1

CLIENT: PWGSC

DATUM: Geodetic

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Belmont Retaining Wall

DRILLING DATE: October 18, 2017

DRILLING CONTRACTOR: Grassroots

N: ~5364301 E: ~466579

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

SAMPLER HAMMER, 140lbs.; DROP, 30in.

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG | DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SAMPLES: BLOWS/0.3m | WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) | SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Pocket Pen -; Q - ●, U - ◐) | GRADATION % CLAY PARTICLE SIZE <= 0.002: GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ground Surface | | | | | | | | | | | | | | | | | |
| 0 | Mole Rat Limited Access Rig | Auger Drilling | FILL - **(SM)** SILTY SAND, some gravel; brown; non-cohesive, dry. | | 0.00 | 1 | AS | | | | | | | | | | | | | |
| 1 | | | FILL - **(SM)** gravelly SILTY SAND; brown, inferred cobbles; non-cohesive, dry. | | 0.61 | 2 | AS | | | | | | | | | | | | | |
| 2 | | | | | | 3 | SS | 21 | 17 | | | | | | | | | | | |
| | | | End of Borehole. (Refusal) | | 2.29 | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: RM

CHECKED: SEM

Golder Associates

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-04

SHEET 1 OF 1

CLIENT: PWGSC
PROJECT: Fort Rodd Hill Geotechnical Investigation
LOCATION: Belmont Retaining Wall
N: ~5364303 E: ~466576
*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

DRILLING DATE: October 18, 2017
DRILLING CONTRACTOR: Grassroots

DATUM: Geodetic

SAMPLER HAMMER, 140lbs.; DROP, 30in.

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG | DRILLING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | RECOVERY % | BLOWS/0.3m | WATER CONTENT PERCENT: Wp W Wl, NP - Non-Plastic; SHEAR STRENGTH Cu, kPa: nat V. + Q - ●, rem V. ⊕ U - ◐, Pocket Pen - ■ | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ground Surface | | | | | | | | | | | | | | | |
| 0 | Mole Rat Limited Access Rig | Auger Drilling | FILL - **(SM)** SILTY SAND, trace organics; dark brown; non-cohesive, dry, loose to compact. | | 0.00 | 1 | AS | | | | | | | | | | | |
| 1 | | | FILL - **(SM)** SILTY SAND, some gravel; dark brown; non-cohesive, dry, compact. | | 0.61 | 2 | AS | | | | | | | | | | | |
| 2 | | | FILL - **(SM/SP)** gravelly SILTY SAND; dark brown; non-cohesive, dry, compact. | | 1.22 | 3 | AS | | | | | | | | | | | |
| | | | End of Borehole. (Refusal) | | 2.44 | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |

DEPTH SCALE
1 : 25

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: RM
CHECKED: SEM

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form:BC_BOREHOLE_GRADATION (AUTO) .dfrenal 7/11/17

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-05

SHEET 1 OF 1

DATUM: Geodetic

CLIENT: PWGSC
PROJECT: Fort Rodd Hill Geotechnical Investigation
LOCATION: Searchlight Engine Room
N: ~5364368 E: ~466525
*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

DRILLING DATE: October 18, 2017
DRILLING CONTRACTOR: Grassroots

INCLINATION: -90°

SAMPLER HAMMER, 140lbs.; DROP, 30in.

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SAMPLES: BLOWS/0.3m | WATER CONTENT PERCENT / SHEAR STRENGTH Cu, kPa | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | | | | | | | | | | | | | | | |
| 0 | Mole Rat Limited Access Rig / Auger Drilling | TOPSOIL - **(SM)** SILTY SAND, some gravel; dark brown, with rootlets and shells; non-cohesive, moist. | | 0.00 | 1 | AS | | | | | | | | | | | | |
| 1 | | FILL - **(ML)** CLAYEY SILT, some sand, some gravel; light brown; non-cohesive, dry to moist. | | 0.61 | 2/3 | SS | 42 | 25 | | | | | | | | | | |
| | | | | | 4 | AS | | | | | | | | | | | | |
| | | End of Borehole. (Refusal) | | 1.52 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |

WATER CONTENT PERCENT: Wp — W — Wl; NP - Non-Plastic; scale 10 20 30 40
SHEAR STRENGTH Cu, kPa: nat V. + Q - ●; rem V. ⊕ U - ◐; Pocket Pen - ■; scale 20 40 60 80

DEPTH SCALE
1 : 25

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: RM
CHECKED: SEM

Golder Associates

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-06

SHEET 1 OF 1

DATUM: Geodetic

CLIENT: PWGSC
PROJECT: Fort Rodd Hill Geotechnical Investigation
LOCATION: Searchlight Engine Room Retaining Wall
N: ~5364383 E: ~466534
*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

DRILLING DATE: October 19, 2017
DRILLING CONTRACTOR: Grassroots

INCLINATION: -90°

SAMPLER HAMMER, 140lbs.; DROP, 30in.

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SAMPLES: BLOWS/0.3m | WATER CONTENT PERCENT / SHEAR STRENGTH Cu, kPa | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | | | | | | | | | | | | | | | |
| 0 | Mole Rat Limited Access Rig / Auger Drilling | TOPSOIL - **(ML)** SILT, some gravel; dark brown, with rootlets; non-cohesive, moist. | | 0.00 | 1 | AS | | | | | | | | | | | | |
| 1 | | FILL - **(SM)** SILTY SAND, trace gravel; light brown; non-cohesive, dry. | | 0.91 | 2 | AS | | | | | | | | | | | | |
| | | End of Borehole. (Refusal) Inferred Cobbles or Bedrock. | | 1.07 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |

WATER CONTENT PERCENT: Wp — W — Wl; NP - Non-Plastic; 10 20 30 40
SHEAR STRENGTH Cu, kPa: nat V. + Q - ●; rem V. ⊕ U - ◐; Pocket Pen - ■; 20 40 60 80

DEPTH SCALE
1 : 25

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: RM
CHECKED: SEM

Golder Associates

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-07

SHEET 1 OF 1

DATUM: Geodetic

CLIENT: PWGSC
PROJECT: Fort Rodd Hill Geotechnical Investigation
LOCATION: Searchlight Engine Room Retaining Wall
N: ~5364383 E: ~466553
*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

DRILLING DATE: October 19, 2017
DRILLING CONTRACTOR: Grassroots

INCLINATION: -90°

SAMPLER HAMMER, 140lbs.; DROP, 30in.

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | RECOVERY % | BLOWS/0.3m | WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) | SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Pocket Pen -; Q -, U -) | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | Ground Surface | | | | | | | | | | | | | | | | | |
| | Mole Rat Limited Access Rig / Auger Drilling | TOPSOIL - **(ML)** SILT, some gravel; dark brown, with rootlets; non-cohesive, dry to moist. | | 0.00 | 1 | AS | | | | | | | | | | | | | |
| 1 | | FILL - **(SM)** SILTY SAND, some gravel; light brown, inferred cobbles; non-cohesive, dry. | | 0.76 | 2 | AS | | | | | | | | | | | | | |
| | | | | | 3 | AS | | | | | | | | | | | | | |
| | | End of Borehole. (Refusal) Inferred Cobbles or Bedrock. | | 1.07 | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE
1 : 25

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: RM
CHECKED: SEM

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-08

SHEET 1 OF 1

CLIENT: PWGSC
PROJECT: Fort Rodd Hill Geotechnical Investigation
LOCATION: Searchlight Engine Room Retaining Wall
N: ~5364384 E: ~466554
*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

DRILLING DATE: October 19, 2017
DRILLING CONTRACTOR: Grassroots

DATUM: Geodetic

SAMPLER HAMMER, 140lbs.; DROP, 30in.

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SAMPLES: BLOWS/0.3m | WATER CONTENT PERCENT / SHEAR STRENGTH Cu, kPa | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | | | | | | | | | | | | | | | |
| 0 | Mole Rat Limited Access Rig, Auger Drilling | TOPSOIL - **(ML)** gravelly SILT; dark brown, with rootlets; non-cohesive, dry to moist. | | 0.00 | 1 | AS | | | | | | | | | | | | |
| | | FILL - **(SM)** SILTY SAND, some gravel; brown; non-cohesive, dry. | | 0.30 | 2 | AS | | | | | | | | | | | | |
| 1 | | | | | 3 | SS | 17 | >50 | | | | | | | | | | |
| | | End of Borehole. (Refusal) Inferred Cobbles or Bedrock. | | 1.52 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |

WATER CONTENT PERCENT: Wp — W — Wl; NP - Non-Plastic; 10 20 30 40
SHEAR STRENGTH Cu, kPa: 20 40 60 80; nat V. + Q - ●; rem V. ⊕ U - ◐; Pocket Pen - ■

GRADATION % CLAY PARTICLE SIZE <= 0.002

DEPTH SCALE
1 : 25

SOIL CLASSIFICATION SYSTEM: GACS
LOGGED: RM
CHECKED: SEM

Golder Associates

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form:BC_BOREHOLE_GRADATION (AUTO) .dfrenal 7/11/17

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-09

SHEET 1 OF 1

DATUM: Geodetic

CLIENT: PWGSC

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Belmont Director's Tower

N: ~5364335 E: ~466587

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

DRILLING DATE: October 23, 2017

DRILLING CONTRACTOR: Drillwell Enterprises Ltd.

SAMPLER HAMMER, 140lbs.; DROP, 30in.

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | TYPE | RECOVERY % | BLOWS/0.3m | WATER CONTENT PERCENT: Wp W Wl, NP - Non-Plastic; SHEAR STRENGTH Cu, kPa: nat V. + Q - ●, rem V. ⊕ U - ◐, Pocket Pen - ■ | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | | | | | | | | | | | | | | |
| 0 | Auger Drilling | FILL - **(SP)** gravelly SAND, trace to some non-plastic fines; brown; non-cohesive, wet, compact. | | 0.00 | 1 | SS | 80 | 22 | | | | | | | | | |
| | | Bedrock Encountered. Refer to Record of Drillhole log for continuation of rock description. | | 0.38 | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

Golder Associates

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: RM

CHECKED: SEM

PROJECT No.: 13-1447-0497 / 8100

CLIENT: PWGSC

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Belmont Director's Tower

N: ~5364335 E: ~466587

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

# RECORD OF DRILLHOLE: BH17-09

SHEET 1 OF 1

DATUM: Geodetic

DRILLING DATE: October 23, 2017

DRILLING CONTRACTOR: Drillwell Enterprises Ltd.

INCLINATION: -90°

Refer to "Lithological and Geotechnical Soil and Rock Description Terminology" for accompanying legend and notes.

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | RUN No. | INDICES: ROCK STRENGTH R5 R4 R3 R2 R1 | INDICES: WEATHERING W2 W3 W4 / ALTERATION 5 2 3 4 | RECOVERY: TOTAL CORE % 80 60 40 20 | RECOVERY: RQD % 80 60 40 20 | FRACTURE INDEX PER 0.3 | DISCONTINUITY DATA: DIP DIRECT. (beta) 90 180 270 | DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (alpha) 0 30 60 90 | DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION | Fault / Breccia / Gouge | Clay Shear Core | Broken Core | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cont'd from Record of Borehole. | | | | | | | | | | | | | | | |
| 1 | Rock Coring | Granodiorite, massive, light grey to green, brown with iron staining within natural fractures. | | **0.38** | 1 | | | | | | | | | | | | |
| | | | | | 2 | | | | | | | | | | | | |
| 2 | | | | | 3 | | | | | | | | | | | | |
| 3 | | End of DRILLHOLE. | | 3.35 | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: RM

CHECKED: SEM

Golder Associates

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-10

SHEET 1 OF 1

DATUM: Geodetic

CLIENT: PWGSC

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Belmont Director's Tower

N: ~5364323 E: ~466577

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

DRILLING DATE: October 23, 2017

DRILLING CONTRACTOR: Drillwell Enterprises Ltd.

SAMPLER HAMMER, 140lbs.; DROP, 30in.

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | TYPE | RECOVERY % | BLOWS/0.3m | WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Pocket Pen -; Q -, U -) | GRADATION % CLAY PARTICLE SIZE <= 0.002: GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | | | | | | | | | | | | | | | |
| 0 | Auger Drilling | FILL - **(SP)** gravelly SAND, some non-plastic fines; brown; non-cohesive, moist, compact. | | 0.00 | 1 | SS | 38 | 12 | | | | | | | | | | |
| | | End of Borehole. (Refusal) Inferred Cobbles or Bedrock. | | 0.66 | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: RM

CHECKED: SEM

Golder Associates

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form:BC_BOREHOLE_GRADATION (AUTO) .dfrenal 7/11/17

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-11

SHEET 1 OF 1

DATUM: Geodetic

CLIENT: PWGSC

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Lower Battery Underground Magazine

N: ~5364406 E: ~466703

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

DRILLING DATE: October 23, 2017

DRILLING CONTRACTOR: Drillwell Enterprises Ltd.

SAMPLER HAMMER, 140lbs.; DROP, 30in.

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | TYPE | RECOVERY % | BLOWS/0.3m | WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Pocket Pen -; Q - ●, U - ◐) | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | Ground Surface | | | | | | | | | | | | | | | |
| | Auger Drilling | TOPSOIL - **(OL)** ORGANIC SILT, trace gravel, trace sand; dark brown, contains rootlets; non-cohesive, moist, loose. | | 0.00 | 1A | SS | 60 | 16 | | | | | | | | | |
| | Auger Drilling | FILL - **(SP)** SAND and GRAVEL, some non-plastic fines; dark brown to black, possible midden; non-cohesive, moist, loose to compact. | | 0.30 | 1B | | | | | | | | | | | | |
| | | End of Borehole. (Refusal) Inferred Cobbles or Bedrock. | | 0.61 | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: RM

CHECKED: SEM

Golder Associates

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF BOREHOLE: BH17-12

SHEET 1 OF 1

CLIENT: PWGSC

DATUM: Geodetic

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Lower Battery Underground Magazine

DRILLING DATE: October 23, 2017

DRILLING CONTRACTOR: Drillwell Enterprises Ltd.

N: ~5364389 E: ~466678

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

INCLINATION: -90°

SAMPLER HAMMER, 140lbs.; DROP, 30in.

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SAMPLES: BLOWS/0.3m | WATER CONTENT PERCENT: Wp, W, Wl, NP - Non-Plastic (10 20 30 40) | SHEAR STRENGTH Cu, kPa: nat V. +, rem V. ⊕, Pocket Pen - ■; Q - ●, U - ◐ (20 40 60 80) | GRADATION % CLAY PARTICLE SIZE <= 0.002: GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | | | | | | | | | | | | | | | | |
| 0 | Auger Drilling | TOPSOIL - **(OL)** ORGANIC SILT, some gravel; dark brown, contains shells and rootlets; non-cohesive, moist, loose. | | 0.00 | 1A | SS | 46 | 25 | | | | | | | | | | | |
| | Auger Drilling | FILL - **(SP)** gravelly SAND to SAND and GRAVEL; brown; non-cohesive, moist, compact to dense. | | 0.53 | 1B | | | | | | | | | | | | | | |
| | Auger Drilling | | | | 2 | SS | 50 | | | | | | | | | | | | |
| | | End of Borehole. (Refusal) Inferred Cobbles or Bedrock. | | 0.85 | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: RM

CHECKED: SEM

Golder Associates

PROJECT No.: 13-1447-0497 / 8100

CLIENT: PWGSC

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Searchlight Engine Room Retaining Wall

N: ~5364377 E: ~466562

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

# RECORD OF TEST PIT: TP17-01

SHEET 1 OF 1

DATUM: Geodetic

DRILLING DATE: October 24, 2017

DRILLING CONTRACTOR: OSKAR Construction

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SAMPLES: BLOWS/0.3m | WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Pocket Pen -, Q -, U -) | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | | | | | | | | | | | | | | |
| 0 | | FILL - **(ML)** gravelly SILT and SAND; dark brown, trace organics (roots and rootlets), trace cobbles (<5%); non-cohesive, moist, loose to compact. | | 0.00 | 1 | SS | | | | | | | | | | | |
| 1 | | FILL - **(ML)** gravelly SILT and SAND; brown, trace organics (roots and rootlets), trace cobbles and boulders (<5%), contains shells; non-cohesive, dry, loose to compact. | | 0.75 | 2 | SS | | | | | | | | | | | |
| 2 | | **(SM)** gravelly SILTY SAND; light brown; non-cohesive, dry, dense. | | 1.50 | 3 | SS | | | | | | | | | | | |
| | | | | | 4 | SS | | | | | | | | | | | |
| | | **(ML)** CLAYEY SILT, trace sand; brown; cohesive, w<PL, hard. | | 2.30 | 5 | SS | | | | | | | | | | | |
| | | End of Test Pit. | | 2.70 | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: RM

CHECKED: SEM

Golder Associates

PROJECT No.: 13-1447-0497 / 8100

CLIENT: PWGSC

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Belmont Director's Tower

N: ~5364316 E: ~468118

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

# RECORD OF TEST PIT: TP17-02

DRILLING DATE: September 28, 2017

INCLINATION: -90°

SHEET 1 OF 1

DATUM: Geodetic

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SAMPLES: BLOWS/0.3m | WATER CONTENT PERCENT / SHEAR STRENGTH Cu, kPa | GRADATION % (CLAY PARTICLE SIZE <= 0.002): GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | Ground Surface | | | | | | | | | | | | | | | | |
| | John Deere 35g Excavator / Excavator Bucket | **(GP)** SANDY GRAVEL, fine to coarse, poorly graded, subangular to angular, trace non plastic fines, light gray; loose to compact, dry | | 0.00 | | | | | | | | | | | | | | |
| | | **(SP)** GRAVELLY SAND, poorly graded, trace non plastic fines, brown; compact to dense, moist | | 0.20 | | | | | | | | | | | | | | |
| 1 | | **(GP)** SANDY GRAVEL, fine to coarse, poorly graded, subangular to angular, trace non plastic fines, dark brown, cobbles, boulders; compact, moist | | 0.50 | | | | | | | | | | | | | | |
| | | End of Test Pit.<br>(refusal, inferred bedrock) | | 1.40 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |

WATER CONTENT PERCENT: Wp — W — Wl; NP - Non-Plastic; 10 20 30 40

SHEAR STRENGTH Cu, kPa: nat V. + Q - ●; rem V. ⊕ U - ◐; Pocket Pen - ■; 20 40 60 80

GRADATION % CLAY PARTICLE SIZE <= 0.002

DEPTH SCALE

1 : 25

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: SEM

CHECKED: RM

Golder Associates

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF TEST PIT: TP17-03

SHEET 1 OF 1

CLIENT: PWGSC

DATUM: Geodetic

PROJECT: Fort Rodd Hill Geotechnical Investigation

DRILLING DATE: September 28, 2017

LOCATION: Belmont Director's Tower

N: ~5364323 E: ~466565

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SAMPLES: BLOWS/0.3m | WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) | SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Pocket Pen -; Q -, U -) | GRADATION % CLAY PARTICLE SIZE <= 0.002: GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | Ground Surface | | | | | | | | | | | | | | | | | |
| | John Deere 35g Excavator / Excavator Bucket | **(GP)** SANDY GRAVEL, fine to coarse, poorly graded, subangular to angular, trace non plastic fines, light gray; loose to compact, dry | | 0.00 | | | | | | | | | | | | | | | |
| | | **(SP)** GRAVELLY SAND, poorly graded, trace non plastic fines, brown; compact to dense, moist | | 0.20 | | | | | | | | | | | | | | | |
| | | End of Test Pit. (refusal, inferred bedrock) | | 0.60 | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: SEM

CHECKED: RM

Golder Associates

PROJECT No.: 13-1447-0497 / 8100

# RECORD OF TEST PIT: TP17-04

SHEET 1 OF 1

CLIENT: PWGSC

DATUM: Geodetic

PROJECT: Fort Rodd Hill Geotechnical Investigation

LOCATION: Belmont Director's Tower

DRILLING DATE: September 28, 2017

N: ~5364320 E: ~466565

*Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.*

INCLINATION: -90°

| DEPTH SCALE METRES | DRILLING RIG / DRILLING METHOD | DESCRIPTION | STRATA PLOT | ELEV. / DEPTH (m) | NUMBER | TYPE | RECOVERY % | BLOWS/0.3m | WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic; SHEAR STRENGTH Cu, kPa; nat V. +, rem V. ⊕, Pocket Pen -; Q - ●, U - ◐) | GRADATION % CLAY PARTICLE SIZE <= 0.002: GRAVEL | SAND | FINES | SILT | CLAY | PLASTICITY INDEX % | ORGANIC CONTENT % | ADDITIONAL LAB. TESTING | PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground Surface | | | | | | | | | | | | | | | |
| 0 | John Deere 35g Excavator / Excavator Bucket | **(GP)** SANDY GRAVEL, fine to coarse, poorly graded, subangular to angular, trace non plastic fines, light gray; loose to compact, dry | | 0.00 | | | | | | | | | | | | | |
| | | **(SP)** GRAVELLY SAND, poorly graded, trace non plastic fines, brown; compact to dense, moist | | 0.20 | | | | | | | | | | | | | |
| | | End of Test Pit. (refusal, inferred bedrock) | | 0.50 | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | |

DEPTH SCALE

1 : 25

SOIL CLASSIFICATION SYSTEM: GACS

LOGGED: SEM

CHECKED: RM

Golder Associates

National IM Server:GINT_GAL_NATIONALIM Unique Project ID: Output Form:BC_BOREHOLE_GRADATION (AUTO) .dfrenal 9/1/18

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Golder Associates

# BELMONT BATTERY REHABILITATION PROJECT

# FORT RODD HILL, BC

# PROJECT NO. R.075097.001

## APPENDIX 6

## FRH 2018 SPECIAL EVENTS

**FRH 2018 Special Events**

| Date | Event | Time | Location | Otentiks Booked off | Staff Leads | SAR ? | Collaborator Contact | Notes |
|---|---|---|---|---|---|---|---|---|
| February 24-25 | Tourist in Your Own Hometown | 10am-4pm | Plotting Room, Casemates | n/a | Sophie, PM2 | Booth | VEMRA | VEMRA's requirements: potentially use otentiks, set-up on the Friday. |
| Sunday April 22 | Earth Day Bioblitz Walk | 10am-12pm OR 2-4pm | | | SAR | | Expert | Guest Naturalist TBD.<br>Maybe a February moss walk with Kem Luther as well during Tourist in your own hometown? |
| June 21, July 19, August 16, September 1? | Night at the Fort- *extra fees may apply | 6-10pm/ 12am | | n/a | | | | Third Thursday of the month. Each of the three will involve: dinner (food truck, skip the dishes or pre-ordered picnic baskets?) music and a guest speaker or activity. Liquor license?<br>June 21: Solstice Picnic (first day of summer) (6-10pm)<br>July 19: Campfire Magic 6-10pm<br>August 16: Movies & Popcorn (8-12pm)<br>September 1: A toast to history (8-12pm) 19 + not a Thursday or September 8 |
| May 13 | Mother's Day Tea Party- NEW | 12-4 | Meadow? | n/a | VE/SAR | | VEMRA, Murchies? | |
| May 18-20 | Encampment | 12-4pm | Field, WOQ, canteen, lower battery | 2 for 17-20 | PM2 | | VEMRA | VEMRA needs interpreter support and involvement. Interps do historic gun demo. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | guard room | | | | | |
| NOT IN RACK CARD June 2 | Private Event Travel Tourism - TBC | 5pm-12am | | All 5 for June 2 | Sophie | | | |
| July 21/22 | Campout at the fort- LTC | 8pm-12am? | | All 5 | Claire, GTS | | | Optional sessions- more flexible<br>Make their own food<br>Maybe combine with Stargaze?? |
| July 1 | Canada Day | 10am-4pm | ALL | All 5 June 31 | PM2, GT | Booth | VEMRA | |
| NOT IN RACK CARD July 8 | Cadillac Car Show- | 10am-4pm | Field | All for 5 for July 7 | PM3, GT | Booth | | Proceed only if they follow certain requirements |
| August 10 | Star Gaze | 8pm-12am | Lower battery | All five for August 10 | GT, PM3, SAR | SAR-bat walk 8pm?, owl walk? | Royal Astronomical Society, Scott Mair speaker. Get a First Nations Speaker | |
| August 18 | Water Gun Wars<br><br>(previously known as fab forts) | 12-4pm | Belmont bowl/field | n/a | GTs | Booth | VEMRA<br>PARMA ? | Follow up with new cars on site procedure |
| September 1 | A Toast to History | 8pm-12am | | | | | | 19 + event (tickets) |
| September 15 | Seaside Festival | | | n/a | PM3 | Booth | City of Colwood | In rack card? partner event |
| September 22 | Lantern Tour | | | 3-5 for Sept 22 | GTs | | VEMRA | VEMRA charges for event we will charge entry as an evening program. |
| October 13 | Coast Salish Pit Cook | 10am-4pm | Meadow/ Field | | SAR | | Cheryl Bryce | |
| November 11 | 100 years of Remembrance | 12-4pm | | | PM3, Gts | | VEMRA | Partner with VEMRA, 5th, etc. |

# BELMONT BATTERY REHABILITATION PROJECT

# FORT RODD HILL, BC

# PROJECT NO. R.075097.001

## APPENDIX 7

## WOOD DOOR AND WINDOW REPAIR SCHEDULE

# FORT RODD HILL

**National Historic Site**

## WOOD DOOR & WINDOW REPAIR SCHEDULE
## BELMONT / FINAL PHASE

**JANUARY 29 / 2018**

**PREPARED FOR: PARKS CANADA AGENCY**

**PREPARED BY: HCW / HCS PSPC**

## WOOD DOOR & WINDOW REPAIR TYPES

| DOOR REPAIR | |
|---|---|
| DR1 | Repaint |
| DR2 | Repair / Replace bottom 5 " of door and/or frame (or more as req'd) |
| DR3 | Reinstate missing wooden components |
| DR4 | Replace missing door(s) |
| DR5 | Repair / Replace / Reinstate hardware |
| DR6 | Repair / Replace broken components |
| DR7 | Remove & Dispose |

| WINDOWS REPAIR | |
|---|---|
| WR1 | Repaint |
| WR2 | Reinstate missing wooden components |
| WR3 | Replace missing door(s) |
| WR4 | Repair / Replace / Reinstate hardware |
| WR5 | Repair / Replace broken components |
| WR6 | Replace missing window |

| MISC REPAIR | |
|---|---|
| MR1 | Repaint |
| MR2 | Repair / Replace broken components |
| MR3 | Reinstate missing wooden components |
| MR4 | Repair / Replace bottom 5 " of wood component (or more as req'd) |
| MR5 | Repair / Replace(If missing) / Reinstate hardware |

**NOTE: See "Notes" column on schedule for further identification of scope of work**

## BUILDING KEY

| CENTRAL BATTERY | |
|---|---|
| WOQ | WARRANT OFFICER'S QUARTERS |

| LOWER BATTERY | |
|---|---|
| EGE | EAST GUN EMPLACEMENT |
| WGE | WEST GUN EMPLACEMENT |
| UGM | UNDERGROUND MAGAZINE |
| AS | ARTILLERY STORE |
| ES | ELECTRIC SHED |
| GDH | GUARDHOUSE |
| CB | CASEMATE BARRACKS AREA |
| C | CANTEEN |

| CENTRAL BATTERY | |
|---|---|
| BCP | BATTERY COMMAND POST |
| WW | WORLD WAR II HUT |
| FS | FITTERS SHOP |

# WOOD DOOR & WINDOW SCHEDULE - FORT RODD HILL NHS
# BELMONT BATTERY AREA

SEARCHLIGHT ENGINE ROOM - SER

| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WXL) | NOTES |
|---|---|---|---|---|---|
| SER1 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / RETAINING WALL | DR3 / DR4 | 38 X 29.5 | New Frame, Door, 2 Hinges, & Lockset |
| SER2 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / EAST ELEVATION | WR1 / WR5 | 125 X 81 | Sash Repair (Circled) |
| SER3 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / NORTH ELEVATION | WR1 / WR5 | 28 X 64 | Sill Repair |

| | | | | | |
|---|---|---|---|---|---|
| SER4 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / NORTH ELEVATION | WR1 / WR5 | 28 X 64 | Sill Repair |
| SER5 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / NORTH ELEVATION | WR1 / WR5 | 28 X 64 | Sill Repair |
| SER6 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / NORTH ELEVATION | DR1 / DR5 | 67.5 X 105 | Repair existing hardware |

| | | | | | |
|---|---|---|---|---|---|
| SER7 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / NORTH ELEVATION | WR1 / WR5 | 28 X 64 | Sill Repair |
| SER8 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / NORTH ELEVATION | WR1 / WR5 | 57 X 20 | Repair existing metal security bars / Window sill repair |
| SER9 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / WEST ELEVATION | WR1 / WR5 | 57 X 20 | Repair existing metal security bars / Window sill repair |

| | | | | | |
|---|---|---|---|---|---|
| SER10 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / WEST ELEVATION | WR6 | 57 X 20 | Full window replacement / Repair existing metal security bars |
| SER11 |  | BELMONT / SEARCHLIGHT ENGINE ROOM / SOUTH ELEVATION | WR1 / WR5 | 57 X 20 | Repair existing metal security bars / Window sill repair |

| BELMONT BATTERY | | | | | |
|---|---|---|---|---|---|
| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
| B1 |  | BELMONT / NW ELEVATION | DR4 | 48 X 81 | |
| B2 |  | BELMONT / NW ELEVATION | DR1 / DR2 / DR4 | 54 X 85 | |

| | | | | | |
|---|---|---|---|---|---|
| B3 |  | BELMONT / NW ELEVATION | DR1 / DR2(FRAME) / DR6 | 43 X 81 | Door frame needs bottom 5-8" replaced / Some minor wood repair at the bottom of the door (Circled) |
| B4 |  | BELMONT / NW ELEVATION | DR1 / DR2(FRAME) / DR6 | 45.5 X 81 | Door frame needs bottom 5-8" replaced / Wood repair on head jamb (circled) |

| | | | | | |
|---|---|---|---|---|---|
| B5 |  | BELMONT / NW ELEVATION | W1 | 32 X 32 | |
| B6 |  | BELMONT / NW ELEVATION | DR1 / DR2(FRAME) / DR6 | 36.5 X 78 | Door frame needs bottom 5-8" replaced / Wood repair on head jamb |
| B7 |  | BELMONT / NW ELEVATION | WR1(SHUTTER) | 67 X 30 | Shutter to be re-painted only. Space between shutter and inside window needs to be cleaned. |

| | | | | | |
|---|---|---|---|---|---|
| B8 |  | BELMONT / SECOND FLOOR | DR1 / DR2 / DR6 | 36 X 79 | Re-use existing hardware / |
| B9 |  | BELMONT / NW ELEVATION | WR1(SHUTTER) | 30 X 51 | Shutter to be re-painted only. Space between shutter and inside window needs to be cleaned. |
| B10 |  | BELMONT / NW ELEVATION | WR1(SHUTTER) | 50 X 51 | Shutter to be re-painted only. Space between shutter and inside window needs to be cleaned. |

| | | | | | |
|---|---|---|---|---|---|
| B11 |  | BELMONT / NW ELEVATION | WR1(SHUTTER) | 30 X 51 | Shutter to be re-painted only. Space between shutter and inside window needs to be cleaned. |
| B12 |  | BELMONT / SOUTH ELEVATION | M1 | 125 X 38 | |

# WOOD DOOR & WINDOW SCHEDULE LOWER & UPPER BATTERY - FORT RODD HILL NHS
## LOWER BATTERY

LOWER BATTERY EAST GUN EMPLACEMENT - EGE

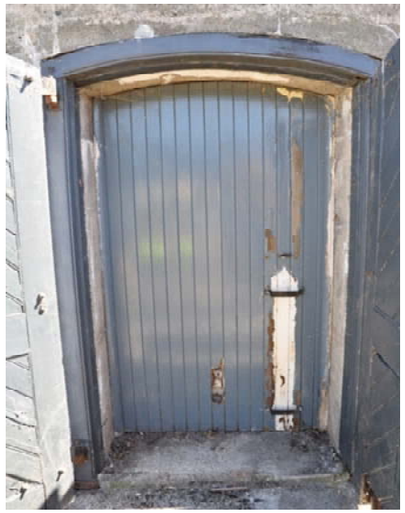
| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
|---|---|---|---|---|---|
| EGE1 |  | LOWER BATTERY / EAST GUN EMPLACEMENT / EAST SIDE | DR1 / DR4 | 26 X 31 | New door to be compatable construction with existing others on site |
| EGE2 |  | LOWER BATTERY / EAST GUN EMPLACEMENT / EAST SIDE | DR1 / DR4 / DR5 | 46 X 72 | Reinstate missing portion of frame (right side) / New door to be compatable construction with existing door leaf / New hardware on door to be of compatable construction to existing hardware |

| | | | | | |
|---|---|---|---|---|---|
| EGE3 |  | LOWER BATTERY / EAST GUN EMPLACEMENT / EAST SIDE | DR1 | 43 X 45 | |
| EGE4 |  | LOWER BATTERY / EAST GUN EMPLACEMENT / EAST SIDE | DR1 | 26 X 14 | |
| EGE5 |  | LOWER BATTERY / EAST GUN EMPLACEMENT / WEST SIDE | DR1 / DR4 / DR6 | 14 X 24 | Portion of wood frame need to be replaced (circled) / New door to be compatable construction with other similar existing doors on site |

| | | | | | |
|---|---|---|---|---|---|
| EGE6A |  | LOWER BATTERY / EAST GUN EMPLACEMENT / WEST SIDE | DR1 | 43 X 80 | |
| EGE6B |  | LOWER BATTERY / EAST GUN EMPLACEMENT / WEST SIDE | MR1 / MR2 | 60 X 2 | Ends are cracked and will require a splice repair. |
| EGE7a |  | LOWER BATTERY / WEST GUN EMPLACEMENT / EAST SIDE | DR1 / DR4 | 43 X 80 | New door to be compatable construction with other similar existing doors on site (See EGE6A for reference). |
| EGE7b |  | LOWER BATTERY / WEST GUN EMPLACEMENT / EAST SIDE | MR1 / MR2 | 60 X 2 | Ends are cracked and will require a splice repair. |

| LOWER BATTERY WEST GUN EMPLACEMENT - WGE | | | | | |
|---|---|---|---|---|---|
| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
| WGE1 |  | LOWER BATTERY / WEST GUN EMPLACEMENT / EAST SIDE | DR1 / DR4 | 14 X 24 | New door to be compatable construction with other similar existing doors on site |
| WGE2 |  | LOWER BATTERY / WEST GUN EMPLACEMENT / EAST SIDE | DR4 | 43 X 45 | New frame / doors to be compatable construction with other similar existing doors on site (See EGE3) / New doors will need 2 hinges per door, plus new lockset to be compatable construction (See EGE3). |

| | | | | | |
|---|---|---|---|---|---|
| WGE3 |  | LOWER BATTERY / WEST GUN EMPLACEMENT / EAST SIDE | DR1 / DR5 | 26 X 14 | Repair existing hardware |
| WGE4A |  | LOWER BATTERY / WEST GUN EMPLACEMENT / WEST SIDE | DR1 / DR2 / DR5 | 46 X 72 | |

| | | | | | |
|---|---|---|---|---|---|
| WGE4B |  | LOWER BATTERY . WEST GUN EMPLACEMENT / WEST SIDE | DR1 / DR3 / DR5 / DR6 | 46 X 72 | |
| WGE5 |  | LOWER BATTERY / WEST GUN EMPLACEMENT / WEST SIDE | DR1 / DR4 | 26 X 31 | New door to be compatable construction with existing others on site |

# WOOD DOOR & WINDOW SCHEDULE LOWER & UPPER BATTERY - FORT RODD HILL NHS
## LOWER BATTERY

LOWER BATTERY UNDERGROUND MAGAZINE - UGM

| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
|---|---|---|---|---|---|
| UGM1A |  | LOWER BATTERY / UNDERGROUND MAGAZINE / TOWER EAST ELEVATION | WR1 | 15 X 24 | |
| UGM1B |  | LOWER BATTERY / UNDERGROUND MAGAZINE / TOWER SOUTH ELEVATION | WR1 | 15 X 24 | |

| | | | | | |
|---|---|---|---|---|---|
| UGM1C |  | LOWER BATTERY / UNDERGROUND MAGAZINE / TOWER WEST ELEVATION | WR1 | 15 X 24 | |
| UGM1D |  | LOWER BATTERY / UNDERGROUND MAGAZINE / TOWER NORTH ELEVATION | WR1 | 15 X 24 | |

## LOWER BATTERY ARTILLERY STORE - AS

| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
|---|---|---|---|---|---|
| AS1 |  | LOWER BATTERY / ARTILLERY STORE DOOR | DR1 / DR2 | 38 X 80 | Bottom of door frame needs a splice replacement on left side only |

## LOWER BATTERY ELECTRIC SHED - ES

| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
|---|---|---|---|---|---|
| ES1 |  | LOWER BATTERY / ELECTRIC SHED | DR1 / DR2 (INTERIOR CONDITION IS UNKNOWN) | 68 X 83 | |

| LOWER BATTERY GUARDHOUSE - GDH | | | | | |
|---|---|---|---|---|---|
| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
| GDH1 |  | LOWER BATTERY / GUARDHOUSE | DR1 / DR2 | 38 X 80 | |
| GDH2 |  | LOWER BATTERY / GUARDHOUSE / LATRINE | WR1 (REPAIRED PORTION ONLY) / WR6 | 36 X 80 | Top right corner of frame needs splice repair. Repaint repaired portion only. |

| LOWER BATTERY CASEMATE BARRACKS - CB | | | | | |
|---|---|---|---|---|---|
| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
| CB1 |    | LOWER BATTERY / CASEMATE BARRACKS / MENS NO. 1 | DR1 / DR5 / DR6 | 38 X 84 | Door needs some repair (circled) / Supply & Install new lockset + 3 new hinges to be compatable with CB2/CB3 hardware construction |
| CB2 |   | LOWER BATTERY / CASEMATE BARRACKS / MENS NO. 2 | DR1 / DR6 | 38 X 84 | |

| | | | | | |
|---|---|---|---|---|---|
| CB3 |   | LOWER BATTERY / CASEMATE BARRACKS / MENS NO. 3 | DR1 | 38 X 84 | |
| CB4 |  | LOWER BATTERY / CASEMATE BARRACKS / KITCHEN | EXTERIOR ONLY DR1 | 43 X 74 | Interior to remain untouched. Exterior needs to be sanded and painted. |
| CB5 |  | LOWER BATTERY / CASEMATE BARRACKS / MENS NO.3 | EXTERIOR ONLY DR1 | 43 X 74 | Interior to remain untouched. Exterior needs to be sanded and painted. |

| | | | | | |
|---|---|---|---|---|---|
| CB6 |  | LOWER BATTERY / CASEMATE BARRACKS / MENS NO.2 | EXTERIOR ONLY DR1 | 43 X 74 | Interior to remain untouched. Exterior needs to be sanded and painted. |
| CB7 |  | LOWER BATTERY / CASEMATE BARRACKS / MENS NO.2 | EXTERIOR ONLY DR1 | 43 X 74 | Interior to remain untouched. Exterior needs to be sanded and painted. |
| CB8 |  | LOWER BATTERY / CASEMATE BARRACKS / MENS NO.1 | EXTERIOR ONLY DR1 | 43 X 74 | Interior to remain untouched. Exterior needs to be sanded and painted. |

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|---|---|---|---|---|---|
| CB9 |  | LOWER BATTERY / CASEMATE BARRACKS / MENS NO.1 | EXTERIOR ONLY DR1 | 43 X 74 | Interior to remain untouched. Exterior needs to be sanded and painted. |
| CB10 |  | LOWER BATTERY / CASEMATE BARRACKS LATRINE AREA | MR1 / MR2 | 62 X 17 | |
| CB11 |  | LOWER BATTERY / CASEMATE BARRACKS LATRINE AREA | DR4 (Includes new metal Lockset + 2 Hinges) | 24 X 80 | New door to be compatable construction with other existing door leaf / New hardware (3 hinges + lockset) on door to be of compatable construction to existing hardware |

| | | | | | |
|---|---|---|---|---|---|
| CB12 |  | LOWER BATTERY / CASEMATE BARRACKS LATRINE AREA | WR6 | 8 X 30 | |
| CB13 |  | LOWER BATTERY / CASEMATE BARRACKS LATRINE AREA | WR1 | 24 X 19 | |
| CB14 |  | LOWER BATTERY / CASEMATE BARRACKS LATRINE AREA | WR1 | 24 X 19 | |

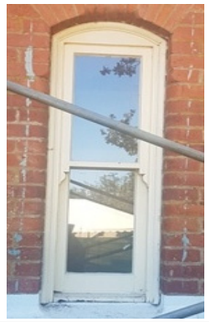
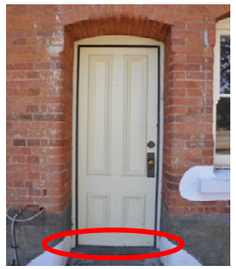
| | | | | | |
|---|---|---|---|---|---|
| CB15 |  | LOWER BATTERY / CASEMATE BARRACKS LATRINE AREA | WR1 | 43 X 74 | Interior to remain untouched. Exterior needs to be sanded and painted. |
| CB16 |  | LOWER BATTERY / CASEMATE BARRACKS LATRINE AREA | WR1 | 23 X 37 | Interior to remain untouched. Exterior needs to be sanded and painted. |
| CB17 |  | LOWER BATTERY / CASEMATE BARRACKS LATRINE AREA | DR1 / DR4 | 32 X 78 | New door to be compatable construction with other similar existing door (See CB11) / New hardware (3 hinges + lockset) on door to be of compatable construction to existing hardware |

| | | | | | |
|---|---|---|---|---|---|
| CB18 |  | LOWER BATTERY / CASEMATE BARRACKS AREA / OIL STORE | DR1 / DR2 / DR5 / DR6 | 37 X 77 | |

| LOWER BATTERY CANTEEN - C | | | | | |
|---|---|---|---|---|---|
| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
| C1 |   | LOWER BATTERY / CANTEEN LATRINE | WR7 (EXISTING) / WR4 (TO MATCH OTHERS ON SITE) (Includes New Lockset + 2 Hinges) | 24 X 74 | New door to be compatable construction with other similar existing door (See C2) / New hardware (2 hinges + lockset) on door to be of compatable construction to existing hardware on site |
| C2 |  | LOWER BATTERY / CANTEEN | WR1 | 51 X 84 | |

# WOOD DOOR & WINDOW SCHEDULE LOWER & UPPER BATTERY - FORT RODD HILL NHS
# WARRANT OFFICER'S QUARTERS

WARRANT OFFICER'S QUARTERS - WOQ

| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
|---|---|---|---|---|---|
| WOQ1 |  | UPPER BATTERY / WARRANT OFFICER'S QUARTERS / WEST ELEVATION | WR1 / WR5 | 20 X 50 | Lower portion of frame needs splice replacement / Sill needs replacement |
| WOQ2 |  | UPPER BATTERY / WARRANT OFFICER'S QUARTERS / WEST ELEVATION | WR1 / WR5 | 36 X 72 | Lower portion of frame needs splice replacement / Sill needs replacement |
| WOQ3 |  | UPPER BATTERY / WARRANT OFFICER'S QUARTERS / WEST ELEVATION | DR1 / DR6 | 36 X 82 | Bottom of door needs minor repair (Circled) / Supply & Install new weatherstripping. |

| | | | | | |
|---|---|---|---|---|---|
| WOQ4 |  | UPPER BATTERY / WARRANT OFFICER'S QUARTERS / WEST ELEVATION | WR1 / WR5 | 36 X 72 | Lower portion of frame needs splice replacement / Sill needs replacement |
| WOQ5 |  | UPPER BATTERY / WARRANT OFFICER'S QUARTERS / WEST ELEVATION | WR1 / WR5 | 36 X 72 | Lower portion of frame needs splice replacement / Sill needs replacement |
| WOQ6 |  | UPPER BATTERY / WARRANT OFFICER'S QUARTERS / REAR COURTYARD | WR1 / WR5 | 24 X 40 | Lower portion of frame needs splice replacement / Sill needs replacement |
| WOQ7 |  | UPPER BATTERY / WARRANT OFFICER'S QUARTERS / REAR COURTYARD | DR1 / DR5 / DR6 | 36 X 82 | Bottom of door needs minor repair (Circled) / Supply & Install new weatherstripping. |

| | | | | | |
|---|---|---|---|---|---|
| WOQ8 |  | UPPER BATTERY / WARRANT OFFICER'S QUARTERS / REAR COURTYARD | WR1 / WR5 | 36 X 72 | Lower portion of frame needs splice replacement / Sill needs replacement |
| WOQ9 |  | UPPER BATTERY / WARRANT OFFICER'S QUARTERS / SOUTH ELEVATION | DR1 | 26 X 36 | |

# WOOD DOOR & WINDOW SCHEDULE LOWER & UPPER BATTERY - FORT RODD HILL NHS
# CENTRAL BATTERY

BATTERY COMMAND POST - BCP

| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
|---|---|---|---|---|---|
| BCP1 |  | LOWER BATTERY / BATTERY COMMAND POST | DR4 | 32 X 80 | New door to be compatable construction with other similar existing door (See BCP2) / New hardware (3 hinges + lockset) on door to be of compatable construction to existing hardware on site |
| BCP2 |  | LOWER BATTERY / BATTERY COMMAND POST | DR5 | 32 X 80 | New lockset supplied & installed only. |

| WORLD WAR II HUT - WW | | | | | |
|---|---|---|---|---|---|
| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
| WW1 |  | WWII OFFICER'S QUARTERS | WR1 / 5% WOOD SIDING REPLACEMENT (WHOLE BUILDING) | n/a | |
| WW2 |  | WWII OFFICER'S QUARTERS | MR1 / MR2 | n/a | |
| WW3 |  | WWII OFFICER'S QUARTERS | FRAME - DR2<br>DOOR - DR1 | | |

| | | | | | |
|---|---|---|---|---|---|
| WW4 |  | WWII OFFICER'S QUARTERS | DOOR DR1 / DR6 | | |
| WW5 |  | WWII OFFICER'S QUARTERS | DOOR SILL WR1 / WR6 | | |

| FITTER'S SHOP - FS | | | | | |
|---|---|---|---|---|---|
| NO. | PHOTO | LOCATION | REPAIR | ROUGH OPENING (INCHES) (WxL) | NOTES |
| FS1 |   | UPPER BATTERY / FITTERS SHOP | DR1 / DR2 | | |