



**Public Works and
Government Services Canada**


Requisition No: EZ899-19-2509

SPECIFICATIONS
for

**Veterans Affairs Canada
Veterans Cemetery New Building & Paving**

Project No. R.098470.001 Dec 2018

APPROVED BY:



Regional Manager, AES

Dec. 19/2018

Date



Construction Safety Coordinator

2018-12-18

Date

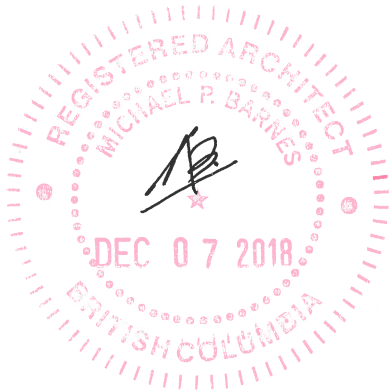
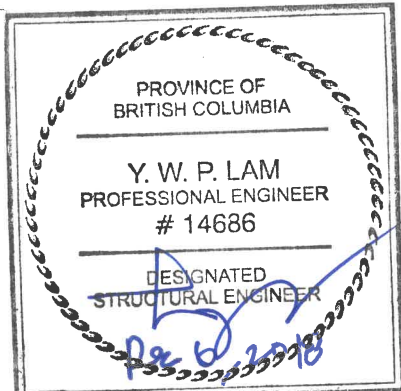



TENDER:



Project Manager

Dec-18-2018

Date

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| <p>ARCHITECTURE</p>  | <p>STRUCTURAL</p>  |
| <p>MECHANICAL</p>  <p>2018-12-05</p> | <p>ELECTRICAL</p>  <p>2018-12-06</p> |
| <p>CIVIL</p>  <p>2018-12-06</p> | |

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PART 1 GENERAL

PSPC Update on Asbestos Use

Effective April 1, 2016, all Public Services 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>

1.1 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):
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 The Canadian Electric Code (as amended).
- .4 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 CSA Z1006-10 Management of Work in Confined Spaces.
 - .5 CSA Z462 Workplace Electrical Safety Standard.
- .5 National Fire Code of Canada 2010 (as amended)
 - .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.
- .6 American National Standards Institute (ANSI):
 - .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .7 Province of British Columbia:
 - .1 Workers Compensation Act Part 3 – Occupational Health and Safety.
 - .2 Occupational Health and Safety Regulations.

1.2 RELATED SECTIONS

- .1 Refer to the following sections as required:
 - .1 Section 01 11 00: Summary of Work
 - .2 Section 01 14 00: Work Restrictions
 - .3 Section 01 50 00: Temporary Facilities
 - .4 Section 01 74 19: Waste Management and Disposal

- .5 Section 02 41 00: Demolition
- .6 Section 02 41 13: Asphalt Paving and Concrete Removal
- .7 Appendix 'B': Pre-Demolition Hazardous Building Material Assessment

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 PSPC may terminate the Contract without liability to PSPC where the Contractor, in the opinion of PSPC, 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: Submittal Procedures.
- .2 Work effected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Site Specific 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 current Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Emergency Procedures.
- .4 The Departmental Representative will review the Contractor's Site-Specific Health and Safety Plan and emergency procedures and provide comments to the Contractor within 5 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 Site-Specific 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 shall:
 - .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, revising, 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 or provide security guard as deemed necessary to protect site against entry.

1.9 PROJECT / SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Multi-employer work site.
 - .2 Federal employees and general public.
 - .3 Energized electrical services.
 - .4 Working from heights
 - .5 Working in the open exposed to unpredictable weather.
 - .6 High volumes of vehicular and pedestrian traffic

1.10 UTILITY CLEARANCES

- .1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work.
- .2 The Contractor will not rely solely upon the Reference Drawings or other information provided for utility locations.

1.11 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.
- .3 Comply with the Pre-Demolition Hazardous Building Materials Assessment, Appendix 'B'.

1.12 WORK PERMITS

- .1 Obtain specialty trade permit (s) related to project before start of work.

1.13 FILING 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.

1.14 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 Site-Specific Health and Safety Plan by PSPC shall not relieve the Contractor of responsibility for errors or omissions in final Site-Specific Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.15 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.
- .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.
- .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.

1.16 HAZARDOUS PRODUCTS

- .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 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 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left the building.
 - .3 Provide adequate means of ventilation in accordance with Section 01 50 00.
 - .4 The contractor shall ensure that the product is applied as per manufacturers recommendations.
 - .5 The contractor shall ensure that only pre-approved products are brought onto the work site in an adequate quantity to complete the work.

1.17 ASBESTOS HAZARD

- .1 Carry out any activities involving asbestos in accordance with applicable Provincial Regulations.
- .2 Removal and handling of asbestos will be performed as indicated in NMS Section 02 41 16, Section 02 82 10, Section 02 82 11 and Section 02 82 12.

1.18 PCB REMOVALS

- .1 Mercury-containing fluorescent tubes and ballasts which contain polychlorinated biphenyls (PCBs) are classified as hazardous waste.
- .2 Remove, handle, transport and dispose of as indicated in NMS Section 02 84 00.

1.19 REMOVAL OF LEAD CONTAINING PAINTS

- .1 All paints containing TCLP lead concentrations above 5 ppm are classified as hazardous.
- .2 Carry out demolition activities involving lead-containing paints in accordance with applicable Provincial Regulations.

1.20 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.

1.21 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.

1.22 OVERLOADING

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

1.23 FALSEWORK

- .1 Design and construct falsework in accordance with CSA S269.1-1975 (R2003).

1.24 SCAFFOLDING

- .1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA-Z797-2009 and B.C. Occupational Health and Safety Regulations.

1.25 CONFINED SPACES

- .1 Carry out work in confined spaces in compliance with Provincial Regulations.

1.26 POWDER-ACTUATED DEVICES

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

1.27 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.

1.28 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.

1.29 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, stand pipes and hose systems for any purposes other than fire fighting.
- .3 Be responsible / liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

1.30 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.

1.31 POSTED DOCUMENTS

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

1.32 MEETINGS

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

1.33 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

PART 1 GENERAL

1.1 DEFINITIONS – AGREEMENT, PARTICIPANTS AND CONTINUITY

- .1 Work of this project will be executed under a “Fixed Price” Agreement between the Government of Canada, the Owner, hereinafter called the “Departmental Representative” and the Contractor.
- .2 Architectural, Engineering and Special Departmental Representatives will also be referred to as “The Departmental Representative”.

1.2 DESCRIPTION OF WORK

- .1 Background Information: the work site is located between the 12th and 17th holes of the Gorge Vale Golf Club in Esquimalt, B.C. (48.4380355 Lat: -123.4133280 Long). In 1947, the Department of Veterans Affairs took over the 1.1 hectare (2.7 acre) cemetery and two (2) sections were joined to become the Veterans Cemetery, known as God’s Acre. The cemetery is a final resting place to over 2,500 military personnel. It is recognized for its picturesque lush green landscape and serves as a reminder to all visitors of the country’s great naval heritage and military history. The main building is a Chapel renovated in 1945 and constructed of various wood species. It is the only building with heritage significance on site. The other significant landmark on site is the Cross of Sacrifice, unveiled in 1961. A monument made of granite and found in all war cemeteries in the British Commonwealth.
- .2 Work under this contract includes provision of all equipment, labour, materials, transport and supervision required to complete, but not limited to, the following:
 - .1 Demolition and careful removal of existing maintenance building (approx. 4.8 m by 8.6 m)
 - .2 Demolition and careful removal of existing storage shed (approx. 4.6 m by 3.1 m) and the asphalt pedestrian pathway (North to South) leading to it.
 - .3 Design and construction of new in situ maintenance building, expanded to approximately 65 square meters in floor area.
 - .4 Remove and dispose of existing asphalt pathways, building concrete pads and pathways; all material to be disposed of at licenced facilities.
 - .5 New paving of a vehicular pathway with asphalt, complete with new concrete curb and gutter system; approximately 765 square meters in area.
 - .6 New crushed gravel paving of a pedestrian walkway, complete with a metal edge trim; approximately 510 square meters in area.
 - .7 The Contractor shall make provisions for the continuous monitoring of excavation work and excavated materials by a designated Archaeological Consultant engaged by the Departmental Representative. Refer to Section 01 35 00: Special Procedures for further description of Work.
 - .8 The provision of power and water services to one future washroom on the adjacent Gore Vale Golf Course north of the new maintenance building.
 - .9 The addition of a Holding Tank with 9100 L storage capacity on the east side of the new maintenance building. Refer to Appendix ‘G’.

- .10 The relocation of existing irrigation tank and plumbing to new storage area complete with new concrete housekeeping pad.
- .11 An Arborist will be engaged by the Departmental Representative. The Contractor shall be responsible for coordination. The Arborist shall be present on site during excavation and backfill near tree roots around the pedestrian pathway, maintenance building and any mature trees adjacent to vehicular pathway to provide direction on pruning and protection of roots.
- .12 As per excavation within the existing septic field:
 - .1 The Contractor is responsible for soil testing where excavation will be happening by a qualified professional as required by the licenced and approved disposal site. Contractor to report the findings to Departmental Representative. Should contaminated soils be encountered, contact the Departmental Representative. If the report indicates the presence of any contaminated soil, then instructions will be provided by Departmental Representative for the removal, stockpile, transfer, transport and disposal of off-site material at a disposal facility licensed for the appropriate soil quality in accordance with laws, regulations and by-laws, which may include, but are not limited to:
 - .1 WorkSafe B.C. Occupational Health and Safety (OHS) Regulations.
 - .2 Environmental Management Act (EMA), Contaminated Sites Regulation (CSR), including amendments.
 - .3 Environmental Management Act (EMA), Hazardous Waste Regulation (HWR), including amendments.
 - .4 Regional District and Municipal Bylaws.
 - .5 Transportation of Dangerous Goods Act (TDG).
 - .2 The Contractor is responsible for identifying, testing (by a qualified professional), managing, collecting, treating, and disposing of groundwater or surface water that may be present in excavations, in accordance with laws, regulations and by-laws as per preceding section.
 - .3 The Contractor should be aware that the assessment and management of soils and groundwater may delay the excavation and / or material disposal process, or other parts of work. The Departmental Representative to be advised if any such delays occur based on the findings. The Contractor will not be compensated for any such delay.
 - .4 The contractor should address work procedures at the septic field in their site-specific Health and Safety Plan.

1.3 "GREEN" REQUIREMENTS

- .1 Use only environmentally responsible green materials / products with no VOC emissions or minimum VOC emissions of indoor off-gassing contaminants for improved indoor air quality – subject to Departmental Representative's approval of submitted MSDS Product Data.

- .2 Use materials / products containing highest percentage of recycled and recovered materials practicable – consistent with maintaining cost effective satisfactory levels of competition.
- .3 Adhere to waste reduction requirement for reuse or recycling of waste materials, thus diverting materials from landfill.

1.4 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.

1.5 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 one 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.

1.6 TIME OF COMPLETION

- .1 Work is to be substantially completed within 28 weeks after contract award.

1.7 WORK SCHEDULE

- .1 Work is to be completed on site no later than 31 August 2019.
- .2 Carry out work as follows:
 - .1 Provide a detailed Project Schedule “phasing bar Gantt chart” showing key milestones, anticipated progress stages and final completion of the work within the time period indicated. Indicate the following:
 - .1 Project Meetings.
 - .2 Submission of shop drawings, product data, MSDS sheets and samples.
 - .3 Commencement and completion of work of each section of the specifications or trades for each phase as outlined.
 - .4 Final completion date within the time period required by the Contract documents.
 - .3 Do not change approved Schedule without notifying Departmental Representative.
 - .4 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.

1.8 HOURS OF WORK

- .1 Refer to Section 01 14 00: Work Restrictions.

1.9 CODES, BYLAWS, STANDARDS

- .1 Perform work in accordance with the National Building Code of Canada (NBC) 2015 and / or the British Columbia Building Code 2012, whichever is more stringent, 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.

1.10 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 / approved shop drawings.
 - .6 Change orders.
 - .7 Other modifications to Contract.
 - .8 Field test reports.
 - .9 Reviewed / approved 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 (NBC) 2015.
 - .13 Archaeological Permit.

1.11 CONTRACTOR'S USE OF SITE

- .1 Use of site:
 - .1 Work on site will be under the control of Departmental Representative. Refer to Section 01 14 00.
 - .2 Assume responsibility for assigned premises for performance of this work.
- .2 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with indicated scheduling.
- .3 Do not unreasonably encumber site with material or equipment.
- .4 Execute Work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .5 Maintain existing services to in-use facilities.
- .6 Closures: protect work temporarily until project is completed.

1.12 EXAMINATION

- .1 Examine site and be familiar and conversant with existing conditions likely to affect work. Refer to Section 01 50 00: Temporary Facilities.

1.13 WORK RESTRICTIONS AND SECURITY

- .1 Refer to Section 01 14 00.

1.14 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate, unless specifically dimensioned.
- .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 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 building elements 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 elements and finishes cut, damaged or disturbed, to Departmental Representatives 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 m in ambient light and includes painting the whole surface to the next change in plane.

1.16 ACCEPTANCE OF SUBSTRATES

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

1.17 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 (NBC) 2015.

1.18 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 project, 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. And provide a copy of the coordination drawings to Departmental Representative for record.
 - .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, service lines, rough-in points and indicate location services entrance to site.
 - .3 Facilitate meeting and review coordination drawings.
 - .4 Record and Publish meeting minutes of each meeting within in 3 days after the 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 that disputes between subcontractors are resolved.
- .5 Departmental Representative is not responsible for, nor accountable for extra costs incurred as a result of Contractor's failure to coordinate Work.
- .6 Maintain efficient and continuous supervision.
- .7 Coordinate and cooperate with institution staff where new work interfaces with active institution equipment and operation.

1.19 PROJECT MEETINGS

- .1 The Contractor shall arrange regular Project Meetings and assume responsibility for setting times and locations. The Departmental Representative shall undertake the recording and distribution of meeting Minutes. Include Project Meetings in the Project Schedule.

- .2 Project Meetings shall take place every 2 weeks at a minimum, for the entire duration of the contract (not including 1-year Warranty review period). Project Meetings can be on site, at the Contractor's facilities elsewhere, or by conference phone call, at the Contractor's discretion.
- .3 Allow for a minimum of 3 on-site Project Meetings during the duration of the contract (not for the 1-year contract Warranty).
- .4 Meetings regarding the performance of the 1-year contract Warranty shall be by off-site telecommunication. The Contractor shall bear all costs for any on-site work required for making the Work whole according to the Warranty.
- .5 Provide sufficient facilities for the conduct of Project Meetings:
 - .1 conference call facilities, or
 - .2 enclosed space with table and chairs for off-site Meetings.

1.20 TESTING AND INSPECTIONS

- .1 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified in individual Sections. Refer to Section 01 45 00: Quality Control.
- .2 The Contractor will appoint and pay for 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 Testing, adjustment and balancing of mechanical and electrical equipment and systems.
 - .1 Mill tests and certificates of compliance.
 - .2 Tests specified to be carried out by Contractor under the Departmental Representative's supervision.
- .3 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 verifying acceptability of corrected work.
- .4 Contractor shall furnish labour and facilities to notify Departmental Representative in advance of planned testing.
- .5 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .6 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.
- .7 The Departmental Representative may require, and pay for, additional inspection and testing services not included above.
- .8 Provide Departmental Representative with two (2) copies of testing laboratory reports as soon as they are available.

1.21 HAZARDOUS MATERIALS

- .1 Undertake the remediation of Pre-Demolition Hazardous Materials per Appendix 'C': Pre-Demolition Hazardous Building Materials Assessment and corresponding specification per Section 01 14 00, Section 01 35 43, Section 01 74 19, Section 02 41 00 and Section 02 41 13, at no cost to the Departmental Representative.

1.22 "AS-BUILT" DOCUMENTS

- .1 The Contractor shall provide four (4) sets of printed drawings, two (2) copies of the original AutoCAD files for "As-Built" purposes in thumb drives and four (4) copies of operations and maintenance manuals (three being digital and one in paper).
- .2 As work progresses, maintain accurate records to show all deviations from the Contract documents.
- .3 Refer to Section 01 78 00: Closeout Submittals.

1.23 CLEANING

- .1 Refer to Section 01 74 19: Waste Management and Disposal.

1.24 DUST CONTROL

- .1 Provide temporary dust tight screens or partitions and wet-down adjacent grounds to localize dust generating activities, and for protection of workers, finished areas of work and facility staff. Refer to Section 01 50 00.

1.25 ENVIRONMENTAL PROTECTION

- .1 Refer to Sections 01 35 43: Environmental Procedures and Section 01 74 19: Waste Management and Disposal.
- .2 Ensure that building envelope is weathertight, and that building interior has been allowed to dry before installation of interior components and finishes.

1.26 SECURITY CLEARANCES

- .1 Refer to Section 01 14 00.

1.27 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. Refer to Section 01 78 00.

1.28 SPECIALTY ENGINEERS

- .1 Various specifications sections require BC Registered Professional Engineers ("Specialty Engineers") to prepare, sign and seal shop drawings, submit NBCC Letters of Assurance and perform Field Services as required. Payment of Specialty Engineer services shall be included in the cost of the appropriate work.

1.29 OTHER CONSULTANTS

- .1 In addition to the Architectural and Engineering design consultants (as directed by the Departmental Representative), the Contractor shall engage and pay for any other Consultants needed in the performance of the work.

1.30 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 referenced in the Contract documents.

1.31 ARCHAEOLOGICAL MONITORING

- .1 Refer to Section 01 35 00: Special Procedures.

1.32 FIRST NATIONS MONITORING

- .1 Refer to Section 01 35 00: Special Procedures.

END OF SECTION

PART 1 GENERAL

1.1 CONTROL AND AUTHORITY OVER SITE

- .1 All Contractor activity on the Veterans Cemetery project is to be in accordance with the Permit conditions. Any proposed variations to the terms of the Permit is to be submitted in writing and formally approved by Veterans Affairs. No extension to the Project Schedule will be allowed due to any delay in receiving said approval.
- .2 While on site, all construction personnel shall remain at all times within the designated work area. Movement beyond the designated work areas must be approved and may require escort by the Veterans Affairs personnel overseeing the work.
- .3 Construction personnel must remain aware of their surroundings and be accountable for their tools / equipment at all times. There is significant potential for interaction with wildlife (birds and large marine mammals) – maintain a safe distance at all times.

1.2 ACCESS AND EGRESS

- .1 All construction staff, materials and equipment on site shall follow routes as designated on the Site Plan, and as instructed by the Departmental Representative.

1.3 HOURS OF WORK

- .1 Daylight work only-1 hour before sunrise to 1 hour after sunset. Submit proposed hours-of-work to Departmental Representative for review and approval along with schedule outlined in Section 01 11 00: Summary of Work.

1.4 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to the natural environment of the site. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services and abide by regulations for personnel access.
- .3 Closures: protect work temporarily until project is completed.
- .4 Areas under construction should not utilize any more space on site than what is absolutely necessary.
- .5 Make good site: remove all surplus material and return site to the condition so that there is no acceleration of soil erosion and natural regeneration can occur.
- .6 A maximum of 8 Contractor personnel are permitted to be on site at any one time, not including First Nations or Archaeological monitors.

1.5 NOISE GENERATION

- .1 Means and procedures of controlling and isolating other excessive or disturbing noise and vibration affecting surrounding areas shall be the responsibility of the Contractor and approved by the Departmental Representative.

1.6 LIGHT GENERATION

- .1 Minimize the use of artificial light sources to strictly necessary tasks so as to limit effects on nocturnal birds.

1.7 ARCHAEOLOGICAL MONITORING

.1 Refer to Section 01 35 00: Special Procedures.

1.8 FIRST NATIONS MONITORING

.1 Refer to Section 01 35 00: Special Procedures.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL INFORMATION

- .1 This Section specifies general requirements and procedures for the Contractor's submissions of shop drawings, product data, samples and other requested submittals to Departmental Representative for review. Additional specific requirements for submissions are specified in individual technical sections.
- .2 Present shop drawings, product data and samples in Metric dimensions.
- .3 Where items or information is not produced in Metric dimensions, converted values are acceptable.
- .4 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submissions.
- .5 Notify Departmental Representative in writing at time of submission, identifying deviations from requirements of Contract documents and stating reasons for deviations.
- .6 Contractor's responsibility for deviations in submission from requirements of Contract documents is not relieved by Departmental Representative's review of submission unless Departmental Representative gives written acceptance of specific deviations.
- .7 Make any changes in submissions which Departmental Representative may require consistent with Contract documents and resubmit as directed by Departmental Representative.
- .8 Notify Departmental Representative in writing, when resubmitting, of any revisions other than those requested by Departmental Representative.
- .9 Do not proceed with work until relevant submissions are reviewed and approved by the Departmental Representative.

1.2 SUBMISSION REQUIREMENTS

- .1 Coordinate each submission with the requirements of the work and the Contract documents. Individual submissions will not be reviewed until all related information is available.
- .2 Allow ten (10) working days for Departmental Representative's review of each submission, unless noted otherwise.
- .3 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.
- .4 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.

- .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative, certifying approval of submissions, verification of field measurements and compliance with Contract documents.
- .5 Seal of Professional Engineer, registered in British Columbia, for all items so required in the various sections of the specifications.
- .6 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.
 - .11 Means of transport to site, landing and storage of work elements.
- .5 After Departmental Representative's review, distribute copies.

1.3 SHOP DRAWINGS

- .1 Shop drawings: original drawings or modified standard drawings provided by Contractor to illustrate details of portions of work which are specific to project requirements.
- .2 Maximum sheet size: 850 mm x 1050 mm. (for hard copy submission).
- .3 Submit electronic versions of shop drawings for each requirement requested in the specification sections and / or as requested by the Departmental Representative.
- .4 Cross-reference shop drawing information to applicable portions of the Contract documents.

1.4 SHOP DRAWINGS REVIEW

- .1 Review of shop drawings by the Departmental Representative is for the sole purpose of ascertaining conformance with the general concept.
- .2 This review shall not mean that the Departmental Representative approves the detail design inherent in the shop drawings, responsibility for which shall remain with Contractor submitting same.
- .3 This review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the construction and Contract documents.

- .4 Without restricting the generality of the foregoing, the Contractor is responsible for:
 - .1 Dimensions to be confirmed and correlated at the job site.
 - .2 Information that pertains solely to fabrication processes or to techniques of construction and installation.
 - .3 Coordination of the work of all sub-trades.

1.5 PRODUCT DATA

- .1 Product data: manufacturers' catalogue sheets, MSDS sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products or any other specified information.
- .2 Delete information not applicable to project.
- .3 Supplement standard information to provide details applicable to project.
- .4 Cross-reference product data information to applicable portions of Contract documents.
- .5 Submit 6 copies of product data.

1.6 SAMPLES

- .1 Samples: examples of materials, equipment, quality, finishes and workmanship.
- .2 Where colour, pattern or texture is a criterion, submit a full range of samples.
- .3 Reviewed and accepted samples will become the standard of workmanship and material against which installed work will be verified.

1.7 APPROVALS

- .1 For approval of shop drawings and samples, refer to Section 01 11 00: Summary of Work.

1.8 PROGRESS SCHEDULE

- .1 Submit work schedule and cost breakdown as required in Section 01 11 00.

1.9 TEST RESULTS AND INSPECTION REPORTS

- .1 Submit in duplicate test results and inspection reports required by specification sections where noted.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 11 00: Summary of Work
- .2 Section 31 23 10: Excavating, Trenching and Backfilling

1.2 DEFINITIONS

- .1 Cultural Resource: a human work, an object or a place that is determined, on a basis of its heritage value, to be directly associated with an important aspect or aspects of human history or culture.
- .2 Archaeological site: a location that contains physical remains of past human activity.
- .3 Traditional Use site: Landforms, natural features, cultural features or other locations of spiritual, cultural or other significance to an Indigenous community.

1.3 REGULATORY OVERVIEW

- .1 Comply with all applicable laws, regulations and requirements of Federal, Provincial, and other regional authorities, and acquire and comply with such permits, approvals and authorizations as may be required.

1.4 GENERAL

- .1 Human remains, artifacts, features, relics, antiquities, and items of both prehistoric and historical value and any objects found on the work site that may be considered artifacts, regardless of condition, shall be reported to the Departmental Representative immediately. The Contractor and workers shall wait for instruction before proceeding with their work.
- .2 All archaeological or historical objects found are protected under Federal / Provincial Acts and regulations. The Contractor and workers shall stop work and protect any artifacts and / or features found and request direction from the Departmental Representative.
- .3 Refer to General Conditions GC6 for changes to the Contract in the case of any discovered items of interest.
- .4 Cultural resource issues to be a component of the daily tailgate meetings.

1.5 ARCHAEOLOGICAL AND FIRST NATIONS MONITORING

- .1 The Contractor shall make provisions and coordinate the continuous monitoring of excavation work and excavated materials by a designated Archaeological Consultant hired by PSPC.
 - .1 First Nations monitoring will be part of the Archaeological consultant team.
- .2 An Archaeological Monitor must be present during any excavation construction and any soil disturbance to record and collect any observed cultural resource, unless determined to be unnecessary by the Archaeological Monitor in which case the excavation could continue under a Chance Find Management Plan.
 - .1 Method of excavation shall be coordinated with the Archaeological Monitor.

- .2 All Contractor personnel involved in excavations must attend an archaeological briefing.
- .3 The Contractor must ensure that no burial plots are damaged during the Work.
- .4 Contractor shall coordinate and permit the Archaeological Monitor time to assess the excavated material.
- .5 Follow instructions from the Departmental Representative for the handling of any uncovered identified items of interest.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 00 73 19: Health and Safety Requirements
- .2 Section 01 33 00: Submittal Procedures
- .3 Section 01 50 00: Temporary Facilities
- .4 Section 01 74 19: Waste Management and Disposal

1.2 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.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00.
- .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: include:
 - .1 Name (s) of person (s) responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Name (s) and qualifications of person (s) responsible for manifesting hazardous waste to be removed from site.
 - .3 Name (s) and qualifications of person (s) 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 to control runoff and to contain materials on site.

- .7 Traffic control plans including measures to reduce erosion of surroundings by construction activities.
- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas including 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.

1.4 FIRES

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

1.5 DISPOSAL OF WASTES

- .1 Refer to Section 01 74 19.
- .2 Do not bury rubbish and waste materials on site.
- .3 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner onto the site.

1.6 DRAINAGE

- .1 Provide erosion and sediment control plan that identifies type and location of erosion and sediment controls to be provided. Plan: include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sedimentations 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.

1.7 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site.
- .2 Restrict plant removal to areas indicated or designated by Departmental Representative.
- .3 Minimize disturbance of topsoil and vegetation.
- .4 At the completion of work, return the site to the condition where there is no acceleration of soil erosion and natural regeneration can occur, to the satisfaction of the Departmental Representative.

1.8 WORK ADJACENT TO WATERWAYS

- .1 Do not operate construction equipment in waterways.
- .2 Do not use waterway beds for borrow material without Departmental Representative's approval.
- .3 Do not dump excavated fill, waste material or debris in waterways.
- .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.
- .7 Do not blast under water or within 100m of indicated spawning beds.

1.9 POLLUTION CONTROL

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

1.10 NOTIFICATION

- .1 The Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection Plan.
- .2 After receipt of such notice, the Contractor shall inform the Departmental Representative of proposed corrective action within 48 hours, for approval by Departmental Representative.
- .3 Departmental Representative will issue stop work order until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Inspection and testing, administrative and enforcement requirements.
- .2 Quality control program.
- .3 Tests and mix designs.
- .4 Mock-ups.
- .5 Mill tests.
- .6 Equipment and system adjust and balance.

1.2 RELATED SECTIONS

- .1 Section 01 33 00: Submittal Procedures
- .2 Section 01 60 00: Product Requirements
- .3 Section 01 78 00: Closeout Submittals

1.3 GENERAL

- .1 At Project commencement, establish quality assurance benchmarks and quality expectations for all workers and Subcontractors to follow.
- .2 The Specification identifies a minimum level of quality, exceed this minimum level.
- .3 Identify a person in the employ of the Contractor to monitor Work quality and to report quality assurance steps being taken, identified or discovered disparities, and corrective action taken.
- .4 Submit written reports monthly to the Departmental Representative, to accompany progress claims.
- .5 Post online daily photos of construction progress, that can be viewed by the Departmental Representative and others.
- .6 Monitor quality control over Suppliers, manufacturer's, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- .7 Comply with manufacturer's instructions, including each step and in sequence. Should manufacturer's instructions conflict with Contract Documents, request clarification from Departmental Representative before proceeding.
- .8 Comply with specified standards as minimum quality for the work except where more stringent tolerance, codes, or specified requirements indicate higher standards or more precise workmanship.
- .9 Perform work with persons qualified to produce required and specified quality.
- .10 Ensure that building envelope is weathertight and that building interior has been allowed to dry before installation of interior components and finishes as well as HVAC systems.

1.4 QUALITY CONTROL PROGRAM

- .1 Develop a quality control program. Program requires approval of the Departmental Representative and prior to commencement of Work.

- .2 Within fourteen (14) days of award of Contract, submit five (5) copies of the quality control program and list of independent inspection agencies for review.
- .3 Prepare all test results in triplicate and provide copies of all tests concurrently to the Departmental Representative and Contractor.
- .4 All test results shall specify at least the following data:
 - .1 Type of test.
 - .2 Dates of sampling, testing and reporting.
 - .3 Personnel involved.
 - .4 Location of test (with sketch if required).
 - .5 Specified requirements.
 - .6 Test results.
 - .7 Remarks regarding conformance with Contract Documents.
- .5 Provide written test results to the Departmental Representative within 12 hours of tests. If the tests are completed on Site, provide the Departmental Representative with field memo summarizing results immediately following testing.
- .6 Minimum testing requirements shall be in accordance with all applicable bylaws, regulations, standards, building codes and requirements of authorities having jurisdiction.

1.5 QUALITY CONTROL PLAN

- .1 Include the following in the quality control plan:
 - .2 An organization chart for the project group including identification of the quality control group and the quality control manager.
 - .3 Resumes of the quality control manager and key quality control personnel.
 - .4 A statement from the Contractor's management that the quality control manager has authority to reject or require correction of work.
 - .5 A process for initiating, tracking and resolving rejected work.
 - .6 A procedure for the quality control of Subcontractors complying with the requirements of the Contract.
 - .7 An outline of the required communication with the Departmental Representative including:
 - .1 reporting procedures, both daily and summary reports;
 - .2 arrangements for pre-work reviews to be organized by the Contractor;
 - .3 arrangements for weekly quality control review meetings; and
 - .4 coordination of quality control activities with quality assurance.
 - .8 A list of test procedures, identification of protocols for sampling and designation of the frequency for each test.
 - .9 Procedures for pre-qualification of materials.
 - .10 Provide copies of proposed inspection and testing reporting forms.
 - .11 Identification of certifications held by the Contractor and relevant to the Work.
 - .12 A definition of Contractor's management procedure for auditing the quality control plan.

1.6 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 may order any 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.

1.7 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection / Testing Agencies shall be engaged by the Contractor for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Contractor. Said inspections, testing and quality assurance shall include, but not be limited to the following:
 - .1 Electrical systems inspection and testing.
 - .2 Inspection and testing of all materials, components and systems as called for specifically in each specification section and as required.
- .2 Submit for approval by Departmental Representative names of proposed Independent Inspection / Testing Agencies
- .3 Provide equipment required for executing inspection and testing by appointed agencies.
- .4 Employment of inspection / testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .5 If defects are revealed during inspection and / or testing, appointed agency will request additional inspection and / or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and re-inspection.

1.8 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.

1.9 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 an orderly sequence so as not to cause delay in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.10 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 may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Departmental Representative.

1.11 REPORTS

- .1 Submit electronic copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to Subcontractor of work being inspected or tested manufacturer or fabricator of material being inspected or tested.

1.12 TESTS AND MIX DESIGNS

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

1.13 SAMPLE INSTALLATIONS / MOCK-UPS

- .1 Prepare sample installations and / or mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
- .2 Construct in all locations acceptable to Departmental Representative.
- .3 Prepare mock-ups for Departmental Representative's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, Departmental Representative will assist in preparing a schedule fixing dates for preparation.
- .6 Remove mock-up at conclusion of Work or when acceptable to Departmental Representative.
- .7 Except where otherwise specified, mock-ups may remain as part of Work.

- .8 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.
- .9 Mock-ups shall be constructed of actual materials to be used in the work unless otherwise approved by the Departmental Representative.

1.14 MILL TESTS

- .1 Submit mill test certificates as required.

1.15 EQUIPMENT AND SYSTEMS

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 00 73 19: Health and Safety Requirements
- .2 Section 01 14 00: Work Restrictions
- .3 Section 01 35 43: Environmental Procedures
- .4 Section 01 74 13: Progress Cleaning
- .5 Section 01 74 19: Waste Management and Disposal

1.2 TEMPORARY FACILITIES PLAN

- .1 In concert with and approval of the Departmental Representative and Veterans Affairs, and in addition to the Logistical Plan provided by all Tenderers, the Contractor shall submit within three (3) weeks of Contract Award a Temporary Facilities Plan indicating locations of the following:
 - .1 Contractor's access, lay-down and marshalling areas.
 - .2 Temporary job trailers, toilets, first aid station, debris bins, storage sheds and site offices to be located off site, directly east of south entrance, prior to entering golf course.
 - .3 Temporary barriers and measures for the protection of the surroundings.
 - .4 Temporary landing / loading area.

1.3 ACCESS AND DELIVERY

- .1 Contractor shall be responsible for providing all transportation of workers, equipment and material to the site.

1.4 STORAGE AND LAY-DOWN AREA

- .1 Confine activities to the immediate area of the site. Storage space is limited on the work site thereby requiring a high degree of scheduling proficiency for construction materials and equipment. Refer to Section 01 14 00.
- .2 Contractors' storage and lay-down facilities shall be confined to that area indicated on the Site Plan.
- .3 At completion of project, make good affected site elements.
- .4 Storage space is limited to lay-down area. Should more storage be required, Contractor shall provide off site.
- .5 Do not load or permit to load any part of Work with weight or force that will endanger Work or existing structure or elements.
- .6 Locate and maintain in clean, orderly and safe condition. Remove and make good site at Project completion. Provide first aid facilities in strict accordance with WCB requirements. Locate temporary facilities in compliance with Temporary Facilities Plan and as directed by Departmental Representative.

1.5 TEMPORARY CONSTRUCTION POWER

- .1 Provide and pay for temporary power by portable generators during construction. Contractor shall also be responsible for connections to power source and for continued maintenance of same for the duration of the project.
- .2 Electrical power and lighting installed under this contract may be used for temporary construction purposes, provided that guarantees are not affected thereby, and electrical components used for temporary power are replaced when damaged. Charges for said power shall be paid for by the Contractor.

1.6 WATER SUPPLY

- .1 Contractor shall make arrangements for temporary water supply. Ground water sources on Veterans Cemetery are limited to well water.

1.7 SANITARY FACILITIES

- .1 Contractor shall provide temporary portable toilets for construction workers off site. Locate in lay-down area and maintain in a sanitary, safe and secure manner. Remove from site and make good at completion of Project.

1.8 DEWATERING

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

1.9 TEMPORARY COMMUNICATIONS FACILITIES

- .1 Provide and pay for temporary communication facilities necessary for own use.

1.10 FIRE PROTECTION

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

1.11 SCAFFOLDING

- .1 Construct and maintain scaffolding in rigid, secure and safe manner in accordance with WCB regulations.
- .2 Erect scaffolding independent of walls. Remove promptly when no longer required.

1.12 PROTECTION, TEMPORARY BARRIERS AND ENCLOSURES

- .1 Protection of Building Finishes:
 - .1 Provide protection for completed and partially completed building finishes and equipment during performance of Work.
 - .2 Provide necessary screens, covers, and hoardings.
 - .3 Confirm with Departmental Representative locations and installation schedule three (3) days prior to installation.
 - .4 Be responsible for damage incurred due to lack of or improper protection.
- .2 Mold Control and Materials Protection: protect all building materials from mold growth and propagation during transit, storage and assembly in accordance with CCA82-2004 – Mold Guidelines for the Canadian Construction Industry.

1.13 CONTRACTOR'S SITE OFFICE

- .1 Provide office or other facility of sufficient size to accommodate site meetings and Contractor's operations.
- .2 Provide a clearly marked and fully stocked first-aid facility in a readily available location. Adhere to WCB directions for first aid facilities.

1.14 EQUIPMENT, TOOLS, AND STORAGE

- .1 All construction personnel must remain accountable for their tools and equipment at all times. At no time should tools and equipment be left unsecured overnight.
- .2 Provide and maintain, in a clean and orderly condition, lockable weatherproof containers for storage of tools, equipment and materials.
- .3 Locate materials not required to be stored in weatherproof sheds on site in a safe and secure manner to cause least interference with work activities and facility operations and security.

1.15 REMOVAL OF TEMPORARY FACILITIES

- .1 Remove temporary facilities from site when directed by the Departmental Representative.

1.16 CLEAN-UP

- .1 Remove daily all construction debris, surplus or waste materials, and used packaging material. Refer to Section 01 74 13.
- .2 At completion of Project:
 - .1 Remove and dispose of all debris, restore site to condition found at commencement of Work.
 - .2 Repair and make good to all damage caused by construction activities, so that there is no acceleration of soil erosion, and natural regeneration can occur, to the satisfaction of the Departmental Representative.
 - .3 Refer to Section 01 74 19.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 45 00: Quality Control

1.2 REFERENCE STANDARDS

- .1 All design and construction work shall be executed in conformance with the latest editions of the following Codes, Laws, regulations and trade/manufacturing quality standards associations:
 - .1 National Building Code of Canada (NBCC).
 - .2 British Columbia Building Code (BCBC).
 - .3 Model National Energy Code of Canada for Buildings.
 - .4 CAN/CSA-B651 – Barrier-Free Design.
 - .5 National Fire Code, Latest Edition.
 - .6 NFPA – National Fire Protection Association.
 - .7 Canada Labour Code – Part 2.
 - .8 HRSDC Fire Protection – Fire Commissioner of Canada.
 - .9 Local Bylaws / Authorities having Jurisdiction.
 - .10 WorkSafe B.C. – Workers Compensation Board of BC.
 - .11 CSA – Canadian Standards Association.
 - .12 CGSB – Canadian General Standards Board.
 - .13 ULC – Underwriters Laboratories of Canada.
 - .14 ASTM – American Society for Testing Materials.
 - .15 ANSI – American National Standards Institute.
 - .16 AASHTO – American Association of State Highways & Transportation Officials.
 - .17 ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers.
 - .18 AWMAC – Architectural Woodwork Manufacturers Association of Canada.
 - .19 CSDFMA – Canadian Steel Door and Frame Manufacturer's Association.
 - .20 CRCA – Canadian Roofing Contractors Association.
 - .21 RCABC – Roofing Contractors Association of BC.
 - .22 AWCCBC – Association of Wall and Ceiling Contractors of BC.
 - .23 CISC – Canadian Institute of Steel Construction.
 - .24 CSSBI – Canadian Sheet Steel Building Institute.
 - .25 CUFCA – Canadian Urethane Foam Contractor's Association.
 - .26 MPI – the Master Painters Institute.
 - .27 NAAMM – National Association of Architectural Metal Manufacturers.
 - .28 SMACNA – Sheetmetal and Air Conditioning Contractor's National Association, Inc.
 - .29 NHLA – National Hardwood Lumber Association.
 - .30 NLGA – National Lumber Grades Authority.

.31 NFCA – National Floor Covering Association.

1.3 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 one 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.
- .6 Fastenings which cause spalling or cracking are not acceptable.
- .7 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .8 Use heavy hexagon heads, semi-finished unless otherwise specified.
- .9 Bolts may not project more than 1 diameter beyond nuts.
- .10 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.
- .11 Deliver, store and maintain packaged material and equipment with manufacturer's seals and labels intact.
- .12 Prevent damage, moisture absorption, contact with organic matter, adulteration and soiling of products during delivery, handling and storage. Immediately remove rejected products from site.
- .13 Store products in accordance with suppliers' instructions.
- .14 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.

1.4 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.

1.5 AVAILABILITY OF PRODUCTS

- .1 Immediately upon project commencement, 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.

1.6 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 re-installation at no increase in either the Contract price or the Contract time.

1.7 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 by performance and referenced standard: select any product meeting or exceeding the referenced standard.
- .3 Products specified to meet particular design requirement: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative.
- .4 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.

1.8 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

PART 1 GENERAL

1.1 RELATED SECTION

- .1 Section 01 74 19: Waste Management and Disposal

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at regularly scheduled times.
- .3 Do not burn or bury waste materials on site.
- .4 Clear snow and ice from access to building, bank / pile snow in designated areas only.
- .5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .6 Provide on-site containers for collection of waste materials and debris.
- .7 Provide and use clearly marked separate bins for recycling. Refer to Section 01 74 19.
- .8 Remove waste material and debris from site and deposit in waste container at end of each working day.
- .9 Dispose of waste materials and debris off site. Refer to Section 01 74 19.
- .10 Clean interior areas prior to start of finish work and maintain areas free of dust and other contaminants during finishing operations.
- .11 Store volatile waste in covered metal containers and remove from site at end of each working day.
- .12 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .13 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .14 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 DEMOLISHED MATERIALS AND CONSTRUCTION WASTE

- .1 The Contractor is responsible for ensuring that all materials are properly disposed of and that under no circumstances are demolished materials, construction waste, screws, fasteners, connectors and other similar items to be left in walls, ceilings, cavities, pockets, and voids.

1.4 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 other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative.
- .6 Do not burn waste materials on site, unless approved by Departmental Representative.
- .7 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .8 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.
- .9 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .10 Clean lighting reflectors, lenses, and other lighting surfaces.
- .11 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .12 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .13 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .14 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .15 Remove dirt and other disfiguration from exterior surfaces.
- .16 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .17 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 00 73 19: Health and Safety Requirements
- .2 Section 01 11 00: Summary of Work
- .3 Section 01 14 00: Work Restrictions
- .4 Section 01 35 43: Environmental Protection
- .5 Section 01 50 00: Temporary Facilities
- .6 Section 02 41 00: Demolition
- .7 Section 02 41 13: Asphalt Paving and Concrete Removal

1.2 DEFINITIONS

- .1 Recyclable: Ability of product or material to be recovered at end of its life cycle and re manufactured into new product for reuse by others.
- .2 Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .3 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.
- .4 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.
- .5 Salvage: Removal of structural and non-structural materials from deconstruction / disassembly projects for purpose of reuse or recycling.
- .6 Waste Reduction Workplan (WRW): a written report which addresses opportunities for reduction, re-use or recycling of materials.

1.3 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

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

- .7 Transport to authorized recycling facility.

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Unless specified otherwise, materials for removal become Contractor's property.
- .2 Protect, stockpile, store and catalogue salvaged items.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect structural components not removed for demolition from movement or damage.
- .5 Separate and store materials produced during dismantling of structures in designated areas.
- .6 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.
- .7 Do work in compliance with Waste Reduction Workplan.

1.5 HAZARDOUS MATERIALS

- .1 Comply with Appendix 'B': Pre-Demolition Hazardous Building Material Assessment and corresponding Specification Sections.

1.6 DISPOSAL OF WASTES

- .1 Remove waste from site on a daily basis.
- .2 Dispose of waste material according to local regulations.
- .3 Do not bury rubbish or waste materials.
- .4 Do not dispose of waste into surroundings or waterways.

1.7 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to surroundings.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 APPLICATION

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

3.2 CLEANING

- .1 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.

END OF SECTION

PART 1 GENERAL

1.1 SUBMISSION

- .1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- .2 Revise content of documents as required before final submittal.
- .3 Phasing of submission:
 - .1 Two (2) weeks before substantial performance of the work, submit to Departmental Representative four (4) final copies of operation and maintenance manuals.
- .4 Ensure spare parts, maintenance materials and special tools provided are new, neither damaged nor defective, and of same quality and manufacture as products provided in work.
- .5 If requested, furnish evidence as to type, source and quality of products provided.
- .6 Defective products will be rejected, regardless of previous inspections. Replace products at own expense

1.2 FORMAT

- .1 All "As-Built" 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 permit for viewing using the Acrobat Reader software free from the internet.
- .2 The Program shall provide multi-level of password entry for access to add new or edit stored data by authorized users.
- .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 program user.

1.3 CONTENTS, EACH VOLUME

- .1 Table of Contents – provide the following:
 - .1 Title of project.
 - .2 Date of submission.
 - .3 Names, addresses, and telephone numbers of Departmental Representative and Contractor with name of responsible parties.
 - .4 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system, 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 Building data shall be collected and stored in a database format as an integral part of the Program. Building data shall include the following:
 - .1 Building Name.
 - .2 Building Address.
 - .3 Facility Manager.
 - .4 Building Photo.

1.4 OPERATION AND MAINTENANCE MANUAL

- .1 Record drawings:
 - .1 As work progresses, maintain accurate records to show all deviations from the Contract Drawings. Note on "As-Built" drawings as changes occur.
 - .2 At Work completion supply:
 - .1 Two (2) set in AutoCAD file format (version 2010) with all as-built information on thumb drive.
 - .2 Four (4) sets of printed "As-Built" drawings.
 - .3 Submit one copy of check plots to Departmental Representative prior to final printing of "As-Built" drawings.
 - .4 Retain original logo and title block area a small company logo, the text "AS-BUILT" and the date.
 - .3 Final Drawings:
 - .1 Drawings shall be converted from the original electronic files, such as CAD, into PDF format. If only the hard copies of the 'As-Built' drawings are available, they shall be scanned and saved in PDF format.
 - .2 PDF files of the "As-Built" 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.
 - .4 Cost for transferring "As-Built" information from marked up working set of drawings to electronic format using ACAD and plotting services shall be included in the Contract.
- .2 Maintenance Manual:
 - .1 Upon completion of project submit to Departmental Representative three (3) thumb drives and one paper (in 3" D ring, loose leaf binder with spine and face pockets) of Operations and Maintenance Manual, made up as follows:
 - .1 All "As-Built" 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 Organize files into CSI Masterformat numbering system or other approved descriptive titles. O&M data and "As-Built" drawings shall be classified by their corresponding disciplines, including:
 - .1 Architectural.
 - .2 Structural.
 - .3 Mechanical.
 - .4 Electrical.
- .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 The manual 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 user:
 - .1 Introduction.
 - .2 Departmental Representative / Contractor / Suppliers List.
 - .3 System Description.
 - .4 Maintenance and Lubrication Schedules.
 - .5 Testing and Commissioning (T&C) Reports.
 - .6 Misc. Reports.
 - .7 Specifications.
 - .8 Equipment and / or point schedules as identified in the hard copy documents.
 - .9 Others as stipulated by the user.
- .5 Building systems data shall be identified by their services, disciplines, function, nature and specific scope. System data shall be classified into the following categories:
 - .1 System Description.
 - .2 Schematic (where applicable).
 - .3 Equipment List.
- .6 Equipment data shall be classified into the following categories: Equipment submittals, T&C Report, Maintenance Data, Maintenance Records, Photo.
- .7 Program shall be executed by Professional Engineers with a minimum of ten (10) years post qualification experience in the field of Building Services Engineering.
- .8 The Contractor shall provide a minimum of three (3) past job references as proven record of similar undertakings commissioned by internationally renowned institutions or government agencies.
- .9 Refer to Mechanical and Electrical Divisions for specific details for Mechanical and Electrical data.

- .10 An example of the service provider is "Company: D-Elements Designing Services Inc. Contact Name: Ken Mak. Phone N^o: (604) 786-8892, Email: kenneth.kc.mak@gmail.com

- .2 Changes made by addenda and change orders.

1.5 EQUIPMENT AND SYSTEMS

- .1 Operating procedures – include the following:
 - .1 Start-up, break-in, and routine normal operating instructions and sequences.
 - .2 Regulation, control, stopping, shutdown, and emergency instructions.
 - .3 Summer, winter, and any special operating instructions.
- .2 Maintenance requirements:
 - .1 List routine procedures for each item of equipment and each system.
- .3 Provide servicing and lubrication schedule, and list of lubricants required.
- .4 Include manufacturer's printed operation and maintenance instructions.
- .5 Include sequence of operation by controls manufacturer.
- .6 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .7 Provide installed control diagrams by controls manufacturer.
- .8 Provide Contractor's coordination drawings with installed colour coded piping diagrams.
- .9 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .10 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .11 Additional requirements: as specified in individual specification Sections.

1.6 MANUFACTURER'S DOCUMENTATION REPORTS

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and system, instruct Departmental Representative's indicated facility's personnel, and provide detailed written report that demonstration and instructions have been completed.
- .2 Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.7 SPARE PARTS

- .1 Provide spare parts in quantities specified in individual specification Sections.
- .2 Provide items of same manufacture and quality as items in work.
- .3 Deliver to on-site location as directed; place and store.
- .4 Receive and catalogue all items.
 - .1 Submit inventory listing to the Departmental Representative.
 - .2 Include approved listings in maintenance manual.

- .5 Obtain receipt for delivered products and submit to Departmental Representative.

1.8 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in work.
- .3 Deliver to on-site location as directed; place and store.
- .4 Receive and catalogue all items.
 - .1 Submit inventory listing to the Departmental Representative.
 - .2 Include approved listings in maintenance manual.
- .5 Obtain receipt for delivered products and submit to Departmental Representative.

1.9 SPECIAL TOOLS

- .1 Provide special tools in quantities specified in individual specification Sections.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed, place and store.
- .4 Receive and catalogue all items.
 - .1 Submit inventory listing to the Departmental Representative.
 - .2 Include approved listings in maintenance manual.

1.10 WARRANTIES, BONDS, TEST REPORTS, INSPECTION REPORTS

- .1 Separate each Document 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, Bonds, Test Results, Inspection Reports executed in duplicate by subcontractors, suppliers, manufacturers, and inspection agencies within ten (10) days after completion of the applicable item of work.
- .4 Except for items put into use with the Departmental Representative's permission, leave date of beginning of time of warranty until the date of substantial performance is determined.
- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittal.

1.11 COMPLETION

- .1 Submit a written certificate that the following have been performed:
 - .1 Work has been completed and inspected for compliance with the 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 Operation of systems has been demonstrated to the personnel indicated by the Departmental Representative.
- .5 Work is complete and ready for final inspection.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 00 73 19: Health and Safety Requirements
- .2 Section 01 11 00: Summary of Work
- .3 Section 01 14 00: Work Restrictions
- .4 Section 01 35 43: Environmental Procedures
- .5 Section 01 50 00: Temporary Facilities
- .6 Section 01 74 19: Waste Management and Disposal
- .7 Appendix 'C': Pre-Demolition Hazardous Building Materials Assessment

1.2 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.

1.3 PRECAUTIONS

- .1 Should material resembling spray or trowel applied asbestos or any other designated substance be encountered in the course of demolition, stop work, take preventative measures and notify the Departmental Representative immediately. Do not proceed until written instructions have been received. Refer to Appendix 'B' & follow B.C. Worksafe guidelines for remediation during demolition.

1.4 PROTECTION

- .1 Provide bracing and shoring as required. Make good damage and be liable for injury caused by demolition.
- .2 Take precaution during demolition to protect all adjacent vegetation and bird burrows.
- .3 Fires burning and selling of waste of materials is not permitted on site.
- .4 Do not bury waste or materials on site.
- .5 Do not dispose of waste or volatile materials such as: mineral spirits, oil, petroleum-based lubricants, or toxic cleaning solutions into storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout project.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 00 73 19 and the Workers' Compensation Board of B.C. latest regulations.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 LOCATIONS

2.1 WORK

- .1 Demolition: existing storage shed and maintenance building, including structural foundation elements as shown on drawings, to suit the work.
- .2 Items shall be removed and turned over to Departmental Representative are noted on the drawings.
- .3 Elements for removal and re-use are noted on the drawings.

PART 3 EXECUTION

3.1 WORK

- .1 Dispose of demolished materials off site except where noted otherwise. Refer to Section 01 74 19.
- .2 Provide Archaeological Monitoring, per Section 01 14 00 part 1.8 during the demolition and removal of sub-grade building elements (foundations or other).
- .3 Unless otherwise noted, all existing items noted as: "Remove and Dispose of" shall be considered as Contractor's salvage.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 00 73 19: Health and Safety Requirements
- .2 Section 01 11 00: Summary of Work
- .3 Section 01 14 00: Work Restrictions
- .4 Section 01 74 19: Waste Management and Disposal

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling as per Section 01 74 19.
- .2 Divert unused concrete and asphalt materials from landfill to local approved facility.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Prior to beginning removal operation, inspect and verify with Departmental Representative the areas, depths and lines of concrete and asphalt pavement to be removed.

3.2 PROTECTION

- .1 Protect existing concrete and pavement not designated for removal, light units and structures from damage. In event of damage, immediately replace or make repairs to approval of the Departmental Representative at no additional cost.

3.3 REMOVAL

- .1 Remove existing concrete and asphalt pavement to lines and grades as indicated.
- .2 Use equipment and methods of removal and hauling which do not damage or disturb underlying pavement.
- .3 Prevent contamination of removed concrete and asphalt pavement by topsoil, underlying gravel or other materials.
- .4 Provide for suppression of dust generated by removal process.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Refer to the following reports (further referred to herein as the “Assessment Reports”), attached in the Appendix of the Project Specifications, for information pertaining to hazardous building materials that have been identified and will require disturbance (removal and disposal) during the Work:
 - .1 Appendix ‘H’ – “Asbestos Building Materials Assessment; Chapel, Equipment Storage; Shed / Office, and Maintenance Shed at Veteran’s Cemetery – 1190 Colville Road, Esquimalt BC”, prepared by Stantec Consulting Ltd., dated November 2, 2017.
 - .2 Appendix ‘C’ – “Pre-Demolition Hazardous Building Materials Assessment; Veteran’s Cemetery: Equipment Shed and Office and Maintenance Shed – 1190 Colville Road, Esquimalt BC”, prepared by Stantec Consulting Ltd., dated September 24, 2018.

1.2 DEFINITIONS

- .1 Dangerous Goods: product, substance, or organism that is specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
- .2 Hazardous Building Material: component of a building or structure that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when altered, disturbed or removed during maintenance, renovation or demolition.
- .3 Hazardous Material: product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
- .4 Hazardous Waste: any hazardous material that is no longer used for its original purpose and that is intended for recycling, treatment or disposal.

1.3 REFERENCE STANDARDS

- .1 Canadian Environmental Protection Act, 1999 (CEPA 1999):
 - .1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).
- .2 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Research Council Canada Institute for Research in Construction (NRC-IRC):
 - .1 National Fire Code of Canada 2015.
- .4 Department of Justice Canada:
 - .1 Transportation of Dangerous Goods Act (TDG Act) 1999, (c. 34).
 - .2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2003-400).

- .5 WorkSafe B.C.:
 - .1 British Columbia's Occupational Health and Safety Regulation (B.C. Reg. 296/97, including amendments to date of work).
 - .2 "Safe Work Practices for Handling Asbestos" (2017).
 - .3 "Lead-Containing Paints and Coatings; Preventing Exposure in the Construction Industry" (2011).
 - .4 "Safe Work Practices for Handling Lead" (2017).
 - .5 "Developing a Silica Exposure Control Plan" (2014).
- .6 Government of Canada:
 - .1 The Canada Labour Code, Part II, Canada Occupational Health and Safety Regulations (COHSR).
 - .2 The Federal PCB Regulations (SOR/2008-273).
 - .3 The Federal Halocarbons Regulation (July 2003).
- .7 Government of British Columbia:
 - .1 British Columbia Hazardous Waste Regulation (B.C. Reg. 63/88).
- .8 Canadian Construction Association:
 - .1 Standard Construction Document CCA 82 "Mould Guidelines for the Canadian Construction Industry" (2004 – further referred to herein as "CCA 82").

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product Data:
 - .1 Submit to Departmental Representative current Material Safety Data Sheet (MSDS) for each hazardous material required prior to bringing hazardous material on site.
- .3 Submit site specific Exposure Control Plans (ECPs) to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Co-ordinate storage of hazardous materials with Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.
- .2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
- .3 Store and handle flammable and combustible materials in accordance with current National Fire Code of Canada 2015 requirements.
- .4 Keep no more than 45 L of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.
 - .1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.
 - .2 Storage of quantities of flammable and combustible liquids exceeding 45 L for work purposes requires the written approval of the Departmental Representative.

- .5 Transfer of flammable and combustible liquids is prohibited within buildings.
- .6 Do not transfer of flammable and combustible liquids in vicinity of open flames or heat-producing devices.
- .7 Do not use flammable liquids having flash point below 38 °C, such as naphtha or gasoline as solvents or cleaning agents.
- .8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.
- .9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.
- .10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 L for liquids:
 - .1 Store hazardous materials and wastes in closed and sealed containers.
 - .2 Label containers of hazardous materials and wastes in accordance with WHMIS.
 - .3 Store hazardous materials and wastes in containers compatible with that material or waste.
 - .4 Segregate incompatible materials and wastes.
 - .5 Ensure that different hazardous materials or hazardous wastes are not mixed.
 - .6 Store hazardous materials and wastes in secure storage area with controlled access.
 - .7 Maintain clear egress from storage area.
 - .8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.
 - .9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.
 - .10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.
- .11 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.
- .12 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.

1.6 TRANSPORTATION

- .1 Transport hazardous materials and wastes in accordance with federal Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.
- .2 If hazardous waste is generated on site:
 - .1 Co-ordinate transportation and disposal with Departmental Representative.
 - .2 Ensure compliance with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.
 - .3 Use licensed carrier authorized by provincial authorities to accept subject material.

- .4 Prior to shipping material obtain written notice from intended hazardous waste treatment or disposal facility that it will accept material and that it is licensed to accept this material.
- .5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.
- .6 Ensure that trained personnel handle, offer for transport, or transport dangerous goods.
- .7 Provide photocopy of shipping documents and waste manifests to Departmental Representative.
- .8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide a photocopy of completed manifest to Departmental Representative.
- .9 Report discharge, emission, or escape of hazardous materials immediately to Departmental Representative and appropriate provincial authority. Take reasonable measures to control release.

1.7 EXISTING CONDITIONS

- .1 Reports and information pertaining to hazardous building materials present within the building that may be handled, removed, or otherwise disturbed and disposed of during this Project are bound into this specification in Appendix 'B'.
- .2 Notify Departmental Representative of suspected hazardous building material discovered during Work and not apparent from drawings, specifications, or reports pertaining to the Work. Do not disturb such material pending instructions from Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Only bring on site quantity of hazardous materials required to perform work.
- .2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

PART 3 EXECUTION

3.1 HAZARDOUS MATERIALS ABATEMENT

- .1 Abatement shall be conducted to handle, alter, remove and dispose of hazardous building materials as identified in the Assessment Reports in accordance with applicable regulations, guidelines, standards and/or best practices for such work.
- .2 Contractor is responsible for reviewing plans, specifications and reports such that they understand the locations and amounts of hazardous building materials that will be impacted by their Work, and such that appropriate plans and budgets for removal and disposal can be included in their overall bids.

- .3 The listing below is a summary of the identified hazardous building material categories that are anticipated to require disturbance (other than asbestos and lead, which are specified elsewhere), along with the associated removal and disposal regulations, guidelines and / or standards:
- .1 Asbestos-Containing Materials (ACMs):
 - .1 Refer to the Assessment Reports for identities and locations of ACMs that will require disturbance during the Work. In summary, the following ACMs are known to be present in the building:
 - .1 Equipment Storage Shed and Office:
 - a. Black window pane caulking on window above washroom door.
 - b. Light gray putty applied to electrical penetrations.
 - c. Dark gray putty applied to electrical penetration.
 - .2 Maintenance Shed:
 - a. No ACMs identified.
 - .2 Actions that will disturb identified ACMs are to be conducted in accordance with the requirements of the 2017 WorkSafe B.C. publication "Safe Work Practices for Handling Asbestos", by appropriately trained personnel.
 - .1 Contractor is to conduct a risk assessment and document work procedures for actions / tasks that will or may disturb identified ACMs.
 - .2 Contractor is to submit the documented work procedures to the Departmental Representative for review, at least five days prior to initiation of work.
 - .3 Contractor must not proceed with work that will impact identified ACMs without approval from Departmental Representative.
 - .4 If air monitoring is required as part of the Contractor's work procedures, the Departmental Representative will provide the required air monitoring and inspections.
 - .5 If, in the opinion of the Departmental Representative, the work procedures developed by the Contractor do not meet the intent of the 2017 WorkSafe B.C. publication "Safe Work Practices for Handling Asbestos", revisions will be required, at no cost to the Owner, and at no impact to the schedule.
 - .3 Waste transportation to be conducted in accordance with B.C. Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.
 - .4 Waste disposal to be conducted in accordance with B.C. Reg. 63/88.
 - .5 Notify Departmental Representative of suspected ACM discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Department Representative.

- .2 Lead and Lead-Containing Paints (LCPs)
 - .1 Refer to the Assessment Reports for identities and locations of lead-containing materials (including LCPs) that will require disturbance during the Work. In summary, the following LCPs are identified to be present:
 - .1 Equipment Storage Shed and Office:
 - a. Off-white coloured paint on interior plywood wall and wood door / trim.
 - b. Beige coloured paint on interior and exterior concrete floor / foundation.
 - .2 Maintenance Shed:
 - a. Green coloured paint on exterior wood trim.
 - b. White coloured paint on exterior wood siding.
 - Analytical results indicate green painted trim and white painted wood siding both contain lead in a dispersible form such that their leachates contain greater than 5.0 mg / L lead, indicating that the materials will require segregation and special disposal (as hazardous waste) during demolition.
 - .2 Actions that will disturb lead-containing materials (including paints and materials coated with LCPs) are to be conducted in accordance with the requirements of the 2017 WorkSafe B.C. publication "Safe Work Practices for Handling Lead", keeping airborne exposure to lead dust to less than COHSR and B.C. Reg. 296/97 regulated 8-hour Occupational Exposure Limit (OEL) for lead of 0.05 milligram per cubic metre (mg / m³).
 - .1 Actual methods to maintain exposures within applicable limits are to be determined by the contractor through their own risk assessment, which will take into account the lead content of the paints as indicated herein, along with their planned disturbance methods (and associated dust control), tools, PPE and the overall duration of the work.
 - .3 Although LCPs and items coated with LCPs may be disturbed and / or removed for disposal during the Work, unless deemed necessary through risk assessment or cost analysis conducted by the Contractor, comprehensive removal of LCPs from items or surfaces is not expected to be required during the Work.
 - .4 Refer to the provisions of the 2017 WorkSafe B.C. document "Safe Work Practices for Handling Lead" for removal of LCPs from surfaces before any welding and torch-cutting, should the Contractor plan to use such methods to complete the Work.

- .1 Contractor will be responsible for verification testing of surfaces where LCPs have been removed. Confirmation of acceptable results is to be provided to the Departmental Representative for review before proceeding with any welding or torch-cutting on surfaces where LCPs were present.
- .5 Waste transportation to be conducted in accordance with B.C. Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.
- .6 Waste disposal to be conducted in accordance with B.C. Reg. 63/88.
- .3 Polychlorinated Biphenyls (PCBs):
 - .1 Removal, alteration and / or disposal of PCB-containing equipment is not anticipated to be required during the Work.
- .4 Mould:
 - .1 Removal, alteration and / or disposal of mould-impacted materials is not anticipated to be required during the Work.
- .5 Mercury:
 - .1 Refer to the Assessment Reports for identities and locations of mercury-containing equipment that will require disturbance (removal and disposal) during the Work.
 - .2 When mercury-containing items are removed (thermostats, fluorescent light tubes), ensure all mercury waste is handled, stored and disposed of in accordance with the requirements the following:
 - .1 The transportation and disposal requirements of B.C. Reg. 63/88.
 - .2 The transportation requirements of the Federal Transportation of Dangerous Goods Regulation.
 - .3 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 / m³ as per the COHSR and B.C. Reg. 296/97. This can be achieved by providing respiratory and skin protection applicable to the hazard and task to be completed.
- .6 Ozone-Depleting Substances (ODSs)
 - .1 Removal, alteration and / or disposal of ODS-containing equipment is not anticipated to be required during the Work
- .7 Silica
 - .1 When silica-containing materials are to be disturbed and / or removed (e.g., demolition of concrete slabs, masonry or concrete units, removal of gypsum board / plaster walls, etc.), ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by the COHSR and B.C. Reg. 296/97. (Cristobalite and Quartz – each 0.025 mg / m³). This would include, but not be limited to, the following:

- .1 Providing workers with respiratory protection.
- .2 Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions.
- .3 Providing workers with facilities to properly wash prior to exiting the work area.

3.2 DISPOSAL

- .1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
- .2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.
- .3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
- .4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
- .5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.
- .6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.
- .7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.
- .8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:
 - .1 Hazardous wastes recycled in manner constituting disposal.
 - .2 Hazardous waste burned for energy recovery.
 - .3 Lead-acid battery recycling.
 - .4 Hazardous wastes with economically recoverable precious metals.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day as per Section 01 74 13: Progress Cleaning.
- .2 Final Cleaning:
 - .1 Upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 20 00: Concrete Reinforcing
- .2 Section 03 30 00: Cast-In-Place Concrete
- .3 Section 31 33 00: Excavating, Trenching and Backfilling

1.2 REFERENCES

- .1 Canadian Standards Association (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 O86-14, Engineering Design in Wood.
 - .3 CSA O121 08, Douglas Fir Plywood.
 - .4 CSA O151 09, Canadian Softwood Plywood.
 - .5 CSA O153-13, Poplar Plywood.
 - .6 CAN/CSA-O325-07, Construction Sheathing.
 - .7 CSA O437 Series 93 (R2006), Standards for OSB and Waferboard.
 - .8 CSA S269.1-16, Falsework and Formwork.
 - .9 CAN/CSA S269.3 M92 (R2003), Concrete Formwork, National Standard of Canada.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 SUBMITTALS

- .1 Submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 33 00.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 00 73 19: Health and Safety Requirements.
- .4 Indicate method and schedule of construction, shoring, stripping and re shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings and Comply with CAN/CSA S269.3 for formwork drawings.
- .5 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
- .6 Indicate sequence of erection and removal of formwork / falsework as directed by Departmental Representative.
- .7 The contractor is responsible for the design of all formwork and shoring and for complying with all Workers' Compensation Board regulations pertaining to formwork construction, design and inspection. Formwork and shoring shall be designed by a qualified professional engineer registered or licensed in British Columbia.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Section 01 50 00: Temporary Facilities.
- .2 Waste Management and Disposal:
 - .1 Separate and recycle waste materials in accordance with Section 01 74 19: Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Materials and resources shall be in accordance with Section 01 60 00: Product Requirements.
- .2 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CAN/CSA O86, CSA O437 Series, CSA O153.
 - .2 Rigid insulation board: to CAN/ULC-S701.
- .3 Form ties:
 - .1 For concrete not designated 'Architectural', use removable or snap off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
- .4 Form liner:
 - .1 Plywood: high density overlay, medium density overlay, Douglas Fir to CSA O121, Canadian Softwood Plywood to CSA O151 or Poplar to CSA O153 grade, square edge, 20 mm thick.
- .5 Form release agent: non-toxic, biodegradable, low VOC.
- .6 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 s and 110 s Saybolt Universal 15 to 24 mm²/s at 40 °C, flashpoint minimum 150 °C, open cup.
- .7 Falsework materials: to CSA S269.1.
- .8 Sealant: to Section 07 92 00: Joint Sealants.

PART 3 EXECUTION

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork / falsework and ensure dimensions agree with drawings.
- .2 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.

- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7 Fabricate and erect formwork in accordance with CAN/CSA S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.
- .8 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .9 Use 20 mm chamfer strips on external corners and / or 20 mm fillets at interior corners, joints, unless specified otherwise.
- .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .11 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
 - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .12 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND SHORING

- .1 Formwork removal and reshoring: Do not remove forms and shoring before the concrete has attained sufficient strength to ensure the safety of the structure and not before the following minimum period of time after placing concrete:
 - .1 24 hours for footings and abutments.
- .2 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .3 Re use formwork and falsework subject to requirements of CSA A23.1/A23.2.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 10 00: Concrete Forming and Accessories
- .2 Section 03 30 00: Cast-In-Place Concrete

1.2 REFERENCES

- .1 American Concrete Institute (ACI):
 - .1 SP-66-04, ACI Detailing Manual 2004.
 - .1 ACI 315 99, Details and Detailing of Concrete Reinforcement.
 - .2 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
 - .2 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A143/A143M-03, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - .2 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .3 ASTM A497/A497M 07, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
 - .3 Canadian Standards Association (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 A23.3 14, Design of Concrete Structures.
 - .3 CAN/CSA G30.18 M92 (R2002), Billet Steel Bars for Concrete Reinforcement, A National Standard of Canada.
 - .4 CSA G40.20/G40.21 13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 CAN/CSA G164 M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles, A National Standard of Canada.
 - .6 CSA W186 M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .4 Reinforcing Steel Institute of Canada (RSIC):
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 SUBMITTALS

- .1 Submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and ACI 315.

- .3 Submit shop drawings including placing of reinforcement and indicate:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
- .4 Detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated.
 - .1 Provide Class B tension lap splices where indicated unless otherwise indicated.
- .5 Quality Assurance: Provide the following to the Departmental Representative.
 - .1 Mill Test Report: upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.
 - .2 Upon request submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with Section 01 50 00: Temporary Facilities.
- .2 Waste Management and Disposal:
 - .1 Separate and recycle waste materials in accordance with Section 01 74 19: Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Materials and resources shall be in accordance with Section 01 61 00: Product Requirements.
- .2 Substitute different size bars only if permitted in writing by Departmental Representative.
- .3 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA G30.18, unless indicated otherwise.
- .4 Reinforcing steel to be welded: weldable low alloy steel deformed bars to CAN/CSA G30.18, grade 400W.
- .5 Cold drawn annealed steel wire ties: to ASTM A497/A497M.
- .6 Deformed steel wire for concrete reinforcement: to ASTM A497/A497M.
- .7 Welded steel wire fabric: to ASTM A185/A185M.
 - .1 Provide in flat sheets only.
- .8 Welded deformed steel wire fabric: to ASTM A497/A497M.
 - .1 Provide in flat sheets only.

- .9 Epoxy Coating of non-prestressed reinforcement for exterior roadway pavement: to ASTM A775/A775M.
- .10 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .11 Mechanical splices: subject to approval of Departmental Representative.
- .12 Plain round bars: to CSA G40.20/G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2, ACI 315 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
 - .1 ACI 315R unless indicated otherwise.
- .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement clearly identified in accordance with bar bending details and lists.

PART 3 EXECUTION

3.1 FIELD BENDING

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

3.2 PLACING REINFORCEMENT

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 03 10 00: Concrete Forming and Accessories
- .2 Section 03 20 00: Concrete Reinforcing
- .3 Section 03 35 00: Concrete Finishing

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM C109-12, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50-mm Cube Specimens).
 - .2 ASTM D260-86 (2001), Standard Specification for Boiled Linseed Oil.
 - .3 ASTM C309-11, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .4 ASTM C332-09, Specification for Lightweight Aggregates for Insulating Concrete.
 - .5 ASTM C827-10, Test Method for Early Volume Change of Cementitious Mixtures.
 - .6 ASTM D1751 04 (R2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
 - .7 ASTM D1752-04a (2013), Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - .8 ASTM C 260 – 10a, Specifications for Air-Entraining Admixtures for Concrete.
 - .9 ASTM C 494M – 13, Specifications for Chemical Admixtures for Concrete.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 19.24 M90, Multicomponent, Chemical Curing Sealing Compound.
- .3 Canadian Standards Association (CSA International):
 - .1 CSA A23.1-14 Concrete Materials and Methods of Concrete Construction.
 - .2 CSA-A23.2 14, Methods of Test for Concrete.
 - .3 CAN/CSA-A3000-08, Cementitious Materials Compendium.
 - .4 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .5 CAN/CSA G30.18 M92 (R2002), Billet Steel Bars for Concrete Reinforcement.

1.3 CERTIFICATES

- .1 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
- .2 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

1.4 QUALITY ASSURANCE

- .1 Minimum 2 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval for following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.
- .2 Health and Safety Requirements: construction occupational health and safety shall be in accordance with Section 00 73 19: Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

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

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19: Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Portland cement: to CAN/CSA A3000.
- .2 Supplementary cementing materials: with minimum 10% Type F fly ash replacement, by mass of total cementitious materials to CAN/CSA A3000.
- .3 Water: to CAN/CSA-A23.1.
- .4 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.
- .5 Air entraining admixture: to CAN/CSA-A3000.
- .6 Chemical admixtures: to CAN/CSA-A3000. Departmental Representative to approve accelerating or set retarding admixtures during code and hot weather placing.

- .7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
 - .1 Compressive strength: 50 MPa at 28 days.
 - .2 Consistency:
 - .1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
 - .2 Flowable: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.
 - .3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
 - .4 Dry pack to manufacturer's requirements.
- .8 Non-premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 50 MPa at 28 days.
- .9 Curing compound: to CAN/CSA-A23.1 white and to ASTM C309, Type 1-chlorinated rubber.
- .10 Cushion pads: tough, resilient, weather, moisture, and oil resistant material that will not corrode or cause corrosion, consisting of either layer of approved cotton duck saturated and bound together by approved rubber or synthetic compounds, or made from specially compounded synthetic materials.
- .11 Ribbed waterstops: extruded PVC (Arctic Grade) of sizes indicated with welded corner and intersecting pieces:
 - .1 Tensile strength: to ASTM D412, method A, Die "C", minimum 11.4 MPa.
 - .2 Elongation: to ASTM D412, method A, Die "C", minimum 275%.
 - .3 Tear resistance: to ASTM D624, method A, Die "B", minimum 48 kN / m.
- .12 Premoulded joint filler:
 - .1 Bituminous impregnated fibreboard: to ASTM D1751.
 - .2 Sponge rubber: to ASTM D1752, Type I, flexible grade.
- .13 Weep hole tubes: plastic.
- .14 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.
- .15 Dampproof membrane:
 - .1 Kraft / polyethylene membrane:
 - .1 Plain: 0.05 mm thick polyethylene film bonded to 2.44 kg / m² asphalt treated creped kraft.
 - .2 Reinforced: two (2) 0.05 mm thick polyethylene films bonded each side of 2.44 kg / m² asphalt treated creped kraft paper, reinforced with 13 mm x 13 mm fibreglass scrim.
 - .3 Membrane adhesive: as recommended by membrane manufacturer.
- .16 Dampproofing: Emulsified asphalt, mineral colloid type, unfilled: to CAN/CGSB-37.2, and to Section 07 11 00 – Dampproofing.
- .17 Polyethylene film: 0.25 mm (10 mil) thickness to CAN/CGSB-51.34.

2.2 MIXES

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1 to give the following properties:
 - .1 Cement: Type GU Portland cement.
- .2 Minimum compressive strength at 28 days, class of exposure and nominal size of coarse aggregate:

| Member | Minimum 28 - days strength (MPa) | Maximum aggregate size (mm) | Exposure Class | Air Content Category |
|----------------------------|----------------------------------|-----------------------------|----------------|----------------------|
| Footings, pilasters, Walls | 25 | 25 | F-2 | 2 |
| Slab on grade (interior) | 25 | 20 | N | - |
| Slab on grade (exterior) | 32 | 20 | C-2 | 1 |

- .3 Slump at time and point of discharge: To CSA-A23.1 Clause 4.3.2.3. When super plasticizers are used, the slump may be increased by shall kept below the point where segregation will occur. The cost of super plasticizers shall be included in the cost of the concrete. Smaller aggregate size may be used where necessary to increase slump.
- .4 Air content: To CSA-A23.1 Table 2 and 4 to suit appropriate exposure class.
- .5 Chemical admixtures: following admixtures in accordance with to ASTM C494M. Admixtures shall contain no salts or acids.
- .6 Concrete mix designs shall be submitted to a material consultant for approval and to Departmental representative for review prior to any concrete work.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Obtain Departmental Representative's approval before placing concrete. Provide minimum 48 hr notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Departmental Representative 's approval of proposed method for protection of concrete during placing and curing.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

- .6 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .7 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 CONSTRUCTION

- .1 Perform cast in place concrete work in accordance with CSA A23.1.
- .2 Sleeves and inserts:
 - .1 No sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.
 - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 mm x 100 mm not indicated, must be approved by Departmental Representative.
 - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.
 - .4 Check locations and sizes of sleeves and openings shown on drawings.
 - .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Anchor bolts:
 - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
 - .2 With approval of Departmental Representative, grout anchor bolts in holes drilled after concrete has set. Drilled holes to be to manufacturer's recommendations.
 - .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
 - .4 Set bolts and fill holes with epoxy grout.
 - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .4 Drainage holes and weep holes:
 - .1 Form weep holes and drainage holes in accordance with Section 03 10 00. If wood forms are used, remove them after concrete has set.
 - .2 Install weep hole tubes and drains as indicated.
- .5 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .6 Finishing:
 - .1 Finish concrete in accordance with CAN/CSA-A23.1.
 - .2 Use procedures acceptable to Departmental Representative or those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.

- .7 Waterstops:
 - .1 Install waterstops to provide continuous water seal. Do not distort or pierce waterstop in such a way as to hamper performance. Do not displace reinforcement when installing waterstops. Use equipment to manufacturer's requirements to field splice waterstops. Tie waterstops rigidly in place.
 - .2 Use only straight, heat sealed butt joints in field. Use factory welded corners and intersections unless otherwise approved by Departmental Representative.
- .8 Joint fillers:
 - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .2 Locate and form isolation, construction and expansion joints as indicated. Install joint filler.
 - .3 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.
- .9 Dampproof membrane:
 - .1 Install dampproof membrane under concrete slabs-on-grade inside building.
 - .2 Lap dampproof membrane minimum 150 mm at joints and seal.
 - .3 Seal punctures in dampproof membrane before placing concrete. Use patching material at least 150 mm larger than puncture and seal.
- .10 Locations of construction joints shall be submitted to the Departmental Representative for review in advance and prior to commencement of construction.
- .11 Supply and set anchor bolts, sleeves, pipe hangers, expansion joints and other inserts and openings as indicated in the structural drawings and specifications or in documents by other consultants.
- .12 All dowels, anchor bolts, embedded plates and other inserts shall be placed before the concrete is poured.
- .13 Slab on grade joints shall be 35 mm deep sawcuts spaced maximum 4500 mm apart, layout of joints shall be approved by the Departmental representative, seal with flexible joint sealer to prevent ingress of water.

3.3 SITE TOLERANCE

- .1 All horizontal surfaces shall meet the Class A Slab and Floor Finish classification (± 8 mm) in accordance with Table 22 of CAN/CSA-A23.1 straight edge method.
- .2 Tolerance closer than those specified in CSA-A23.1 may be required at certain locations for structural, architectural and construction requirements.

3.4 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by a CSA certified Testing Laboratory designated by Departmental Representative in accordance

with CAN/CSA-A23.1. Submit all concrete testing results to the departmental representative.

- .2 Contractor will pay for costs of tests as specified in Section 01 11 00: Summary of Work.
- .3 Contractor will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .4 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2.
- .5 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

3.5 VERIFICATION

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

3.6 CLEANING

- .1 Use trigger operated spray nozzles for water hoses.
- .2 Designate cleaning area for tools to limit water use and runoff.
- .3 Cleaning of concrete equipment to be done in accordance with Section 01 35 43: Environmental Procedures.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 31 23 10 – Excavating, Trenching and Backfilling

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 260/C 260M, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C 309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C 494/C 494M, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C 1017/C 1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .5 ASTM D 412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .6 ASTM D 624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
 - .7 ASTM D 1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .8 ASTM D 1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283, Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
 - .2 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.3 CERTIFICATION

- .1 Minimum 2 weeks prior to starting concrete work submit to Departmental Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Blended hydraulic cement.

- .3 Supplementary cementing materials.
 - .4 Grout.
 - .5 Admixtures.
 - .6 Aggregates.
 - .7 Water.
 - .8 Waterstops.
 - .9 Waterstop joints.
 - .10 Joint filler.
- .2 Provide certification from Materials Representative that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1
 - .3 Provide certification from Materials Representative that mix proportions selected will produce concrete of specified quality, durability and yield and that strength will comply with CAN/CSA-A23.1.

1.4 CONSTRUCTION QUALITY CONTROL

- .1 Quality Assurance: in accordance with Section 01 45 01 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.
- .3 Submit proposed quality control procedures for Departmental Representative's approval. Submit in accordance to 01 33 00 – Submittal Procedures.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Portland Cement: to CAN/CSA-5.
- .2 Supplementary Cementing Materials: to CSA-A23.5.
- .3 Water: to CSA-A23.1.
- .4 Aggregates: to CAN/CSA-A23.1.
- .5 Air entraining admixture: to CAN/CSA-A266.1.
- .6 Chemical admixtures: to CAN/CSA-A266.2. Departmental Representative to approve acceleration or set retarding admixtures during cold and hot weather placing.
- .7 Grout:
 - .1 Provide grout certification prior to use.
 - .2 To be as specified in Contract Documents. Alternative to be approved by Departmental Representative.
 - .3 Use in accordance with manufacturer's recommendations.
- .8 Curing Compound:
 - .1 To be spray applied, liquid type conforming to ASTM C309 containing a fugitive dye.
 - .2 To be applied in accordance with manufacturer's recommendations.

- .3 Other curing methods such as sheet material and burlap mats, subject to Departmental Representative's approval.
- .9 Premoulded Joint Fillers (expansion joint): Bituminous impregnated fibre board: to ASTM D1751.

2.2 CONCRETE MIXES

- .1 Proportion concrete in accordance with CAN/CSA-A23.1, Table 11. Alternative 1 and to specific design criteria specified on Contract Drawings.

2.3 FORMS

- .1 Forms to CAN/CSA-A23.1.11.
- .2 Free from surface defects for all concrete faces exposed to view.
- .3 Form ties to be metal and of type such that no metal left within 25mm of concrete surface when forms removed.

2.4 FORM RELEASE AGENT

- .1 Non-staining material type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.

PART 3 EXECUTION

3.1 GENERAL

- .1 Do cast-in-place concrete work, including surface tolerances, finishing and field quality control, in accordance with CAN/CSA-A23.1 except where specifically stated otherwise.

3.2 FORMWORK

- .1 Formwork to conform to shape, lines and dimensions shown on Contract Drawings.
- .2 Formwork to be substantial, sufficiently tight to prevent leakage of mortar and braced and tied to maintain position and shape.
- .3 Formwork to be unlined unless specified otherwise.

3.3 CONSTRUCTION

- .1 Obtain Departmental Representative's approval before placing concrete. Providing minimum 24h notice prior to placing of concrete.
- .2 .Pumping of concrete is permitted only after Departmental Representative's approval of equipment and mix.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing.
- .5 Ensure placement and compaction procedures to CAN/CSA-A23.1 and to approval of Departmental Representative.
- .6 Protect exposed surfaces from weather and vandalism during initial set period.
- .7 Strip forms ensuring no damage to concrete.

- .8 Ensure curing procedures consistent with weather and temperature conditions.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 Do not place load upon new concrete until authorized by Departmental Representative.

3.4 JOINT FILLERS

- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless authorized otherwise by Departmental Representative. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .2 Locate and form all joints as shown on Contract Drawings or as otherwise require. Install joint filler where applicable.
- .3 Use 13mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to finished slab surface unless indicated at bottom.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 ENVIRONMENTAL REQUIREMENTS

- .1 Temporary lighting:
 - .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
- .2 Electrical power:
 - .1 Provide sufficient electrical power to operate equipment normally used during construction.
- .3 Work area:
 - .1 Make work area water tight protected against rain and detrimental weather conditions.
- .4 Temperature:
 - .1 Maintain ambient temperature of not less than 10 °C from seven (7) days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.
- .5 Moisture:
 - .1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
- .6 Safety:
 - .1 Comply with WorkSafe B.C.
- .7 Ventilation:
 - .1 Ventilate enclosed spaces in accordance with Section 01 51 00: Temporary Utilities.
 - .2 Provide continuous ventilation during and after coating application.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 60 00: Product Requirements 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.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- .1 Product quality and quality of work in accordance with Section 01 60 00.
- .2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.

2.2 CHEMICAL HARDENERS

- .1 Non-metallic hardener: premixed, aggregate type, dry shake surface hardener, cement to hardener ratio 2 to 1, cement colour as indicated.

2.3 SEALING COMPOUNDS

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

2.4 CURING COMPOUNDS

- .1 Select low VOC, water-based, curing compounds.

2.5 MIXES

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

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verify that substrate surfaces are ready to receive work indicated.

3.2 PREPARATION OF EXISTING SLAB

- .1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radiused edges unless otherwise indicated.
- .2 Saw cut control joints to CAN/CSA-A23.1, 24 hours maximum after placing of concrete.
- .3 Use strong solvent mechanical stripping to remove chlorinated rubber or existing surface coatings.

- .4 Use protective clothing eye protection respiratory equipment during stripping of chlorinated rubber or existing surface coatings.

3.3 APPLICATION

- .1 Apply concrete finishing floor hardener to all exposed floors and where indicated on the finish schedule.
- .2 In locations where floors may be subjected to vehicular traffic, it shall be slip resistant, have high abrasion and impact resistance to withstand frequent wheeled traffic with high point loading. It shall also be resistant to chemicals related to regular snow and ice removal.
- .3 Apply floor hardener in accordance with manufacturer's written instructions, and CSA-A23.1-94, Concrete Materials and Methods of Construction
- .4 Clean over spray, and clean sealant from adjacent surfaces.

3.4 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
 - .2 Clean in accordance with Section 01 74 13: Progress Cleaning.
- .2 Final Cleaning:
 - .1 Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.
- .3 Waste Management:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 19.

3.5 PROTECTION

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00: Submittal Procedures
- .2 Section 01 74 19: Waste Management and Disposal
- .3 Section 09 90 00: Painting and Coating

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A 36/A 36M-14, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, Threaded Rod 60,000psi Tensile Strength.
 - .3 ASTM A325-10e1, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .4 ASTM A 325M-13, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength.
 - .5 ASTM A 108-07, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- .2 Canadian General Standards Board (CGSB):
 - .1 CGSB 85.10-99, Protective Coatings for Metals.
- .3 Canadian Institute of Steel Construction (CISC) / Canadian Paint Manufacturer's Association (CPMA):
 - .1 CISC/CPMA 1-73a, A Quick-Drying One-Coat Paint for Use on Structural Steel.
 - .2 CISC/CPMA 2-75, A Quick-Drying Primer for Use on Structural Steel.
- .4 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-G40.20-13, General Requirements for Rolled or Welded Structural Quality Steel.
 - .2 CAN/CSA-G40.21-13, Structural Quality Steel.
 - .3 CAN/CSA-G164-M92 (withdrawn), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .4 CAN/CSA-S16-14, Design of Steel Structures.
 - .5 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
 - .6 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
 - .7 CSA W55.3-08 (R2013), Certification of Companies for Resistance Welding of Steel and Aluminum.
 - .8 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
 - .9 CSA W178.1-14, Certification of Welding Inspection Organizations.
 - .10 CSA W178.2-14, Certification of Welding Inspectors.

1.3 DESIGN REQUIREMENTS

- .1 Provide splices as indicated on drawings. Unless noted otherwise, all continuous elements called up on the drawings shall be provided with full strength splice either by full strength groove weld or by full strength splice plates on each end of the connection elements.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 33 00. Shop drawings for anchor bolt layout and embedded plate layout shall also be submitted for review.
- .2 On erection drawings, indicate all details and information necessary for assembly and erection purposes such as, description of methods, sequence of erection, type of equipment used in erection and temporary bracings.
- .3 No fabrication or work shall be commenced until the review and approval of the shop drawings. The contractor shall assume full responsibility for any fabrication and work done prior to review and approval of the shop drawings.
- .4 Contractor shall co-ordinate and verify all dimension and locations prior to production of the drawing.
- .5 All fabricator designed assemblies, components and connections, and drawings to be stamped and signed by qualified professional engineer licensed in the British Columbia, Canada.

1.5 QUALITY ASSURANCE

- .1 Submit 2 copies of mill test reports showing chemical and physical properties and other details of steel to be incorporated into work at least 2 weeks prior to fabrication of structural steel. Mill test reports shall be certified by metallurgists qualified to practice in British Columbia, Canada.
- .2 Fabricator of structural steel shall, in addition, provide an affidavit stating that materials and products used in fabrication conform to applicable material and products standards called for by design drawings and specifications.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Structural steel: to CAN/CSA-G40.21 Grade as indicated on drawings.
- .2 Anchor bolts: ASTM A307 unless noted otherwise on drawings.
- .3 Bolts, nuts and washers: to ASTM A 325.
- .4 Welding materials: to CSA W48 Series and CSA W59 and certified by Canadian Welding Bureau.
- .5 Shop primer: to CISC/CPMA 2-75.

2.2 FABRICATION

- .1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.
- .2 Welding shall be performed by certified welders. Fabrication shops shall be approved by the Canadian welding bureau to CSA-W47.1 (Division 1 or 2). Certification shall be supplied to the Departmental Representative upon request.
- .3 Unless noted otherwise, install all rolled steel sections with mill camber upwards.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.

2.3 SHOP PAINTING

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CSA-S16 except where members to be encased in concrete.
- .2 Clean all members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces in accordance to SP7 Brush Off Blast Cleaning for primer.
- .3 Apply one coat of CISC/CPMA 2-75 in shop to all steel surfaces to manufacturer's instructions, except:
 - .1 Surfaces to be encased in concrete.
 - .2 Surfaces and edges to be field welded.
- .4 Apply pain under cover on dry surfaces when surface and air temperatures are above 5°C.
- .5 Maintain dry condition and 5°C minimum temperature until paint is thoroughly dry.

PART 3 EXECUTION

3.1 GENERAL

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

3.2 MARKING

- .1 Mark materials in accordance with CAN/CSA G40.20/G40.21. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
- .2 Match marking: shop mark for fit and match.

3.3 ERECTION

- .1 Erect structural steel, as indicated and in accordance with CAN/CSA S16 and in accordance with reviewed erection drawings.
- .2 Field cutting or altering structural members: to approval of Departmental Representative.

- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.
- .5 Install and torque all bolts and drilled anchors in accordance with manufacturer's specifications and procedures.
- .6 Any misfit or misalignment must be reported to the Departmental Representative. The contractor shall provide proposed remedial measures to the Departmental Representative for review and approval. Any remedial work on connections must be reviewed and/or redesigned by the connection engineer. Costs of remedial work are at the expense of the contractor.
- .7 Do not notch or cut openings in any of the framing members and connection without prior approval from the Departmental Representative.
- .8 Provide temporary bracing to structure for stability and safety as required until the completion of the steel structure.

3.4 FIELD QUALITY CONTROL

- .1 The Departmental Representative will not be responsible for inspection of the Contractor's work as described in Clause 7.12 of the CISC Code of Standard Practice for Structural Steel. The Contractor is responsible for the accuracy and completeness of his own work and shall verify that the structural steel has been fabricated, erected and finished in accordance with the contract specifications.
- .2 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.
- .3 Testing requirements are as follows:
 - .1 Non-Destructive Testing of Welds: 100% of all welds to be visually inspected.
- .4 Welding inspector shall be certified to CSA W178.2 Level 2 or Level 3.
- .5 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.
- .6 Submit test reports to Departmental Representative within 1 week of completion of inspection.
- .7 Costs of tests shall be borne by the Contractor.

3.5 FIELD REPAIR

- .1 Touch up damaged surfaces and surfaces without shop coat with primer to SSPC SP7 except as specified otherwise. Apply in accordance with CGSB 85.10-99

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 269 08, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .3 ASTM A 307-07v, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM B 209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .5 ASTM B 221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
- .2 Canadian Standards Association (CSA):
 - .1 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.
 - .2 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA S16-09, Design of Steel Structures.
 - .4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .5 CSA W59-M03 (R2008), Welded Steel Construction (Metal Arc Welding) [Metric].
 - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .4 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual - current edition.
- .5 Green Seal Environmental Standard GS 03 (anti-corrosive primer).

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS in accordance with Section 00 73 19: Health and Safety Requirements
 - .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g / L.

- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia. Submit Letter of Assurance Schedule B1, B2 and C-B.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.3 QUALITY ASSURANCE

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

1.4 DELIVERY, STORAGE & HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 60 00: Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 19: Waste Management and Disposal.
- .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 74 19.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.
- .2 Welding materials: to CSA W59.
- .3 Welding electrodes: to CSA W48 Series.
- .4 Bolts and anchor bolts: to ASTM A 307.
- .5 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.
- .6 Aluminum: to ASTM B209, clear anodized finish.

- .7 Grout: non-shrink, non-metallic flowable, 15MPC at 24 hours.
- .8 Security fasteners: screws and bolts with spanner type heads to prevent removal except with special tools; non-corrosive type.
- .9 Shop coat primer: to CAN/CGSB-1.40M.
- .10 Galvanize touch-up primer: zinc rich, read mix to CGSB-1-GP-181M.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 610 g / m² to CAN/CSA-G164.
- .2 Shop coat primer: CGSB 1GP 40M in accordance with chemical component limits and restrictions requirements and VOC limits of GC-03. Prepare surface to an abrasive blast specification SSPC-SP10.
- .3 Zinc primer: To CGSB 1GP 48, CISC/CPMA 1-73A, CISC/CPMA 2-75 in accordance with chemical component limits and restrictions requirements and VOC limits of GC-03. Prepare surface to an abrasive blast SSPC-SP10.

2.4 ISOLATION COATING

- .1 Isolate 2 different metals 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 Primer: VOC limit 250 g / L maximum to GC-03.
- .2 Apply one shop coat of primer to metal items, with exception of aluminum, galvanized or concrete encased items.
- .3 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 °C.
- .4 Clean surfaces to be field welded; do not paint.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications 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.
 - .4 Contractor shall verify field measurements are as shown on shop drawings prior to fabrication.

3.2 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 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Weld field connection.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
 - .1 Primer: maximum VOC limit 250 g / L to GC-03.
 - .2 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
 - .3 Primer: maximum VOC limit 250 g / L to GC-03.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
 - .2 Clean in accordance with Section 01 74 13: Progress Cleaning.
- .2 Final Cleaning:
 - .1 Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Sections 01 74 13.

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

3.4 PROTECTION

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

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Structural floor, wall, parapet, and roof framing.
- .2 Preservative treatment of wood.
- .3 Fire retardant treatment of wood.
- .4 Miscellaneous framing.
- .5 Connection hardware.

1.2 RELATED SECTIONS

- .1 Section 06 16 00: Sheathing
- .2 Section 10 28 13: Washroom Accessories

1.3 REFERENCES

- .1 ASME B18.2.1-2012 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws.
- .2 ASME B18.6.1-1981 (R2016) - Wood Screws.
- .3 ASTM A153/A153M-16a - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .4 ASTM A307-14 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
- .5 ASTM A563-15 - Standard Specification for Carbon and Alloy Steel Nuts.
- .6 ASTM A653/A653M-15e1 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .7 ASTM A666-15 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
- .8 ASTM C954-15 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in (2.84 mm) in Thickness.
- .9 ASTM F1667-15 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .10 AWPA M4-15 - Standard for the Care of Preservative-Treated Wood Products.
- .11 CSA B111-1974 (R2003) - Wire Nails, Spikes and Staples.
- .12 CSA O80 Series-15 - Wood Preservation.
- .13 CSA O86-14 - Engineering Design in Wood.
- .14 CSA O141-05 (R2014) - Softwood Lumber.
- .15 ICC-ES ESR-1539 - Power-Driven Staples and Nails.
- .16 NLGA (National Lumber Grades Authority) - Standard Grading Rules for Canadian Lumber, 2014 Edition.
- .17 National Building Code of Canada 2015.

- .18 For Projects overseen by a Construction Manager or Design-Build Contractor in lieu of a General Contractor, references to "Contractor" shall apply to the relevant Subcontractor (s).

1.4 ACTION SUBMITTALS

- .1 Product Data:
- .1 For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - .2 Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - .3 For connectors, include installation instructions.
- .2 Submit one sample of each different type of wood member exposed to view, minimum 300 mm in size, illustrating wood grain, stain, and finish.

1.5 INFORMATIONAL SUBMITTALS

- .1 In lieu of grade stamping lumber exposed to view, submit manufacturer's certificate certifying that products meet or exceed specified requirements.
- .2 Provide letter outlining steps to be taken during construction to ensure adequate weather protection of wood structures.

1.6 QUALITY ASSURANCE

- .1 Perform Work in accordance with CSA O86. Lumber grading agency shall be certified by NLGA.
- .2 Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years of experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

- .1 Protect wood products from weather during transit to Project site.
- .2 Stack wood products flat with spacers beneath and between each bundle to provide air circulation.
- .3 Protect wood products from weather by covering with waterproof sheeting, securely anchored.
- .4 Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 DIMENSION LUMBER FRAMING

- .1 Lumber Grading Rules: NLGA. All softwood lumber shall conform to CSA O141 and CSA O86.

- .2 Factory mark each piece of lumber with grade stamp of grading agency. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
- .3 Deliver to site with certificates as to species, grades, stress grades, seasoning, moisture content, and other evidence as required to show compliance with the Specifications.
- .4 Maximum Moisture Content: 19% unless noted otherwise.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- .1 Wood Preservative (Pressure Treatment): CSA O80 Series.
- .2 Wood Preservative (Surface Application): CSA O80 Series treated by immersion (not by brush).
- .3 Material treated using oil-borne preservatives shall be subjected to a vacuum expansion bath at a treatment plant according to CSA O80 Series to produce a material that is free of excessive surface oil.
- .4 Material treated using water-borne preservatives shall have an average moisture content not exceeding 25% at 25 mm depth below the surface prior to preservative treatment.
- .5 Following treatment, dry material to maximum moisture content of 19% unless noted otherwise.
- .6 Identify preservative-treated wood with certification mark authorized by the Canadian Wood Preservers Bureau (CWPB).
- .7 Treat items only as indicated on the Drawings. Any fasteners in contact with treated wood must be hot-dip galvanized or stainless steel.

2.3 MISCELLANEOUS LUMBER

- .1 Provide miscellaneous lumber indicated and for support or attachment of other construction, including the following:
 - .1 Rooftop equipment bases and support curbs.
 - .2 Cants.
 - .3 Furring.
 - .4 Grounds.
- .2 For items of dimension lumber size, provide Construction or N^o 2 grade lumber of any species.
- .3 For blocking and nailers, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- .4 For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 FASTENERS

- .1 Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Where rough carpentry is exposed to weather (during or after construction), in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153 or of Type 304 stainless steel.

- .2 Nails, Spikes, and Staples: ASTM F1667.
- .3 Wood Screws: ASME B18.6.1 or as specified on the Drawings.
- .4 Lag Screws: ASME B18.2.1.
 - .1 All lag screws to be machined threaded, not cast threaded.
 - .2 Pre-drilled hole sizes in wood members for lag screws to be in accordance with CSA O86.
 - .3 Lag screws are acceptable only where specifically indicated on the Drawings. Do not substitute lag screws for self-tapping wood screws.
- .5 Screws for Fastening Sheathing to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- .6 Through Bolts and Anchor Bolts: ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers, hot dip galvanized to ASTM A153.

2.5 METAL FRAMING ANCHORS

- .1 Provide products with design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- .2 Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653, Z180 (G60) coating designation. Use for interior locations unless noted otherwise.
- .3 Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); Z550 (G185) coating designation; and not less than 0.91 mm thick. Use for wood-preserved-treated lumber and where indicated.
- .4 Stainless-Steel Sheet: ASTM A666, Type 304. Use for exterior locations and where indicated.
- .5 Steel Plate: CSA G40.20/G40.21, Grade 300W. Use where indicated.
- .6 Joist hangers, top flange hangers, post bases, joist ties, rafter tie-downs and hold downs: as indicated on the Drawings.

2.6 MISCELLANEOUS MATERIALS

- .1 Sill-Sealer Gaskets: Closed-cell foam, 6.4 mm thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- .2 Specialty and / or proprietary products shown on the Drawings have been selected and specified based on the manufacturer's representation. The Departmental Representative shall not become guarantor of the product. Install specialty products in strict conformance with the manufacturer's recommendations. Contractor is responsible for proper workmanship during installation.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Examine substrates in areas to receive wood framing, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

- .1 Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- .2 Comply with Part 9 of the National Building Code of Canada 2015 unless noted otherwise.
- .3 Provide temporary shores, guys, braces, and other supports during erection to keep wood framing secure, plumb, and in alignment against wind loads, seismic loads, temporary construction loads, and loads equal in intensity to design loads. Any failure to make proper and adequate provisions for stresses during erection shall be solely the responsibility of the Installer. Fasteners required for erection purposes are the responsibility of the Contractor and are to be included in the bid.
- .4 Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- .5 Install sill sealer gasket to form continuous seal between sill plates and foundation walls. At all other locations where wood framing abuts concrete or masonry construction, provide moisture barrier as indicated. Acceptable barriers include light gauge metal, asphalt-impregnated building paper, closed-cell foam gasket material, saturated felt roll roofing, or 0.1mm-thick polyethylene.
- .6 Do not splice structural members between supports unless noted otherwise.
- .7 Where Drawings indicate compression members consisting of multiple laminations, fasten laminations in accordance with CSA O86.
- .8 Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 400 mm o.c.
- .9 Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- .10 Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - .1 Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 2400 mm o.c. with solid wood blocking or non-combustible materials accurately fitted to close furred spaces.
 - .2 Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 2400 mm o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood

- blocks of same width as framing members and 50 mm nominal (38 mm actual) thickness.
- .3 Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 9.3 sq.m and to solidly fill space below partitions.
 - .4 Fire block concealed spaces behind combustible cornices and exterior trim at not more than 6000 mm o.c.
- .11 Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
 - .12 Comply with AWPA M4 and revisions specified in CSA O80 Series, Supplementary Requirements to AWPA M2 for applying field treatment to cut surfaces of preservative-treated lumber.
 - .1 Use inorganic boron for items that are continuously protected from liquid water.
 - .2 Use copper naphthenate for items not continuously protected from liquid water.
 - .3 Use two coats of specified preservative to all fresh cuts or holes.
 - .13 Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
 - .14 Securely attach to substrate by anchoring and fastening as indicated, complying with the following:
 - .1 ICC-ES ESR-1539 for power-driven fasteners.
 - .2 Table 9.23.3.4, "Nailing for Framing," in Part 9 of the National Building Code of Canada 2015.
 - .15 Use common steel wire nails unless noted otherwise. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless noted otherwise.
 - .16 Substitution of common nails with power-driven nails of the same length and diameter is acceptable. Substitution of power-driven nails of smaller diameter is permitted only with the Structural Departmental Representative's approval. Set nail gun pressure so that nail heads do not crush plywood surface; nail head penetration shall not exceed 2mm.
 - .17 For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
 - .1 Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
 - .2 Use finishing nails unless noted otherwise. Countersink nail heads and fill holes with wood filler.

3.3 WALL AND PARTITION FRAMING INSTALLATION

- .1 Provide single bottom plate and double top plates using members of 38mm actual thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing

partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs.

- .1 Fasten plates to supporting construction unless noted otherwise.
- .2 Provide continuous horizontal blocking at midheight of partitions more than 2400 mm high, using members of 38 mm actual thickness and of same width as wall or partitions.
- .2 Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- .3 Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - .1 For non-load-bearing partitions, provide double-jamb studs and headers not less than 89 mm actual depth for openings 1200 mm and less in width, 140 mm actual depth for openings 1200 mm to 1800 mm in width, 184 mm actual depth for openings 1800 mm to 3000 mm in width, and not less than 235 mm actual depth for openings 3000 mm to 3600 mm in width.
 - .2 For load-bearing walls, provide double-jamb studs for openings 1.5 m and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated or, if not indicated, according to Tables A-12 to A-16 in Part 9 of the National Building Code of Canada 2015.
- .4 Laminate studs solid beneath all beam ends and carry through to concrete foundation below. Unless noted otherwise, built-up studs shall match number of laminations in built-up member being supported. Fully block all joist spaces below point loads. Take care to ensure beams bear fully on supporting members.

3.4 FRAMING INSTALLATION

- .1 Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate, and nail to first joist or anchor with framing anchors or metal straps. Provide 19 mm x 184 mm or 38 mm x 89 mm actual size stringers spaced 1200 mm o.c. crosswise over main ceiling joists.
- .2 Notch rafters to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
 - .1 At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 50 mm deeper. Bevel ends of jack rafters for full bearing against valley rafters.
 - .2 At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 50 mm deeper. Bevel ends of jack rafters for full bearing against hip rafter.
- .3 Provide collar beams (ties) as indicated or, if not indicated, provide 19 mm x 140 mm actual size boards between every third pair of rafters, but not more than 1200 mm o.c. Locate

below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

- .4 Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.5 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

- .1 Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- .2 Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless noted otherwise.
- .3 Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 38 mm wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.6 WOOD FURRING INSTALLATION

- .1 Install furring as required, whether indicated or not, where services, piping, ductwork, and other items project or become visible through finished surfaces.
- .2 Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- .3 Where furring is to receive plywood or hardboard paneling, install 19 mm x 63 mm actual size furring horizontally and vertically at 600 mm o.c.
- .4 Where furring is to receive gypsum board or plaster lath, install 19 mm x 38 mm actual size furring vertically at 400 mm o.c.
- .5 Finish surface of furring to match surrounding materials.

3.7 ADDITIONAL ITEMS

- .1 Make allowance for, provide, and install items such as blocking, bracing, backing, infill pieces, fasteners, furring, grounds, shims, bucks, dowels, bolts, washers, and other hardware. Provide such additional items, whether indicated or not, as required for strength and against movement and deflection, as directed by the Structural Departmental Representative or Architectural Departmental Representative, and as required by the applicable building codes and bylaws.
- .2 No additional funds will be paid to the Contractor to provide such items to complete the Project as intended.

3.8 ERECTION TOLERANCES

- .1 For rectangular floor areas, the corner-to-corner diagonal measurements should not deviate from each other by more than 13 mm or 0.25% of the length of the shortest side of the rectangle, whichever is greater.
- .2 Posts:
 - .1 Plumbness: 0.25% of post height (1:400) maximum deviation from plumb.
 - .2 Position: plus or minus 10 mm from theoretical at base in both directions.

- .3 Walls:
 - .1 Plumbness: 0.25% of wall height (1:400) maximum deviation from plumb measured at any point along the wall.
 - .2 Position: plus or minus 10 mm from theoretical at base.
 - .3 Length: plus or minus 10 mm from theoretical.
 - .4 Stud Spacing: plus or minus 16 mm from specified.
- .4 Floors and Roofs:
 - .1 Overall Surface Levelness: 6 mm in 3 m maximum measured at any two points.
 - .2 Individual Joist Levelness: 6 mm in 3 m maximum.
 - .3 Elevation: plus or minus 10 mm from theoretical.
 - .4 Joist Spacing: plus or minus 16 mm from specified.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Floor, wall, parapet, and roof sheathing.
- .2 Preservative treatment of wood.
- .3 Fire retardant treatment of wood.
- .4 Miscellaneous sheathing.
- .5 Connection hardware.

1.2 RELATED SECTIONS

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 07 92 00: Joint Sealants

1.3 REFERENCES

- .1 APA AFG-01 – Adhesives for Field-Gluing Plywood to Wood Framing.
- .2 ASME B18.6.1-1981 (R2016) – Wood Screws.
- .3 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A153/A153M-16a – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .2 ASTM C954-15 – Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - .3 ASTM D2898-10 – Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
 - .4 ASTM D3201/D3201M-13 – Standard Test Method for Hygroscopic Properties of Fire-Retardant Wood and Wood-Based Products.
 - .5 ASTM D3498-03 (2011) – Standard Specification for Adhesives for Field Gluing Plywood to Lumber Framing for Floor Systems.
 - .6 ASTM D5516-09 – Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures.
 - .7 ASTM D6305-08 (2015) e1 – Standard Practice for Calculating Bending Strength Design Adjustment Factors for Fire-Retardant-Treated Plywood Roof Sheathing.
 - .8 ASTM E84-16 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .9 ASTM F1667-15 – Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .4 CANPLY (Canadian Plywood Association) – Grading and certification.
- .5 Canadian Standards Association (CSA):
 - .1 CSA O80 Series-08 (R2012) – Wood Preservation.
 - .2 CSA O86-14 – Engineering Design in Wood.

- .3 CSA O121-08 (R2013) – Douglas Fir Plywood.
- .6 ICC-ES ESR-1539 – Power-Driven Staples and Nails.
- .7 National Building Code of Canada 2015.
- .8 For Projects overseen by a Construction Manager or Design-Build Contractor in lieu of a General Contractor, references to “Contractor” shall apply to the relevant Subcontractor (s).

1.4 ACTION SUBMITTALS

- .1 Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - .1 Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include treatment manufacturer’s written instructions for handling, storing, installing, and finishing treated material.
 - .2 Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - .3 For fire-retardant treatments, include physical properties of treated sheathing both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
 - .4 For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - .5 For connectors, include installation instructions.

1.5 INFORMATIONAL SUBMITTALS

- .1 In lieu of grade stamping plywood exposed to view, submit manufacturer's certificate certifying that products meet or exceed specified requirements.
- .2 Provide letter outlining steps to be taken during construction to ensure adequate weather protection of wood structures.

1.6 QUALITY ASSURANCE

- .1 Perform Work in accordance with CSA O86. Plywood grading agency shall be certified by CANPLY.
- .2 Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years of experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

- .1 Protect panels from weather during transit to Project site.
- .2 Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect panels from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 SHEATHING

- .1 Wall and Parapet Sheathing: Douglas Fir plywood, sheathing grade (C-C), conforming to CSA O121. Thickness as indicated, not less than 13 mm. Interior wall sheathing to be G1S (A-C) for transparent finish.
- .2 Roof Sheathing: T&G Douglas Fir plywood, select grade (B-C), conforming to CSA O121. Thickness as indicated, not less than 13 mm. White water-based transparent stain finish.
- .3 Factory mark panels to indicate compliance with applicable standard.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- .1 Wood Preservative (Pressure Treatment): CSA O80 Series.
- .2 Wood Preservative (Surface Application): CSA O80 Series treated by immersion (not by brush).
- .3 Material treated using oil-borne preservatives shall be subjected to a vacuum expansion bath at a treatment plant according to CSA O80 Series to produce a material that is free of excessive surface oil.
- .4 Material treated using water-borne preservatives shall have an average moisture content not exceeding 25% at 25 mm depth below the surface prior to preservative treatment.
- .5 Following treatment, dry material to maximum moisture content of 19% unless noted otherwise.
- .6 Identify preservative-treated wood with certification mark authorized by the Canadian Wood Preservers Bureau (CWPB).
- .7 Treat items only as indicated on the Drawings. Any fasteners in contact with treated wood must be hot-dip galvanized or stainless steel.

2.3 FASTENERS

- .1 Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Where rough carpentry is exposed to weather (during or after construction), in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153 or of Type 304 stainless steel.
- .2 Nails, Spikes, and Staples: ASTM F1667.
- .3 Power-Driven Fasteners: ICC-ES ESR-1539.
- .4 Wood Screws: ASME B18.6.1 or as specified on the Drawings.
- .5 Screws for Fastening Sheathing to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

2.4 TRANSITION EDGE TRIM

- .1 Type "TR-2": metallic 'F' profile with anodized aluminum finish, model as appropriate to accommodate installation.
 - .1 Use this product to transition from interior plywood sheets to T&G ceiling.

- .2 An example of accepted product is "Reveal F" by Fry Reglet. Other products having the same characteristics will not be excluded.

2.5 MISCELLANEOUS MATERIALS

- .1 Provide miscellaneous sheathing indicated and for support or attachment of other construction.
- .2 Adhesives for Field Gluing Panels to Wood Framing: ASTM D3498 or APA AFG-01, approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
- .3 Specialty and / or proprietary products shown on the Drawings have been selected and specified based on the manufacturer's representation. The Departmental Representative shall not become guarantor of the product. Install specialty products in strict conformance with the manufacturer's recommendations. Contractor is responsible for proper workmanship during installation.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Examine substrates in areas to receive sheathing, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- .2 Cut panels at penetrations, edges, and other obstructions of work. Fit tightly against abutting construction unless noted otherwise.
- .3 Use common steel wire nails unless noted otherwise. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless noted otherwise.
- .4 Substitution of common nails with power-driven nails of the same length and diameter is acceptable. Substitution of power-driven nails of smaller diameter is permitted only with the Departmental Representative's approval. Set nail gun pressure so that nail heads do not crush plywood surface; nail head penetration shall not exceed 15% of plywood thickness.
- .5 For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
- .6 Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
- .7 Securely attach sheathing to substrate by anchoring and fastening as indicated.

- .8 Secure floor and roof sheathing with longer edge perpendicular to framing members and with end joints staggered and sheet ends over bearing. For sheathing over solid wood panels, locate sheathing joints away from gaps between panels.
- .9 Fully engage tongue and groove edges where applicable.
- .10 Secure wall sheathing to wall studs, with ends over firm bearing and staggered. Long dimension of sheathing may be parallel or perpendicular to wall studs.
- .11 Coordinate wall, parapet, and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- .12 Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the work day when rain is forecast.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 06 10 00: Rough Carpentry

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CSA O86-14, Engineering Design in Wood.
 - .2 CAN/CSA O80 Series-15 – Wood Preservation.
 - .3 CSA 0112.10-08 (R2013) – Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure)
 - .4 CSA 0112.9-10 (R2014) – Evaluation of adhesives for structural wood products (exterior exposure)
 - .5 CSA-G40.20-13/G40.21-13 – General requirements for rolled or welded structural quality steel / Structural quality steel.
 - .6 CAN/CSA-G164-M92 (withdrawn) – Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 QUALIFICATION OF MANUFACTURERS

- .1 Fabricator for steel connections to be certified in accordance with CSA W47.1.
- .2 Manufacturers of Engineered Wood products (Parallel Strand Lumber and Laminated Veneer Lumber) to be approved by Departmental Representative.

1.4 SHOP DRAWINGS

- .1 Submit shop and erection drawings in accordance with Section 01 33 00: Submittal Procedures.
 - .1 Indicate shop applied finishes, shop and erection details including cuts, holes, notches, fastenings and connection hardware.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Wrap Engineered Wood products with a moisture resistant wrapping prior to leaving the plant.
- .2 Supply Engineered Wood products in one solid piece to thickness and depth indicated on drawings.
- .3 Use padded, non-marring slings for handling Engineered Wood products members.
- .4 Protect corners with wood blocking.
- .5 Slit underside of membrane during storage on site.
- .6 Store Engineered Wood products blocked off ground and separated with stripping, so air may circulate around all faces of members.
- .7 Store wood I-Joists in a vertical position prior to installation and protect from weather.
- .8 Cover top and sides with opaque moisture resistant membrane if outside.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Engineered Wood products to meet the following factored design stresses (Limit States Design):

| Property | Parallel Strand Lumber Grade 2.2 E | Parallel Strand Lumber Grade 1.8 E | Laminated Veneer Lumber Grade 2.0 E |
|--|---------------------------------------|---------------------------------------|--|
| | Stress MPa / psi | Stress MPa / psi | Stress MPa / psi |
| Flexural Stress, f_b | 37.0 / 5,360 | 30.4 / 4,435 | 33.1 / 4,805 |
| Tension parallel to grain, f_t | 25.9 / 3,750 | 22.4 / 3,245 | 19.8 / 2,870 |
| Compression parallel to grain, f_c | 31.9 / 4,630 | 27.5 / 3,990 | 27.6 / 4,005 |
| Compression perpendicular to grain, f_{cp} | 7.83 / 1,135 | 5.34 / 775 | 9.41 / 1,365 |
| Horizontal shear parallel to grain, f_y | 3.72 / 540 | 2.45 / 355 | 3.65 / 530 |
| Modulus of elasticity, MOE | 15,200 / 2.2×10^6 | 12,400 / 1.8×10^6 | 13,800 / 2.0×10^6 |

- .2 Adhesive: To CSA 0112.
- .3 Steel for Connections: To CSA-G40.21-13.
- .4 Shop Coat Primer for Steel Connections: To CGSB 85.10-99, Protective Coatings for Metals.
- .5 Galvanizing: To CSA-G164-M92, hot dipped, minimum zinc coating of 600 g / m².
- .6 Sealer: Penetrating type, clear, non-yellowing liquid which will protect lumber against moisture entry during shipping and erection.
- .7 Preservative: Pressure treatment to CSA-080 applied in accordance with manufacturers instructions.

2.2 FABRICATION

- .1 Mark Engineered Wood products for identification during erection. Marks must be concealed in final assembly.
- .2 Apply sealer to all sides and ends of members.
- .3 Connections: Design by manufacturer in accordance with CSA-O86-14 and to Departmental Representative's approval except where connections are detailed on drawings.
- .4 Prime paint connections after fabrication.

PART 3 EXECUTION

3.1 ERECTION

- .1 Erect Engineered Wood members in accordance with reviewed shop drawings and in strict accordance with manufacturer's instructions.
- .2 Except where detailed otherwise on the drawings, provide lateral support at points of bearing to prevent lateral displacement and rotation. Provide erection bracing to maintain joists straight and plumb during erection and to ensure adequate lateral support for the entire system until the permanent sheathing material has been applied.
- .3 Brace and anchor materials until permanently secured by the structure.
- .4 Where members are framed into masonry or concrete, provide a minimum 12 mm air space at ends and sides of members.
- .5 Engineered Wood members supported on concrete shall be separated from the concrete surface with 0.05 mm polyethylene sheet or type S roll roofing.
- .6 Notching and drilling are not permitted without prior approval of Consultant.
- .7 Splice and joint only at locations indicated on reviewed shop drawings.
- .8 Engineered Wood lumber shall have a moisture content not exceeding 19% at time of installation.
- .9 Remove from site all damaged members. Repairs are not permitted.
- .10 Fit all members closely and accurately to all other members and other assemblies.
- .11 Field cutting and alteration of members is not permitted without Consultant's approval.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 05 50 00: Metal Fabrications
- .2 Section 06 10 00: Rough Carpentry
- .3 Section 06 41 16: Plastic Laminate
- .4 Section 09 90 00: Painting and Coating

1.2 REFERENCE STANDARDS

- .1 Do millwork to "custom" grade to Millwork Standards of the Architectural Woodwork Manufacturer's Association of Canada, latest edition.

1.3 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Shop Drawings:
 - .1 Clearly indicate details of construction, profiles, jointing, fastening and other related details.
 - .2 Submit shop drawings to all interfacing sections requiring coordination.
- .3 Samples:
 - .1 Submit duplicate 300 mm x 300 mm samples of each type of solid wood or veneer plywood to receive stain or transparent finish, in accordance with Section 01 33 00. Submit duplicate 600 mm long samples of each type of trim and moulding.

1.4 COORDINATION & VERIFICATION

- .1 Verify all dimensions and existing conditions on job site prior to all shop fabrication and work on site. Where major discrepancies occur, alert Consultant immediately.
- .2 Coordinate work of this section with that of wall, ceiling-framing, electrical and mechanical sections where millwork and trim interface with drywall partitions, ceiling suspension, plumbing, electrical outlets, etc.
- .3 It shall be the responsibility of this section to verify the dimensions and installation details for all Departmental Representative supplied equipment and furnishings requiring cut-outs, adaptations and interfacing with millwork items.

1.5 INSPECTION

- .1 Architectural woodwork shall be manufactured and installed to AWMAC Quality Standards ("Custom" Grade) and shall be subject to an inspection at the plant and/or site, by an appointed inspector approved by the M.M.A.B.C. (the B.C. Chapter of AWMAC). Such inspection costs shall be included in the tender price for this project. Shop drawings shall be submitted for review before any work is commenced. Where it is deemed necessary by the Consultant, a sample cabinet (consisting of a minimum of 1 drawer, 1 door, showing precisely the materials, hardware and the type of construction the manufacturer intends to use), shall be submitted for inspection.

- .2 Any work which does not meet AWMAC Quality Standards as specified, shall be replaced by this Trade Contractor at no additional cost to the Departmental Representative and to the satisfaction of the Consultant and the inspector.

1.6 GUARANTEE

- .1 This Trade Contractor shall furnish the Departmental Representative with a two (2) year M.M.A.B.C. (the B.C. Chapter of AWMAC) Guarantee Certificate or an equivalent maintenance bond, to the full value of the architectural woodwork sub-contract, certifying that the architectural woodwork supplied will be in accordance with the Standards incorporated in the AWMAC Quality Standards manual, latest edition.
- .2 The Guarantee shall cover replacing and refinishing to make good any defects in architectural woodwork due to faulty workmanship or defective materials supplied by this Trade Contractor, which appear during a two (2) year period following the substantial completion of the Project.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19: Waste Management and Disposal, the Waste Reduction Workplan and the Waste Management Plan to the maximum extent economically possible.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Softwood lumber: to C.S.A. 0141-1970 and National Lumber Grades Authority requirements, with maximum moisture content of 6% for interior applications as follows:
 - .1 Lumber selected for paint finish: Fir species to AWMAC Custom Grade.
- .2 Interior walls plywood: premium clear 16 mm birch plywood, sanded 1 side, for clear finish.
 - .1 Douglas Fir plywood: to C.S.A. 0121-M1978, good one side, sanded grade.
- .3 Wall base: hardwood plywood to match interior walls, sanded 1 side, for clear finish.
- .4 Millwork plywood: premium birch ply, sanded two sides, appearance grade for painting.
- .5 Nails and staples: to C.S.A. B111-1974, galvanized, typical.
- .6 Plastic Laminate: for flatwork, to CAN3-A172-M79, type general purpose, 1.5 mm thick based upon the following ranges: solid colour, woodgrain and metallic. Colour / Pattern as selected by the Architect.

2.2 CABINET HARDWARE

- .1 Hinges: high quality all metal concealed style for overlay door application.
- .2 Door and Drawer Locks: 22 mm ($\frac{7}{8}$ ") Pin Tumbler Drawer / Cabinet deadbolt Lock, 26D (Satin Chrome) finish, all keyed alike.
- .3 Door and Drawer Pulls: nom. 102 mm metal D-pull, 26D (Satin Chrome) finish.

- .4 Drawer Slides: full extension heavy-duty type, steel ball bearings, closed position hold-in, positive out-stop.
- .5 Slotted shelving equal to K&V:
 - .1 Tracks: heavy-duty steel double slot, 26D (Satin Chrome) finish.
 - .2 Brackets: heavy-duty double slot metal bracket, 26D (Satin Chrome) finish, lengths to not exceed depth of shelves.
- .6 All shelf pins shall be metal.

2.3 TRANSITION EDGE TRIM

- .1 Type "TR-2": metallic 'F' profile with anodized aluminum finish, model as appropriate to accommodate installation.
 - .1 Use this product to transition from interior plywood sheets to T&G ceiling.
 - .2 An example of accepted product is "Reveal F" by Fry Reglet. Other products having the same characteristics will not be excluded.

PART 3 EXECUTION

3.1 CABINETWORK

- .1 Cabinet doors shall be A.W.M.A.C. type overlay 19 mm thick, flush.
- .2 Set nails and screws, apply stained plain wood filled to indentations, sand smooth and leave ready to receive finish.
- .3 Install and adjust cabinet hardware for shelves, doors, and drawers. Recess shelf standards unless noted otherwise. Shelving to be adjustable unless otherwise noted.
- .4 Provide cut-outs for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures. Make allowances for all wiring required within cabinet units, and conceal where possible. Refer to Mechanical and Electrical Drawings.
- .5 All shelving shall be plywood (no MDF shelving), birch veneer where painted.
- .6 Fit painted shelves with hardwood edging.
- .7 Details are shown on drawings for appearance purposes only and are not intended to supersede these specifications for fabrication methods or grades of material. Submit details with shop drawings.
- .8 Unless otherwise indicated, interiors of cabinets, all surfaces of concealed shelving and insides of drawers (except front panels) shall be melamine or shop-painted as scheduled.
- .9 Veneer backing shall be MDF where possible, birch ply elsewhere. Veneering to AWMAC standards for "custom" grade. No veneer backing for Plastic Laminate doors as per AWMAC standards.

3.2 INTERIOR TRIM

- .1 Standing and running trim for transparent and painted finish shall be A.W.M.A.C. Custom Grade construction. Trim shall be as detailed.

3.3 INSTALLATION

- .1 Set and secure cabinetwork and finish carpentry items in place rigid, plumb and square.
- .2 Use purpose designed fixture attachments for wall mounted components.
- .3 Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units, counter tops, and shelving.
- .4 When necessary to cut and fit on site, make material with ample allowance for cutting. Provide trim for scribing and site cutting.
- .5 Fix cabinets and counter bases to floor using appropriate angles and anchorages.
- .6 Counter-sink all semi-concealed anchorage devices used to wall mount components and conceal with solid plugs of species to match surrounding wood. Place flush with surrounding surfaces.
- .7 Carefully scribe cabinetwork which is against other building materials, leaving gaps of 0.8 mm maximum. Do not use additional overlay trim for this purpose.
- .8 Install and adjust all cabinet hardware to ensure smooth and correct operation.
- .9 Site-install all computer wire grommets into millwork as directed by Departmental Representative and indicated on drawings.
- .10 Use proper exterior and interior panel adhesives for shop-bonding aluminum sheets to backing. Use proper pressing techniques to eliminate potential "telegraphing" and "oil canning".
- .11 Coordinate tile associated with millwork with Section 09 30 13: Ceramic Tiling.
- .12 Install all Departmental Representative-supplied equipment and components associated and interfaced with Finish Carpentry and Millwork.
- .13 Gently arise leading edge of MDF wall base. Mastic-apply.

3.4 FIRE RETARDANT TREATMENT (WHERE REQUIRED)

- .1 Treat wood material by pressure impregnation with fire resistive chemicals in accordance with CAN/CSA-080-M or ASTM D-2898 to provide a flame spread ration of less than 25.
- .2 Fire retardant treated wood to bear underwriter's label or be accompanied by a certificate in a form acceptable to the Consultant showing compliance.
- .3 Conform strictly to the manufacturer's directions for delivery, handling and storage of treated wood.
- .4 Use galvanized steel fasteners for fastening fire retardant treated wood products.

3.5 SCHEDULE OF FINISH CARPENTRY, MILLWORK ITEMS

- .1 Supply and install the following carpentry and millwork items as shown and detailed or as specified, complete with all anchors and fastenings required for a complete installation.
 - .1 Countertops, cabinets and drawers, shelving, desks, misc. trim, paneling, sills, installation of grilles and like items.
 - .2 Cabinet hardware, door hardware and finish components.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 06 20 00: Finish Carpentry and Millwork

1.2 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Samples:
 - .1 Submit duplicate samples of pattern / colours, joints, edging, cut-outs and post-formed profiles.
- .3 Maintenance Data:
 - .1 Provide maintenance data for plastic laminate work for incorporation into maintenance manual.

1.3 PRODUCT HANDLING

- .1 Cover finished laminated plastic surfaces with heavy kraft paper or put in cartons during shipment. Protect installed laminated surfaces by approved means. Do not remove until immediately before final inspection.
- .2 Do not store or install materials in areas where relative humidity is less than 25% or greater than 60% at 22 °C.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Laminated plastic for flatwork: to CAN3-A172-M79, Type general purpose, 1.5 mm thick based upon the following ranges: solid colour, patterned, woodgrain and metallic.
 - .1 Colours and patterns to be selected by Architect from manufacturer's standard palette:
 - .1 PL-1 – Speckled stone-like pattern – for kitchen countertop.
 - .1 An example of accepted product is “Formica Laminate” by Formica. Colour: 7735 – Portico Marble. Finish: 58 – Matte. Other products having the same characteristics will not be excluded.

- .2 PL-2 – Solid Medium Grey – for kitchen cabinets.
 - .1 An example of accepted product is “Formica Laminate” by Formica. Colour: 961 – Fog. Finish: 58 – Matte. Other products having the same characteristics will not be excluded.
- .2 Stone and composition solid surface related to millwork (“SS”):
 - .1 Not used.
- .3 Laminated plastic adhesive: recorcinol resin as recommended by laminated plastic manufacturer’s technical literature.
- .4 Draw bolts and splines: as recommended by AWI/AWMAC.

2.2 SHOP FABRICATION

- .1 Comply with CAN3-A172-M79 and AWI/AWMAC standards.
- .2 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .3 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .4 Veneer laminated plastic to core material in accordance with adhesive manufacturer’s instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 8’-0”. Keep joints 8 in. from sink cut-outs.
- .5 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degree. Do not mitre laminate edges.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Conform to all requirements of AWI/AWMAC for “Custom Grade” laminate work.
- .2 Veneer laminated plastic to core material in accordance with adhesive manufacturer’s instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 8’-0”.
- .3 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges. Install work, plumb, true and square, neatly scribed adjoining surfaces.
- .4 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.
- .5 Provide cutouts for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.
- .6 At junction of laminated plastic counter adjacent wall finish, apply small bead of sealant.

- .7 Site apply laminated plastic to units as indicated. Adhere laminated plastic over entire surface. Make corners with hairline joints. Use full sized laminate sheets. Make joints only where indicated or approved. Slightly bevel arises.
- .8 For site application, offset joints in plastic laminate facing from joints in core.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Proprietary plastic moisture barrier system below concrete slab on grade.
- .2 Benonite sub-grade geotextile waterproofing system.

1.2 RELATED WORK

- .1 Section 07 21 20: Building Insulation
- .2 Section 07 27 13: Exterior Wall Membranes

1.3 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product Data Sheets:
 - .1 Submit manufacturer's product data sheets for products proposed for use in the work of this section.
- .3 Samples:
 - .1 Submit sample of proposed products for review by Consultant.

PART 2 PRODUCTS

2.1 MOISTURE BARRIER-MEMBRANE-SLABS

- .1 Membrane Material:
 - .1 Permeance, as tested after conditioning: 0.6 ng (Pa • s • m²) (0.01 perms (gm / ft² / in-Hg)) to ASTM E1745-09 paragraphs 7.1.2 through 7.1.5.
- .2 Strength: Class A to ASTM E1745-09.
- .3 Thickness of plastic: 0.25 mm (10 mils) minimum.
- .4 Moisture barrier membrane joint tape:
 - .1 Description: High density polyethylene tape, pressure sensitive, 100 mm wide, product as per vapour barrier membrane manufacturer's installation instructions.
- .5 Penetration flashing:
 - .1 Vapour barrier membrane material and vapour barrier joint tape in accordance with manufacturer's instructions.
- .6 Acceptable Products:
 - .1 W.R. Meadows 'PERMINATOR', thickness specified above.
 - .2 Stego Industries 'Stego-Wrap', thickness specified above.
 - .3 Or approved equal.

2.2 BENTONITE GEOTEXTILE WATERPROOFING

- .1 Should encountered sub-grade conditions warrant or where directed by Geotechnical Consultant: Waterproof below-grade walls and under slab of elevator pit with Bentonite Geotextile Waterproofing System composed of high strength geotextile fabric encapsulating 1.10 pounds of sodium Bentonite per square foot and an integrally bonded polyethylene liner.
- .2 System shall conform to the following table of properties:

| Property | Test Method | Typical Value |
|---------------------------------|-------------------|--|
| Bentonite Mass Per Unit Area | ASTM D3776 (mod.) | 1.10 lbs. / sq.ft |
| Peel Adhesion to Concrete | ASTM D903 (mod.) | 15 lbs/in (2.6 kN / m min) |
| Hydrostatic Pressure Resistance | ASTM D5385 (mod.) | 231 ft (70 m) |
| Permeability | ASTM D5084 | 1x10 ⁻¹⁰ cm / sec |
| Grab Tensile Strength | ASTM D4632 | 120 lbs (530 N) |
| Puncture Resistance | ASTM D4833 | 140 lbs (620 N) |
| Low Temperature Flexibility | ASTM D1970 | Unaffected @ -25 °F (-32 °C) |
| Water Vapour Transmission Rate | ASTM E96 | 0.03 grains per hour / ft ² |

- .3 Provide system complete with all associated accessory products including sealants, joint waterstops, tapes and detailing agents; all products of the primary waterproofing system manufacturer.
- .4 Accepted products:
 - .1 "Voltex DS" Geotextile Waterproofing System, "Bentoseal", "Hydrobar Tubes", "Waterstoppage", "TB-Boot" and "Cet Seal" seam tape all as manufactured by Cetco Building Materials Group.
 - .2 Other products having the same characteristics will not be excluded.

PART 3 EXECUTION

3.1 UNDER-SLAB MOISTURE BARRIER INSTALLATION

- .1 Place under all new interior concrete slabs on grade (over rigid insulation) where present.
- .2 Level gravel base, place rigid insulation and take care to avoid damaging membrane when laying reinforcing and concrete.

- .3 Place screeds to require a minimum number of perforations.
- .4 Install moisture barrier membrane in accordance with manufacturer's instructions and ASTM E1643-09.
- .5 Install moisture barrier membrane using largest practical sheet size to minimize joints over compacted fill.
- .6 Inspect vapour barrier membrane sheets for continuity. Repair punctures and tears in vapour barrier membrane with sealing tape before work is concealed.
- .7 Moisture barrier membrane installation shall be continuous and vapour tight.
- .8 Overlap moisture barrier membrane joints 200 mm minimum and tape seal with vapour barrier joint tape.
- .9 Unroll membrane with longest dimension parallel with direction of concrete placement.
- .10 Lap membrane up foundation walls and column footings a minimum of 100 mm and tape seal with vapour barrier joint tape.
 - .1 Keep area of tape adhesion free of dust, dirt, and moisture.
- .11 Centre joint tape over membrane laps and joints.
 - .1 Keep area of tape adhesion free of dust, dirt, and moisture.
- .12 Cut slit around pipes, ductwork, rebar, and wire penetrations to place the initial layer of moisture barrier membrane. Protect the concrete slab from external moisture sources vapour barrier membrane and place a collar around this as well.
 - .1 Cut a piece of membrane minimum width of 300 mm. The length should be 1-½ times the pipe circumference. With a roofer's knife or scissors, cut "fingers" half the width of the film.
 - .2 Wrap membrane around and tape the collar onto the pipe and completely tape fingers to the bottom layer of vapour barrier membrane with vapour barrier joint tape.
- .13 In the event that moisture membrane is damaged during or after installation, repairs shall be made:
 - .1 Cut a piece of membrane large enough to cover damage by minimum overlap of 150 mm.
 - .2 Clean adhesion areas of dust, dirt, and moisture.
 - .3 Tape down edges using vapour barrier joint tape.

3.2 BENTONITE GEOTEXTILE WATERPROOFING SYSTEM INSTALLATION

- .1 Install bentonite waterproofing system in strict accordance with manufacturer's printed instructions.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Wall cavity thermal insulation.
- .2 Rigid thermal insulation.
- .3 Concrete Faced Insulated Wall Panels (perimeter skirt).
- .4 Fiberglass roof framing thermal spacers.

1.2 RELATED WORK

- .1 Section 01 45 00: Quality Control
- .2 Section 07 21 29: Sprayed Thermal Insulation
- .3 Section 07 27 13: Exterior Wall Membrane
- .4 Section 07 41 13: Metal Roof Panels
- .5 Section 07 42 44: Phenolic Wall Panels

1.3 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Samples:
 - .1 Submit representative samples of each specified insulation material, insulation clips, adhesives, fasteners, tapes and other material for review.
- .3 Manufacturer's Product Data:
 - .1 Submit manufacturer's product data sheets for products proposed for use in the work of this section.
 - .2 Submit data and installation instructions for materials and prefabricated devices, providing descriptions sufficient for identification at the site.
 - .3 Submit data from manufacturer's or independent laboratory indicating compatibility and adhesive results of proposed materials.

1.4 REFERENCE STANDARDS

- .1 Model National Energy Code for Buildings (NECB):
 - .1 Wall and grade slab assemblies to NECB 2015.

PART 2 PRODUCTS

2.1 THERMAL BATT INSULATION FOR WOOD STUDS AND FRAMING

- .1 Friction-fit mineral wool fibre blankets, made from basalt rock and slag, thickness as noted on drawings, width-sized to fit wood studs and framing at 400 mm o.c. (or as otherwise indicated) and possessing the following characteristics:

- .1 CAN/ULC-S702-97: Thermal Insulation Mineral Fibre for Buildings; Type 1 Complies.
- .2 CAN4-S114: Determination of Non-Combustibility; Non-Combustible.
- .3 CAN/ULC S102: Surface Burning Characteristics; Flame Spread = 0; Smoke Developed = 0
- .4 CCM Evaluation Listing: MasterFormat 07210 Mineral Fibre Batt Insulation 12018-L
- .5 Density: (32 kg / m³) meets NBC/ULC Standards of CAN/ULC-S702-97
 4.8 kg / m² @ 150mm
 2.8 kg / m² @ 89mm
 2.0 kg / m² @ 65mm
- .2 Thermal resistance rating: as indicated on drawings.

2.2 RIGID THERMAL INSULATION

- .1 Extruded polystyrene insulation panels, purpose made for scheduled use including below floor panels and roof panel insulation, conforming to CAN/ULC-S701 Type 4, ship lapped edges, and meeting the values of the following table of properties:

| Property and Test Method | Value |
|--|------------------------|
| Thermal Resistance per 25 mm ASTM C518 @ 24 °C mean Temp., m ² • °C / W min., R-value (RSI) | 5.0 (.87) |
| Compressive Strength ⁽¹⁾ , ASTM D1621, kPa, min. | 210 |
| Water Absorption, ASTM D2842, % by volume, max. | <0.7 |
| Water Vapour Permeance, ASTM E96, perm (ng / Pa • s • m ²) | 0.9 (50) |
| Maximum Use Temperature °C | 74 |
| Coefficient of Linear Thermal Expansion, ASTM D696, mm / m •°C | 6.3 x 10 ⁻² |

- .2 Concrete Faced Insulated Wall Panels (perimeter skirt)
 - .1 Latex modified concrete facing, bonded to 50 mm rigid polystyrene foam insulation backing, with related flashings and accessory components, conforming to:
 - .1 CAN/ULC-S701, Standard for Thermal Insulations, Polystyrene, Boards and Pipe Covering.
 - .2 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

| Property and Test Method | Value |
|---|-----------|
| Thermal Resistance per 25 mm ASTM C518, R-value (RSI) | 5.0 (.87) |

| | |
|---|----------|
| Compressive Strength ⁽¹⁾ , ASTM D1621, kPa, min. | 240 |
| Water Absorption, ASTM D2842, % by volume, max. | <0.7 |
| Water Vapour Permeance, ASTM E96, perm | 0.8 (50) |

2.3 FIBREGLASS ROOF FRAMING THERMAL SPACERS

- .1 Thermal spacers for fastening roof sheathing to T.&G. decking shall be installed in the rigid insulation space.
- .2 Spacers shall be 100% pultruded glass fibre and thermoset polyester resin, height dimension to hatch thickness of rigid insulation.
- .3 Sizes, type and spacing of fasteners and attachment devices associated with the thermal spacer assembly shall be in strict accordance with reviewed shop/erection drawings as sealed by the Roof Panel Speciality Engineer, and of material which will minimize thermal bridging.

PART 3 EXECUTION

3.1 BATT INSULATION INSTALLATION

- .1 Install insulation, in thicknesses as indicated, in such manner as to maintain continuity of thermal protection to building elements and spaces. Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .2 Do not compress insulation to fit into spaces.
- .3 Overlap thermal insulation sufficiently to maintain continuity.
- .4 Loose-fill all exterior hollow metal door frames with thermal batt insulation.

3.2 RIGID INSULATION

- .1 Shop-install rigid insulation, as detailed in wall and floor assemblies.
- .2 Coordinate rigid roof insulation with spacing of fiberglass thermal spacers.

3.3 CONCRETE FACED INSULATED WALL PANELS

- .1 Install per architectural details and manufacturer's recommendations.
- .2 Dado corner joints to conceal insulation.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 All materials, labour, equipment and services required for the manufacture and installation of spray-applied polyurethane combination thermal insulation/air barrier system to building envelope elements where indicated, detailed and required.

1.2 RELATED SECTIONS

- .1 Section 00 73 19: Health and Safety Requirements
- .2 Section 01 35 43: Environmental Procedures
- .3 Section 07 21 00: Building Insulation
- .4 Section 07 27 13: Exterior Wall Membranes

1.3 REFERENCES

- .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC) (latest editions):
 - .1 CAN-ULC-S705.1-98: Standard regarding rigid polyurethane foam spray thermal insulation, intermediate density – materials specifications.
 - .2 CAN-ULC-S705.2-98: Standard regarding rigid polyurethane foam spray thermal insulation, intermediate density – installer responsibilities.
- .3 Publications of the Canadian Urethane Foam Contractor Association (CUFCA).
- .4 National Building Code of Canada (NBCC) 2015.
- .5 Model National Energy Code for Buildings (NECB):
 - .1 Wall and grade slab assemblies to NECB 2017.

1.4 SUBMITTALS

- .1 Submit in compliance with Section 01 33 00: Submittal Procedures, the results of all tests conducted in order to verify if the quality of the insulation material is equal or superior to the requirements outlined in this section.
- .2 Submit the results of all CCMC air barrier systems tests approved according to the CCMC's Technical Manual #07272 conducted in order to prove that the air barrier system meets National Building Code (2010) requirements.
- .3 Product Data Sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.

1.5 MOCK-UPS

- .1 Create samples that are in compliance with Section 01 33 00.
- .2 Create a sample of 5 m² minimum, showing both inner and outer corners. This sample may be part of the completed structure.

- .3 Using the polyurethane foam insulation sample that was sprayed in place, the following trials must be conducted on site, as required by the Canadian Urethane Foam Contractor Association (CUFCA):
 - .1 Verify core density.
 - .2 Verify adhesion between any transition membranes and the substrate.
 - .3 Verify cohesion/adhesion between the insulation material and the substrate.
 - .4 Ensure results are in compliance and enter them in the CUFCA daily report.

1.6 PROTECTIVE MEASURES

- .1 Ensure the work area is adequately ventilated, in compliance with requirements set out in Section 01 35 43 as well as WCB and WHMIS regulations.
- .2 Ensure continuous ventilation of the work area, through a fresh air intake and the extraction of foul air, during the course of the application process and for 24 hours thereafter.
- .3 Install temporary partitions in order to prevent any effect on the ambient air – outside of the work area – from the sprayed-on insulation material.
- .4 Ensure all structures are well protected, in accordance with the manufacturer's recommendations.
- .5 Protect all adjacent surfaces and equipment against any damage that may be caused by dispersion and overspray of insulation material beyond prescribed limits.
- .6 All remaining foam particles must be flushed out of the spray gun on a daily basis. This procedure must be performed in areas designated for this purpose, and the contents of the empty containers neutralized accordingly to the procedure established by the CUFCA and other authorities having jurisdiction.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Ensure that application equipment and packaged material can be accommodated by helicopter if site-applied.
- .2 All materials shall be delivered and stored in their original packaging bearing the manufacturer's name, quantity, CCMC numbers, and other appropriate technical indicators or references. The expiry date must also appear on the containers.
- .3 Store materials above ground, in a dry location, protected from weather, moisture and areas of high humidity. Damaged packages found unsuitable for use will be rejected and removed from the project.

1.8 QUALITY ASSURANCE

- .1 The insulating material shall be applied by a company and personnel who are certified by the material manufacturer and CUFCA or the National Energy Conservation Association (NECA). These certified individuals must have their certification cards in their possession and available for presentation upon request.
- .2 Copies of the material manufacturer's and CUFCA installation manuals for the application of sprayed on polyurethane foam shall be kept on site.
- .3 Tests shall be conducted daily on both core density and cohesion/adhesion to the substrate, following procedures established by CUFCA/NECA. The results of these tests shall be entered in the daily report forms provided by CUFCA/NECA.

- .4 Adhesion tests shall be conducted on all corners, as well as the wall/slab intersections. Do one test on every wall that is less than 30 meters in length.
- .5 Verify the adhesion of any transition self-adhesive membranes at the perimeters of all openings.
- .6 Access to the jobsite by any material manufacturer's or CUFCA/NECA representative shall be permitted for the purposes of technical assistance or verifying operator certification or the quality of the polyurethane foam application.

1.9 ENVIRONMENTAL CONDITIONS

- .1 Only spray the insulating material if the surface and ambient air temperatures are within the manufacturer's prescribed limits. i.e., -10 °C to +40 °C.
- .2 Surfaces to be covered with polyurethane foam must be clean and dry, as required by CAN/ULC-S705.2. Since adhesion of the polyurethane foam is of the utmost importance, the substrate must be free of all frost, dust, oil, grease, oxidization, or any other element that may affect this property, nor should it present a high moisture content.
- .3 Metallic surfaces shall be checked to ensure no oxidization has occurred. Use of a primer is strongly recommended. Refer to the CUFCA manual.

1.10 PERFORMANCE REQUIREMENTS

- .1 Long Term Thermal Resistance LTTR: Tested by an independent laboratory in accordance with CAN/ULC S770-03 and achieving the following minimum values at a minimum core density of 28.34 kg / m³ (1.77 lb / ft³):
 - RSI 0.91 per 25 mm @ 50 mm.
 - RSI 0.95 per 25 mm @ 75 mm.
 - RSI 0.98 per 25 mm @ 100 mm.
- .2 Aged R-values based on test methods other than LTTR or at densities lower than specified will not be accepted.
- .3 LTTR-values shall be based on density not less than minimum insitu density.
- .4 Core density shall be confirmed by field testing.

1.11 COORDINATION

- .1 Coordinate the work of this section with all interfacing sections, especially Section 07 27 13.
- .2 Coordinate with related work to allow for installation of required materials prior to spray insulation. Perform sprayed foam installation to ensure an un-interrupted and complete thermal and air barrier installation.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Insulation: a spray polyurethane foam listed under CAN.ULC-S705.1, with CCMC #12840-R for insulation and CCMC #1232-R for the air barrier system, according to CCMC technical manual #07272, with the following physical properties:
 - .1 Density (ASTM D-1622) = 30.4 kg / m³, minimum Thermal resistance approved by the standard.
 - .2 Dimensional stability (ASTM D-2126), % volume change after 28 days: - 0.047% at -20 °C, 8.45% at +100 °C, 7.64% at +70 °C with relative humidity > 90 ± 3%.
 - .3 Flame spread classification (CAN.ULC-S102, including S127) = 375.
 - .4 Compressive strength (ASTM D-1621), 10% parallel to rise = 222 kPa.
 - .5 Tensile strength (ASTM D-1623) = 337 kPa.
 - .6 Open cell content (ASTM D-2856) = <1%.
 - .7 Water absorption (ASTM D-2842) by volume = 2.5%.
 - .8 Water vapour permeance (ASTM E-96) = 125 ng / Pa • s • m².
 - .9 VOC during curing: Below detectable limit after 24 hours or during curing.
- .2 Primers: as recommended in the CIFCA/NECA Technical Manual, taking into account the type and condition of work surfaces.

2.2 COMPATIBILITY

- .1 Ensure that materials used are compatible with all interfacing materials. Obtain confirmation from sprayed foam insulation manufacturer.
- .2 Provide written proof of compatibility.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Shop-apply to pre-fabricated wall panels as detailed.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Follow the manufacturer's written instructions when spraying the polyurethane foam. Refer to manufacturer's technical product documentation, application guide section.
- .2 The manufacturer's recommendations shall be followed with regard to outside air temperature and substrate conditions (refer to manufacturer's data).
- .3 Spraying shall be done using a positive displacement pump with preset ratios specially designed for use with rigid polyurethane foam. Follow the directions for use and the cleaning and maintenance procedures set out in the equipment manufacturer's manual.

3.3 EXAMINATION

- .1 Verify existing conditions before commencing work.
- .2 Verify that substrate is free of any foreign material that will impede application.

- .3 Verify that other work on and within spaces to be insulated is complete prior to application.
- .4 Notify Departmental Representative of conditions that would adversely affect the application.
- .5 Commencement of installation implies applicator accepts existing conditions.

3.4 PREPARATION

- .1 Comply with manufacturer's written installation instructions for preparing substrates indicated to receive sprayed insulation.
- .2 Mask and protect adjacent surfaces from overspray or damage.
- .3 Remove foreign materials, dirt, grease, oil, paint, laitance, efflorescence, and other substances that will affect application.

3.5 APPLICATION

- .1 Shop-apply insulation to building envelope elements where indicated on drawings and reasonably required.
- .2 Spray the foam in consecutive layers of no less than 12.5 mm and no more than 50 mm thick each, for a total thickness as indicated on drawings.
- .3 Cover all excessively wide joints prior to application of polyurethane foam insulation.
- .4 Spray apply polyurethane foam with a tolerance of +6/-0 mm in relation to the specified thickness.
- .5 When spraying polyurethane foam, avoid the formation of sub-layer air pockets.
- .6 Avoid spraying the foam on any surfaces other than those indicated. Use dropsheets or masking tape to protect other surfaces.
- .7 Once the foam has hardened, remove all overspray from non-prescribed surfaces while at the same time taking care not to damage them.
- .8 Do not allow polyurethane foam, once applied, to be damaged during work by other trades, unless prior agreement has been reached.
- .9 Ensure the subsequent coverage of the applied insulating foam will be completed within the manufacturer's prescribed time frame. Refer to manufacturer's technical product documentation.
- .10 Spray apply the polyurethane foam in overlapping layers, so as to obtain a smooth, uniform surfaces.
- .11 In cold weather when applying on a flat surface of more than 15 linear meters in either direction, apply the first layer in 3 meter strips at 1 meter intervals. After the curing period (\pm 4 hours) has elapsed, spray the polyurethane foam on the unfilled spaces.
- .12 Do not spray polyurethane foam any closer than 75 mm from chimneys, heating vents, steam pipes, recessed lighting fixtures, and other heat sources. Do not spray the insides of any exit openings or electrical junction boxes (refer to the CUFCA/NECA manual).
- .13 Cover all mechanical fixtures and electrical boxes with polyurethane foam in order to reduce thermal bridging.
- .14 Completely fill voids between metal stud flanges and exterior concrete walls with sprayed thermal insulation.

- .15 Leave sprayed thermal insulation ready for covering with drywall at walls and sprayed fire resistive crust at soffits.

3.6 FIELD QUALITY CONTROL

- .1 Inspect application for insulation thickness and density. Rectify deficiencies.

3.7 PROTECTION AND CLEANING

- .1 Do not permit subsequent work to disturb applied insulation.
- .2 As work proceeds and on completion, clean up and remove from the premises all rubbish and surplus materials resulting from this work.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Sheet-applied self-adhered vapour permeable combination air / vapour barrier sheathing membrane at rain screen cavity assemblies.
- .2 Sheet-applied self-adhered non-vapour permeable flashing/transition membrane.
- .3 Sheet-applied self-adhered foil-faced membrane flashing required to provide continuity detailing at interruptions in wall envelope at aluminum fenestration.
- .4 Liquid-applied flashing membrane as a wall penetration and detailing sealant.

1.2 RELATED WORK

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 07 11 00: Dampproofing
- .3 Section 07 62 00: Sheetmetal Flashing and Trim
- .4 Section 08 11 00: Steel Doors and Frames

1.3 QUALITY ASSURANCE

- .1 Qualifications: Work of this section shall be executed by competent installers with minimum 5 years experience in application of products, systems and assemblies specified and with approval and training of product manufacturer.
- .2 Conduct quality control in accordance with Section 01 45 00: Quality Control.
- .3 All sealants, primers, mastics and adhesives associated with the sheathing membrane shall be products of said sheathing membrane manufacturer.

1.4 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product data sheets:
 - .1 Submit manufacturer's product data sheets for products proposed for use in the work of this section.
- .3 Mock-up:
 - .1 Construct minimum 100 ft² area of wall assembly if requested.
 - .2 Locate at the place of work as part of final installation. Space installation to include exterior wall panel incorporating window, glazing system and installation.
 - .3 Do not proceed until mock-up has been reviewed by the Consultant.
- .4 Samples:
 - .1 At the Consultant's request, samples of materials shall be submitted for approval, prior to commencing work concerned.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store all materials in their original packaging in undamaged condition, sealed with labels intact, having manufacturer's name, brand, weight, CSA and other references to accepted standards clearly shown.

- .2 Make all necessary arrangements with regard to delivery and storage on the site with the Departmental Representative and schedule deliveries accordingly. In general, deliver material as required for installation and keep site storage to a minimum.
- .3 Provide all plant and equipment necessary for off-loading of materials to complete the work of this section.
- .4 Protect materials from damage, weather and store in a dry place.
- .5 Handle materials and equipment in strict accordance with manufacturer's recommendations. Damaged or deteriorated materials shall be removed from premises.

1.6 JOB CONDITIONS

- .1 Conform to membrane manufacturer's requirements for minimum application temperatures and humidity. Check surfaces and areas specified and shown to receive membrane.
- .2 Report any unsatisfactory conditions and/or surfaces to the Consultant in writing. Starting work shall imply acceptance of surfaces and conditions.
- .3 Take all necessary measurements and levels at the building. The work shall be laid out to accurately fit the conditions at the building and with adjacent work.
- .4 Notify the Consultant of any variations beyond the accepted tolerances in the substrate or in the adjacent work, including membrane roofing.
- .5 Provide forced air circulation during curing period for enclosed applications.
- .6 Low temperature application:
 - .1 Perform adhesion test for membrane when ambient temperature is below -5 °C. Sheathing membrane manufacturer must produce both "summer" and "winter" (low temp.) grades.
 - .2 Proceed with work when temperature is (or predicted) to fall below -5°C ambient temperature only with the mutual documented agreement of inspection and testing company, manufacturer and applicator.
- .7 Do not perform installation during rainy or inclement weather or on wet or frost covered surfaces.
- .8 Provide temporary protection of the applied membrane to prevent mechanical damage or damage from spillage of oil or solvents.

1.7 PERFORMANCE REQUIREMENTS

- .1 Sheathing membrane system shall perform as a continuous air barrier and liquid water drainage plane flashed to discharge incidental condensation or water penetration to the exterior of the building envelope while allowing vapour within the wall to escape to the exterior.
- .2 The vapour impermeable membrane system is employed as a transition membrane between envelope components and other membranes and waterproofing systems. Ensure compatibility between systems.
- .3 The foil-faced membrane flashing shall perform as a detailing flashing by providing continuity at interruptions in sheathing systems at openings such as windows, doors and louvers.

- .4 All self-adhered membrane systems shall accommodate substrate movement, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding the specified limits and requirements, or interruption in the drainage plane.
- .5 Self-adhered membrane systems shall be joined in a weathertight and flexible manner to air barrier material of adjacent building envelope systems, employing transition membrane, allowing for relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between the following unless otherwise applicable:
 - .1 Foundation and walls.
 - .2 Walls and openings (windows, doors, louvers, and other wall penetrations).
 - .3 Different wall systems.
 - .4 Wall and roof.
 - .5 Wall and roof over non-climate-controlled space.
 - .6 Walls, floor and roof across construction, control, and expansion joints.
 - .7 Walls, floors and roof to utility, pipe and duct penetrations.
- .6 Provide temporary protection of the applied membrane to prevent mechanical damage or damage from spillage of oil or solvents.

PART 2 PRODUCTS

2.1 SELF-ADHERED SHEATHING MEMBRANE (VAPOUR PERMEABLE)

- .1 Description: Self-adhering vapour permeable air barrier membrane composed of triple layer laminated polypropylene facers and underside of self-adhering material covered with a silicone release film.
- .2 Thickness: 0.6 mm (24 mil) for 2 in. minimum side laps and 3 in. minimum end laps.
- .3 Physical properties as follows:

| Property | Standard | Value |
|--|--------------------------|--------------------------|
| Tensile strength, MD/XD | ASTM D882 | 5.95 kN/m / 3.65 kN/m |
| Tear resistance, MD/XD | CAN/CGSB 51.33-M89 | 64 N / 54 N |
| Water vapour permeance | ASTM E96-B ASTM E96-A | 8.7 perm 7.6 perm |
| Cold bending at -30 °C (-22 °F) Initial Ageing as per CGSB 51.32, 25 cycles | CAN/CGSB 51.33-M89 | No cracking |
| Dimensional stability at 85 °C (185 °F), MD/XD | ASTM D1204 | -0.45 / 0.11% |

| | | |
|--|---------------------|--------------------------------|
| Plywood adhesion | ASTM D3330 | 356 N / m |
| Lap joint strength | ASTM D1876 | 300 N / m |
| Adhesion after elevated temperature exposure AAMA 711-05, level 3, 7 days @ 80°C (176°F) | ASTM D3330 | 1200 N / m |
| Air permeance @ 75 Pa | ASTM E2178 | 0.0025 L / m ² • s* |
| Nail sealability | ASTM D1970 modified | Must Pass |

- .4 Acceptable product: “Soprseal Stick VP” by Soprema Waterproofing.

2.2 SELF-ADHERED FLASHING/TRANSITION MEMBRANE (NON-PERMEABLE)

- .1 Description: Self-adhering modified bituminous non-permeable membrane system consisting of SBS modified bitumen and a tri-laminated woven polyethylene facer. The underface shall be covered with a silicone release paper or film. Membrane shall be available in “summer” and “winter” grades and shall comply with the following physical properties:
- .1 Thickness: 1.0 mm (40 mils) minimum.
 - .2 Application temperature: as per manufacturer’s printed installation instructions.
 - .3 Min. tensile strength to ASTM D5147: 11.3/15.4 kN / m (64/88 lb / in).
 - .4 Min. tensile strength to ASTM D412: 11.2/31.1 MPa.
 - .5 Static puncture: 400 N (90 lb) to ASTM D5602; 747 N (168 lb) to ASTM E154.
- .2 Primer: as manufactured by membrane manufacturer specifically for membrane.
- .3 Termination mastic: as recommended by membrane manufacturer.
- .4 Ensure that self-adhering membrane is compatible with and will adhere permanently to all interfacing substrate materials and systems, including foil-faced membrane and Membrane Roofing.
- .5 If required by the Consultant, demonstrate accelerated long-term adhesion to all substrate appropriate to this Project.
- .6 Acceptable Products:
- .1 Protecto Wrap “100/40”
 - .2 Soprema ‘Soprseal Stick 1100T Summer Grade and Winter Grade with ‘Elastocol Stick’ primer.

2.3 SELF-ADHERED FOIL-FACED MEMBRANE FLASHING

- .1 Multi-purpose, self-adhering detailing membrane for adhesion to aluminum components at openings, vents and other interruptions, where noted, in the wall membrane system.
- .2 Membrane shall be composed of a proprietary base fabric/film laminated to an aluminum foil and available in various roll widths.

- .3 Acceptable products:
 - .1 'Protector Seal 45" by Protecto Wrap.
 - .2 "Sopra Solin HD" by Soprema.

2.4 LIQUID-APPLIED FLASHING MEMBRANE

- .1 Liquid-applied flashing membrane for use as a sealant at penetrations to the wall sheathing membrane, as a detailing sealant and as noted and detailed.
- .2 Material shall be a gun grade waterproofing, adhesive and detailing compound composed of 99% solids, roller / trowel / brush applied, single component, high performance, elastomeric, silyl-terminated polyester coating / sealant exhibiting the combined benefits of silicone and urethane. Product shall meet all current VOC requirements and contain no solvents or isocyanates.
- .3 Liquid-applied flashing system shall comply with the following properties when cured:
 - .1 Hardness, Shore A: 40-45.
 - .2 Tensile Strength: 180 Psi.
 - .3 Elongation at Break: 400%.
 - .4 Peel Strength: 25 pli.
 - .5 Accelerated Weathering: Must Pass.
 - .6 Water Vapour Transmission: 14 perms @ 12 mils.
 - .7 Surface Burning ASTM E84: Flame Spread: 0; Smoke Developed: 15; NFPA and ICC Class A Building Material.
- .4 Uncured properties:
 - .1 Tack Free Time: <30 minutes.
 - .2 Cure Rate: 3/16 in. / 24 hours.
 - .3 Volatile Organic Content: 1.5% by wt.; 27 g / Lt .2 lbs. / gal.
 - .4 Water Vapour Transmission: 6.34 grains / hour / ft².
- .5 An example of the accepted product is "R-Guard Fast Flash" as manufactured by Prosoco. Other products having the same demonstratable characteristics will not be excluded.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Preparation of all surfaces to receive self-adhering membranes including substrate, joints, cracks, coves etc. shall be carried out in accordance with manufacturer's written directions.
- .2 Ensure that all substrate surfaces are smooth, dry and firm. Remove any frost, ice, loose particles, ridges, laitance, cracks, grease, asphalt, oil and other foreign matter which could prevent adhesion of the membrane to the substrate.
- .3 Do not install membranes until other work which penetrates membrane has been completed.

- .4 Seal around membrane penetrating elements in accordance with manufacturer's printed installation instructions.

3.2 PRIMING

- .1 All surfaces to receive self-adhering membrane shall be primed at the rate recommended by the manufacturer. Primer shall be uniformly applied.
- .2 Open time of 30 minutes shall be allowed before installation of self-adhering membrane.

3.3 SHEATHING MEMBRANE INSTALLATION

- .1 Install membrane in accordance with manufacturer's printed instructions over flashings and corner reinforcement.
- .2 Begin installation at the base of the wall placing top edge of membrane immediately below materials protruding from substrate.
- .3 When properly positioned, place against surface by pressing firmly into place. Roll membrane with extension-handled countertop roller immediately after placement.
- .4 Overlap horizontally-adjacent pieces 2 in. and roll seams.
- .5 Bottom edge shall be slit to fit around penetrations. Membrane shall overlap the membrane sheet below by 2 in. Roll firmly into place.
- .6 Seal around materials penetrating membrane with termination mastic.
- .7 At end of each working day, seal top edge of membrane to substrate with termination mastic.
- .8 Do not allow the rubberized asphalt surface of membrane to come in contact with polysulfide sealants, creosote, uncured coal tar products or EPDM.
- .9 Do not expose membrane to sunlight for more than thirty days prior to enclosure.
- .10 Apply a bead or towel coat of mastic along membrane edges, seams, cuts, and penetrations.
- .11 Roll membrane with 3 in. wide hand roller.
- .12 Tie into adjacent wall systems and roof systems for continuous air barrier at building envelope.
- .13 Flashing and Corner Reinforcing:
 - .1 Where applicable, bring flashing a minimum of 6 in. onto horizontal surfaces and a minimum of 8 in. up walls from horizontal elevation shown.
 - .2 Stagger flashing and membrane seams.
 - .3 Install flashing to protrusions, expansion joints, control joints and the like. Bring flashing a minimum of 6 in. onto the membrane.
 - .4 Wrap air barrier membrane into jambs and sills at openings. Terminate membrane at points that will prevent visibility from interior.

- .14 Inspection:
 - .1 Inspect membrane for punctures, misaligned seams and fishmouths, apply additional layer of membrane over affected area, extending minimum of 6 in. beyond damaged area in all directions.
- .15 Coordinate proper construction of the roof/wall intersection to maintain the continuity of the air barrier system from the wall to the roofing membrane system.

3.4 TRANSITION / FLASHING AND FOIL-FACED MEMBRANE INSTALLATION

- .1 Apply self-adhering "detailing" membranes to surfaces as indicated on drawings and as specified.
- .2 Application of membrane, including temperature limitations, curing requirements and all other application procedures shall be carried out in accordance with membrane manufacturer's written directions.
- .3 Coordinate proper construction of roof / wall junctions between interfacing materials and systems so as to maintain continuity of the air barrier from wall to roof.
- .4 Cut and seal membrane around protrusions to form tight air seal.
- .5 Apply trowelled bead of mastic to all terminations at end of each day's work.
- .6 Inspect membrane thoroughly before being covered and make any corrections immediately. Misaligned or inadequately capped seams, punctures or other damage shall be repaired by patching and sealing with membrane manufacturer's directions.
- .7 Adhere transition membrane to sheathing membrane at wall openings and flash into pckets of fenestration, louvers and doors as detailed, taking extra care to ensure continuity of the air/vapour barrier.
- .8 Membrane shall be continuously supported.
- .9 Extend all membrane patches a minimum 6 in. from repair location or penetration. Seal all around patch with mastic.
- .10 Seal all side laps without factory bitumen edge and all top laps with mastic.
- .11 Mechanically attach membrane to door and window frames and use additional reinforcing membrane at such locations in accordance with manufacturer's directions.
- .12 Fill all joints or gaps wider than ¼ in. with foam backer rod and apply 12 in. piece of membrane over joints prior to application of the field membrane.
- .13 Coordinate installation of membrane with other interfacing Sections to minimize exposure of membrane.
- .14 When self-adhering membrane interfaces with incompatible membranes, ensure that bond is made only to bridge membranes.

3.5 LIQUID-APPLIED FLASHING MEMBRANE APPLICATION

- .1 At penetrations to all self-adhered wall sheathing and transition membranes: Apply liquid-applied flashing system onto foil-faced self-adhered membrane in strict accordance with manufacturer's printed instructions by brush, roller or towel between ambient temperatures of +1 °C and 30 °C.

3.6 ADJUST AND CLEAN

- .1 Repair, remove and clean all smears on exposed finished surfaces or surfaces to be subsequently finished. Clean off immediately as directed by and to the satisfaction of the Consultant.
- .2 Protect all adjacent surfaces from damage due to self-adhered membrane operations.
- .3 As work proceeds and on completion, clean up and remove from the premises all rubbish and surplus materials resulting from this work.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Pre-formed and pre-finished metal snap-lock type standing seam roof cladding assembly over plywood sheathing (refer to Section 06 16 00). Include SBS underlayment membrane, panel clip system, all fixings and associated accessories including flashings, trim, closures and sealants.
- .2 Special and stock flashing collars, to match roof cladding, for use with stove stacks and other penetrations through roof cladding.
- .3 Soffit Panels.

1.2 RELATED SECTIONS

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 06 16 00: Sheathing
- .3 Section 07 27 13: Exterior Wall Membranes
- .4 Section 07 62 00: Sheetmetal Flashing and Trim

1.3 REFERENCES

- .1 CSA-S136 for the design of Cold Formed Steel Structural Members.
- .2 Canadian Sheet Steel Building Institute Standards 10M and 20M.
- .3 Sheet Metal and Air Conditioning Contractor's National Association, Inc., "Architectural Sheet Metal Manual" (SMACNA).
- .4 Roofing Contractors' Association of BC (RCABC) Manual.
- .5 Canadian Roofing Contractors' Association (CRCA) Manual.
- .6 BC Building Code (BCBC) 2012.
- .7 National Building Code of Canada (NBCC) 2015.

1.4 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications, data sheets and colour samples in accordance with Section 01 33 00: Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop details and erection drawings in accordance with Section 01 33 00.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
 - .3 Where metal roof cladding components interface with equipment and other building elements, this section shall be responsible for obtaining all measurements of said items prior to preparation of shop drawings.

- .3 Maintenance Data:
 - .1 Provide maintenance data for cleaning and maintenance of panel finishes for incorporation into manual specified in Section 01 78 00: Closeout Submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, Shipping, Handling, and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Section 01 60 00: Product Requirements.
- .2 Storage and Protection:
 - .1 Store and protect cladding materials in strict compliance with manufacturer's recommendations.
 - .2 Protect from damage due to weather, excessive temperatures and scratching/denting from construction operations in accordance with CSSB1 Standards.

1.6 QUALITY ASSURANCE

- .1 Manufacturers/fabricators of the metal roof cladding system shall demonstrate at least five (5) years experience in projects similar in scope.
- .2 Installation of pre-formed metal cladding shall be performed by manufacturer-approved installers having at least five (5) years experience in metal cladding installations.

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 cardboard, packing material in appropriate on-site containers for recycling in accordance with Waste Management Plan.
- .4 Note that certain components related to underlayment membrane and gutter liner may be hazardous and will require special handling, transportation, storage and disposal.

1.8 DESIGN CRITERIA

- .1 Design pre-formed roof cladding systems to provide for thermal movement of component materials caused by ambient temperature range of 70 °C without casing buckling, failure of seals, leakage and undue stress on fasteners or other detrimental effects.
- .2 Ensure air tightness of roof system is continuous, is sealed at openings and terminations and is overlapped at changes in wall structure and where roof and wall meet.
- .3 Cladding systems shall meet the following criteria:
 - .1 Air infiltration: to ASTM E283 no air leakage at 2.86 lbs. / sf.
 - .2 Water penetration: no leakage at 20 lbs. / sf when tested to ASTM E331.
- .4 Design members to withstand dead load, live loads from foot traffic, roof snow load as indicated and positive and negative wind loads for locality, in accordance with BCBC 2012. Maximum allowable deflection is 1/180th of span. Design members to accommodate building movement, local temperature extremes and weather tightness.

- .5 Make allowance for wind up-lift load and provide extra fastening where required.

1.9 COMPATIBILITY

- .1 Compatibility between components of cladding system is essential. Provide written declaration to the Departmental Representative stating that materials and components, as assembled in system, meet this requirement.

PART 2 PRODUCTS

2.1 CLADDING AND FLASHING SHEET MATERIAL

- .1 Sheet steel cladding and associated flashing shall be formed to profiles as shown from 22 gauge (minimum), Grade C, 40 ksi, AZ-55 pre-finished coil stock conforming to ASTM 792-86.
 - .1 Colour / Finish: dark grey to be selected by the Architect from manufacturer's standard color palette.
- .2 Flashing and trim shall be fabricated from the same materials and finish as the respective roof cladding.
- .3 All cladding and flashing shall be factory finished with a two (2) coat minimum silicone modified polyester (SMP) paint system, cured by baking.

2.2 CLADDING COMPONENTS

- .1 Factory-finish metal, pre-formed, concealed-fixing, snap-on standing seam roof cladding system for use over plywood substrate. Refer to Section 06 16 00.
- .2 Cladding profile shall be approx. 44 mm high standing seams at 400 mm o.c. max.
- .3 Provide all concealed fixing, drag load protection, clips, etc. for a complete system. Panels shall be installed in continuous lengths (no end laps).
- .4 Secure standing seam roofing panels to roof structure as prescribed to meet design loads and manufacturer's recommendations. Employ extension members where required.
- .5 Provide all matching trim, closures, flashings, sealants, valleys and reinforcing as required to produce a complete weathertight installation.
- .6 An example of accepted product is "Prestige" by Vicwest. Colour: 56072 - Charcoal. Other products having the same characteristics will not be excluded.

2.3 METAL FLASHINGS AND TRIM

- .1 Form flashings associated with metal roof cladding from same material thickness and finish as roof panels. Form to profiles as detailed and required at roof edge eave, gable edge, profile closures, collar flashings at roof penetrations and trim.
- .2 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 13 mm, provide clip fasteners spaced at 600 mm o.c. Mitre and seal corners with sealant. Make allowance for expansion at joints. Use either S-lock seams at joints and seal with sealant or fasten through 13 mm slotted holes using fasteners with washers to conceal holes, space fasteners at maximum 600 mm. At mitered

corners use standing seams. All fasteners in roof systems flashing concealed from view except as approved otherwise.

- .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 in contact with pressure treated wood and dissimilar bare metals.
- .6 Provide all fabrication and proprietary flashings of size to accommodate roof penetrations. Pre-finish where exposed in final assembly and described as follows:
 - .1 Pipe and stack flashing: flexible neoprene or EPDM flashing, adjustable hole size, resistant to ozone and UV, with collar clamp and integral fastening ring at base of 1 mm thick aluminum alloy A1100-0 or stainless steel, and stainless-steel screws.

2.4 ACCESSORIES

- .1 Fasteners:
 - .1 Self-tapping screws to CSA B35.3, purpose made, galvanized finish and stainless-steel fasteners as indicated:
 - .1 Exposed fasteners: Equal to "Climaseal" with colour matching heads where exposed to view.
 - .2 Concealed fasteners: stainless steel.
- .2 Sealants:
 - .1 Seam sealant in roof panels at overlapping joint: factory-applied to manufacturer's standard to meet design criteria. Refer to Section 07 90 00.
 - .1 Exposed sealant: as recommended by manufacturer.
 - .2 Tape: butyl tape to manufacturer's standard, to meet design criteria.
- .3 Flashing and Trim:
 - .1 Flashing and Gutters: In accordance with Section 07 62 00. Formed from same materials as the roof sheet. Custom fabricated to suit architectural details, as required.
 - .2 Closures: Foam and metal closures to suit profiles selected, to manufacturer's recommendations.

2.5 FABRICATION

- .1 Fabricate roof components to comply with dimensions, profiles, gauges and details as shown on the shop drawings, including fascia and valley panels and all companion flashing.
- .2 Fabricate all components of the system in the factory, ready for field installation.
- .3 Provide roof sheet and all accessories in longest practicable length to minimize field lapping of joints.

2.6 UNDERLAYMENT MEMBRANE

- .1 Self-adhesive membrane composed of woven polyethylene and SBS modified bitumen for application over plywood sheathing.
- .2 Apply underlayment using primer as recommended by manufacturer.

- .3 The underlayment membrane shall conform to the following properties:

| Properties | Test Standards | Value |
|-----------------------------|----------------|------------------------------------|
| Thickness | - | 40 mil |
| Dimension | - | 75 ft x 36 in. |
| Roll Weight | - | 44 lb. |
| Top face | - | Tri-Laminate Woven Polyethylene |
| Under face | - | "Split-Back" Silicone release film |
| Breaking Strength, MD/XD | ASTM D1970 | 64 / 88 lb. / in. |
| Elongation at Break, MD/XD | ASTM D1970 | 52 / 24% |
| Tear Resistance | ASTM D1970 | 84 / 90lb. |
| Static puncture | ASTM D5602 | 90 lb. |
| Adhesion to Plywood, 4.5°C | ASTM D1970 | 12 lbf / ft |
| Adhesion to Plywood, 24°C | ASTM D1970 | 39.4 lbf / ft |
| Low temperature flexibility | ASTM D1970 | Pass at -30 °C |
| Water Vapour Permeance | ASTM E96 | 0.022 perm |
| Nail Sealability | ASTM D1970 | Pass |

PART 3 EXECUTION

3.1 PREPARATION

- .1 Install metal roof cladding assembly following completion and approval of plywood sheathing and underlayment membrane.
- .2 Precut panels and flashing sections in factory where practical. Torch cutting of material on site is not acceptable.

3.2 SYSTEM INSTALLATION

- .1 Install roof system in accordance with approved shop drawings, RCABC standards and manufacturer's instructions.
- .2 Over sound new plywood sheathing, install self-adhesive underlayment fully adhered to properly primed solid substrate according to manufacturer's recommendations. Ensure all joints are properly lapped and sealed. Tie in with barriers on adjacent surfaces to ensure weathertight construction. Provide a continuous seal around all openings in the metal roof system.

- .3 Precut panels and flashing sections in the shop where practical. Torch cutting of material on site is not acceptable.
- .4 Install exterior prefinished roof panels on plywood sheathing, using manufacturer's proper construction procedure. Ensure metal roofing sheet side-lap is positively retained and proper sheet coverage is maintained. Add sealant as required.
- .5 Install pre-finished sheet metal roof collars and flashings for all roof penetrations in accordance with approved shop drawings and manufacturer's instructions.
- .6 Commence with installation of panels on one end and arrange panels symmetrically so that roof penetrations will not intersect ribs and that spacing is equal from end walls. Break form end panels to form flashing at end walls as indicated on shop drawings.
- .7 Counter flash roof panels at roof / wall juncture. Install all gutters, down pipes, vent flashing, vents, counter flashing and special assemblies in accordance with approved shop drawings, manufacturer's written instructions and RCABC standards.
- .8 Coordinate work of this Section with that for special gutters, downspouts and other assemblies covered in Section 07 62 00.

3.3 CLEAN-UP

- .1 Clean exposed panel surfaces in accordance with manufacturer's instructions.
- .2 Repair and touch up with colour matching high grade enamel minor surface damage, only where permitted by the Departmental Representative and only where appearance after touch-up is acceptable to Departmental Representative.
- .3 Replace damaged panels and components that, in opinion of the Departmental Representative, cannot be satisfactorily repaired.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Provide all material, labour, equipment and services required for the engineered design, fabrication and installation of factory-finished phenolic wall panel rainscreen system to all areas noted on drawings as "phenolic wall panel system".
- .2 Include panels and all sub-framing, girts, trim, fixings, anchorage, sealants and tie-in to interfacing building components and weather barriers.

1.2 RELATED SECTIONS

- .1 Section 01 45 00: Quality Control
- .2 Section 06 10 00: Rough Carpentry
- .3 Section 07 27 13: Exterior Wall Membrane
- .4 Section 07 92 00: Joint Sealants
- .5 Section 07 62 00: Sheet Metal Flashing and Trim
- .6 Section 08 11 00: Steel Doors and Frames
- .7 Section 08 51 13: Aluminum Windows

1.3 REFERENCES (LATEST EDITIONS OF FOLLOWING)

- .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM C-920, Standard Specification for Elastomeric Joint Sealants.
 - .2 ASTM E-72, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
 - .3 ASTM E-84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .4 ASTM E-96, Standard Test Methods for Water Vapour Transmission of Materials.
 - .5 ASTM E-136, Standard Test Method for Behaviour of Materials in a Vertical Tube Furnace at 750 °C.
 - .6 ASTM E228, Standard Test Method for Linear Thermal Expansion of Solid Materials with a Vitreous Silica Dilatometer.
 - .7 ASTM G26, Standard Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Non-metallic Materials.
- .2 CAN/CSA S136-07, North American Specification for the Design of Cold-Formed Steel Structural Members.
- .3 CSSBI 50M-87, Lightweight Steel Framing Manual.
- .4 CSSBI 52M-91, Lightweight Steel Framing Binder.
- .5 National Building Code of Canada (NBCC) 2015.

1.4 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product Data:
 - .1 Submit product data sheets.
- .3 Shop Drawings:
 - .1 Submit shop drawings showing layout, profiles, and product components, including edge conditions, panel joints, fixture location, anchorage, accessories, finish colours, patterns and textures.
 - .2 Shop drawings shall also be approved by panel material manufacturer in order to maintain warranty.
 - .3 Shop drawings shall be sealed by a professional engineer (specialty engineer) registered in British Columbia.
- .4 Samples:
 - .1 Submit 200 mm x 250 mm colour samples for selection by Designer.
- .5 Quality Assurance Submittals:
 - .1 Test Reports:
 - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.
 - .2 Qualification Certificates:
 - .1 Submit certificate indicating compliance with qualification requirements in Quality Assurance article.
 - .3 Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Manufacturer's installation instruction manual.
- .7 Closeout Submittals:
 - .1 Closeout Submittals (Maintenance Data and Operation Data):
 - .1 Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
 - .2 Warranty:
 - .1 Warranty documents specified herein.

1.5 QUALITY ASSURANCE

- .1 Installer shall have a minimum of five (5) years of proven experience in the installation of the specified products on projects of a similar size and scope.
 - .1 Fabricator / Installer Qualifications: Installer shall be approved by the panel material manufacturer in writing.
- .2 Install a full wall mock-up on the building in a location as directed by the Consultant.
 - .1 Mock-up shall incorporate panels and all accessories including sub-framing, flashing and windows, and may remain as permanent part of building.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery:
 - .1 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .2 Storage and Protection:
 - .1 Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.
- .3 Remove damaged materials from site.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19: Waste Management and Disposal.

1.8 PROJECT CONDITIONS AND COORDINATION

- .1 Field Measurements:
 - .1 Verify actual measurements / openings by field measurements before fabrication; show recorded measurements on shop drawings.
 - .2 Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
- .2 Coordinate work of this section with that of all interfacing component sections.
- .3 Make all penetrations by interfacing sections through panel system, as well as interfacing joints, weathertight.

1.9 SYSTEM DESIGN REQUIREMENTS

- .1 Components:
 - .1 Design and size to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of panel, conforming to NBCC, 2015 for project location climatic conditions.
- .2 Allowable framing deflection: L/175.
- .3 Thermal Movement:
 - .1 Design system to accommodate vertical and horizontal thermal movement of components without causing buckling, failure of joint seals, undue stress on fasteners, and oil canning when subject to seasonal temperature cycling.
 - .2 Systems that accommodate movement with enlarged / slotted attachment holes not accepted.
- .4 Drainage:
 - .1 Design for positive drainage of water leakage and condensation to exterior of wall panel system, including gutter system at each horizontal joint.
 - .2 Systems that do not evacuate water from the cavity at every horizontal will not be accepted.

- .5 Tolerance of Substructure:
 - .1 Design system to accommodate up to 6 mm in 3050 mm variation out of plane.
 - .2 Accommodate tolerances of building structural framing.
- .6 Design entire composite wall panel system to perform as an effective pressure equalized rainscreen conforming to the principles outlined in AAMA 508-07.

1.10 WARRANTY

- .1 Provide the following warranties:
 - .1 Panel manufacturer's transferable ten (10) year warranty covering defects in materials. (Warranty only available when material installed by certified installation contractor and Shop drawings approved by manufacturer).
 - .2 Panel System Fabricator: two (2) year fabrication Warranty for conformance to design and performance and requirements.
 - .3 Installer: two (2) year Workmanship Warranty.

PART 2 PRODUCTS

2.1 WALL PANELS

- .1 Solid phenolic wall panels:
 - .1 Material: solid panel manufactured using a combination of high pressure and temperature to create a flat panel created from thermosetting resins, homogenously reinforced with wood-based fibers and an integrated decorative surface or printed décor.
 - .2 Color / Finish: light grey to be selected by the Architect from manufacturer's standard palette.
 - .3 Panel Core: fire retardant (FR) black core.
 - .4 Panel Thickness: as indicated on the drawings.
 - .5 Physical Properties:
 - .1 Modulus of Elasticity: 1,300,000 psi (9000 N / mm²) minimum, ISO 178.
 - .2 Tensile Strength: 10,100 psi (70 N / mm²) minimum, ISO 527-2.
 - .3 Flexural Strength: 14,500psi (120 N / mm²) minimum, ISO 178.
 - .4 Thermal Conductivity: 2.1 BTU / inch / ft² • hr • °F, EN 12524.
 - .5 Structural Performance (ASTM E330):
 - .1 Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 15 pounds per square foot. Wind load testing shall be done in accordance with this standard to obtain the following results:
 - .2 Normal to the plane of the wall, the maximum panel deflection shall not exceed L/175

- .3 Normal to the plane of the wall between supports, deflection of the aluminum sub-framing members shall not exceed L/175 or 3/4 in., whichever is less
 - .4 At 1.5 times design pressure, permanent deflection of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion.
 - .5 If system tests are not available, mock ups shall be constructed and tests performed under the direction of an independent third-party laboratory which show compliance to the minimum standards listed above.
- .6 Fire Performance:
- .1 Flame Spread: Class A, ASTM E 84.
 - .2 Smoke Development: Less than 450, ASTM E 84.
 - .3 Ignition Temperature: Greater than 650 °F (350 °C) above ambient, ASTM D1929. d. Burning Classification: CC1 or CC2, ASTM D635.
 - .4 When required for compliance with local building codes, the wall cladding assembly shall show no degradation of the rating of Fire-Resistant Assemblies, ASTM E119.
 - .5 When required for compliance with local building codes, the wall cladding assembly including cladding and non-cladding elements such as, but not limited to, specific weather resistive barriers and/or exterior insulation materials, shall meet the performance requirements of NFPA 285. Performance shall be determined by actual testing in accordance with NFPA 285 or through an equivalency analysis provided by a recognized fire protection expert.
 - .6 When required for compliance with local building codes, the wall cladding assembly shall not ignite when exposed to a radiant heat energy source, NFPA 268.
- .7 Finish Performance: Electron Beam Cure resin in conformance with the following general requirements:
- .1 Color: As selected by the Architect from manufacturer's standard colors or a custom color to be matched by the panel supplier.
 - .2 Humidity Resistance: No formation of blisters when subjected to condensing water fog at 100% relative humidity and 100 °F (38 °C) for 3000 hours, ASTM D 2247.
 - .3 Salt Spray Resistance: Corrosion creepage from scribe line (1/16 in. (1.6 mm) max.) and minimum blister rating of 8 within the test specimen field, ASTM B117.
 - .4 Weather Exposure: Accelerated - 3000 hours in Atlas Type Weatherometer using cycle of 90 minutes light and 30 minutes diminished light and demineralized water with a maximum color change of 5 Delta E units from the original color according to ASTM D-

- 2244, with the exception of Uni-Colors A12.3.7 / A18.3.5 / A04.1.7, which will not deviate more than 10 Delta E units from original color according ASTM D-2244.
- .5 Color Stability: The decorative surface complies with, classification, 4 - 5 measured with the grey scale according to ISO105 A02-93 according to test method EN 438-2:29.
 - .6 Microbial Characteristics: Will not support micro-organic growth (ISO 846).
- .2 Mounting System:
- .1 TS110 - Exposed fastening on fixed depth aluminum sub-framing.
 - .2 TS120 - Exposed fastening on variable depth aluminum sub-framing.
 - .3 TS210 - Concealed fastening over fixed depth aluminum sub-framing.
 - .4 TS220 - Concealed fastening over variable depth aluminum sub-framing.
 - .5 TS110-285 - Exposed fastening on fixed depth aluminum sub-framing tested and meeting the performance requirements of NFPA 285.
 - .6 TS120-285 - Exposed fastening on variable depth aluminum sub-framing tested and meeting the performance requirements of NFPA 285.
 - .7 TS210-285 - Concealed fastening over fixed depth aluminum sub-framing tested and meeting the performance requirements of NFPA 285.
 - .8 TS220-285 - Concealed fastening over variable depth aluminum sub-framing tested and meeting the performance requirements of NFPA 285.
 - .9 Other installation systems - Include test documentation showing compliance with the performance criteria set forth in the specification and in accordance with the local building code.
- .3 Aluminum Sub Structure:
- .1 Aluminum sub-structure designed to withstand structural loading due to wind load and the dead load of the panel, painted as required to conceal behind the open joinery of the attachment system.
 - .1 Extrusions, including corner closures, joint closures and vent screens, formed members, sheet, and plate shall conform with the recommendations of the manufacturer.
- .4 Extruded Aluminum Trim:
- .1 Shall be colored to match panels where required by the Architect.
- .5 Fasteners (Concealed / Exposed):
- .1 Fasteners shall be non-corrosive and as recommended by panel manufacturer.
 - .2 Exposed fasteners shall be colored to match panels where required by the Architect.
- .6 Panel Corner Profile:
- .1 Dimensions: 143.70 inches by 11.81 inches by 11.81 inches (3650 mm x 300 mm x 300 mm) with a $\frac{5}{16}$ inch (8 mm) thick by $\frac{3}{4}$ inch (19 mm) radius.
 - .2 Dimensions: 143.70 inches by 11.81 inches by 11.81 inches (3650 mm x 300 mm x 300 mm) with a $\frac{3}{8}$ inch (10 mm) thick by $\frac{3}{4}$ inch (19 mm) radius.

- .7 An example of accepted product is "Pura NFC Siding" by Trespa. Colour: Silver Grey. Finish: Satin. Other products having the same characteristics will not be excluded.

2.2 FABRICATION

- .1 Panels: solid phenolic impregnated kraft paper wall panels with no voids, air spaces or foamed insulation in the core material.
 - .1 Accessory items in accordance with manufacturer's recommendations and approved submittals
- .2 Panel Weight: 8 mm (2.4 lb / ft²), 10 mm (3 lb / ft²), 13 mm (3.8 lb / ft²).
- .3 Panel Bow: = 2 mm / m (= 0.079 in. / 39.38 in.).
- .4 Field fabrication shall be allowed where necessary but shall be kept to an absolute minimum.
- .5 All fabrication shall be done under controlled shop conditions when possible.
- .6 Appearance: panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.
- .2 Surfaces to receive panels shall be even, smooth, dry, and free from defects detrimental to the installation of the panel system. Notify Contractor in writing of conditions detrimental to proper and timely completion of the work.
- .3 Confirm exterior sheathing is plumb and level, with no deflection greater than ¼ in. (6 mm) in 20 ft (6096 mm).
- .4 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- .1 Install solid phenolic wall panels and sub-frame system in accordance with manufacturer's instructions.
- .2 Install solid phenolic wall panels plumb and level and accurately spaced in accordance with manufacturer's recommendations and approved submittals and drawings.

- .3 Anchor panels and sub-framing securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary movement and structural support.
- .4 Fasten solid phenolic wall panels with fasteners approved for use with supporting substrate.
- .5 Do not install panels or component parts which are observed to be defective or damaged including, but not limited to: warped, bowed, abraded, scratched, and broken members.
- .6 Do not cut or trim component parts during installation in a manner that would damage the finish, decrease the strength, or result in visual imperfection or a failure in performance. Return component parts with require alteration to the shop for re-fabrication or replacement.
- .7 Install corner profiles and trim with fasteners appropriate for use with adjoining construction as indicated on the Contract Drawings and as recommended by manufacturer.

3.4 FIELD QUALITY CONTROL

- .1 The manufacturer's or supplier's professional specialty engineer shall be responsible for periodic inspections during construction as required. Such inspections and associated costs shall be included in the Contract.
- .2 Letters of Assurance at completion of work:
 - .1 The Engineer who seals the shop drawings submission shall submit an Assurance of "Structural Design" and Commitment for "Field Review" on Human Resource Development Canada Fire Protection Engineering Services Standard Form Schedule B-1 and B-2.
 - .2 Written inspection reports of field review shall be submitted to the Departmental Representative an Assurance of Field Review and Schedule C-B.
- .3 Provide Schedules S-B:
 - .1 Assurance of professional Design and Commitment for Field Review & S-C:
Assurance of Professional Field review and Compliance to the Consultant.

3.5 CLEAN UP

- .1 Remove manufacturer's protective film at appropriate time in advance of the date of substantial performance of the Project. Review concurrently to ensure there is no damage or marring to the wall panels. Replace damaged or marred panels accordingly to the approval of the Consultant.
- .2 Clean panels to remove surface dust, dirt, stains and marks on the panels caused by ambient environmental weather conditions and construction activities. Use cleaners approved by the manufacturer of surfaces to be cleaned.
- .3 Protect panels from damage by other trades.
- .4 At completion of the work of this Section, remove any excess materials, debris and equipment, pertaining to the work of this Section, from the site.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 07 27 13: Exterior Wall Membranes
- .2 Section 07 41 13: Metal Roof Panels
- .3 Section 07 42 44: Phenolic Wall Panels
- .4 Section 07 92 00: Joint Sealants

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM International):
 - .1 ASTM A653/A653M03, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Roofing Practices Manual as published by the Roofing Contractors Association of B.C.
- .3 Sheet Metal and Air Conditioning Contractor's National Association, Inc., "Architectural Sheet Metal Manual" (SMACNA).

1.3 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Samples: submit 100 mm x 150 mm samples of each type of sheet metal material, colour and finish.

PART 2 PRODUCTS

2.1 SHEET FLASHING MATERIALS

- .1 Zinc coated steel sheet: Commercial quality to ASTM A653/A653M, with Z275 designation zinc coating, shop-spray-painted with a PPG Fluoropolymer coating.
 - .1 Colour: grey to be selected by Architect to match door frames.
 - .2 Metal thickness shall be minimum 22-gauge, but adjusted to accommodate use and span in order to yield a smooth, non-oil-canned surface, except for
 - .3 26-gauge zinc coated steel sheet for the underside of floor assemblies.
- .2 Aluminum sheet: proprietary minimum 22-gauge utility sheet, plain pattern, to CAN/CGSB 93.1.
 - .1 Colour: grey to be selected by Architect to match door frames.

2.2 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Plastic cement: to CAN/CGSB 37.5.
- .3 Self-adhered Membrane: as per Section 07 27 13.
- .4 Sealants: In accordance with Section 07 92 00.

- .5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .6 Fasteners: of same material as sheet metal, to CSA B111, flat head roofing nails of length and thickness suitable for metal flashing application.
- .7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .8 Touch-up paint: as recommended by prefinished material manufacturer.

2.3 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable RCABC details, SMACNA details and as indicated.
- .2 Form pieces in 2438 mm maximum lengths. Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 13 mm. 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.

2.4 METAL FLASHINGS AND FORMED SHEET METAL

- .1 Form flashings to profiles indicated from minimum 22-gauge material.
- .2 Form reglets, gum pockets, clamping bars and other members shown on drawings from zinc alloy of sufficient thickness to safely produce a weather tight seal with workmanlike appearance.

2.5 METAL GUTTERS

- .1 Form gutters from min. 22-gauge thick material.
- .2 Sizes and profiles as indicated and as per requirements of RCABC and SMACNA.
- .3 Provide necessary fastenings.

2.6 BASE FLASHING COLLAR, COLLARS, CAP

- .1 All metal components to be heavy-duty stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION OF SELF ADHERED MEMBRANE UNDERLAYMENT

- .1 Inspect self-adhered membrane (refer to Section 07 27 13) for damage upon delivery to site.
 - .1 Replace defective material.
- .2 Install membrane as detailed in strict accordance with manufacturer's written directions.
- .3 Prior to installation of membrane cover all exposed fasteners, sharp corners and other similar conditions detrimental to the membrane with small strips or patches of membrane to prevent sharp edges from penetrating finished membrane.
- .4 Install membrane under cap flashings and over upper leg of cross cavity flashings.

3.2 INSTALLATION

- .1 Install sheet metal work in accordance with RCABC details, SMACNA details and as indicated.
- .2 Use concealed fastenings except where approved before installation.
- .3 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock seams forming tight fit over hook strips, as detailed.
- .4 Use standing seams at corners.
- .5 Lock end joints and caulk with sealant.
- .6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.
- .7 Insert metal flashing into reglets and under cap flashings to form weather tight junction.
- .8 Turn top edge of flashing into recessed reglet or mortar joint minimum of 1 in. Lead wedge flashing securely into joint.
- .9 Caulk flashing at reglet and cap flashing with sealant.

3.3 INSTALLATION OF GUTTERS

- .1 Install gutters as indicated and to requirements of RCABC and SMACNA.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC):
 - .1 ULC-S115-05, Fire Tests of Firestop Systems.
- .3 Sealing service penetrations in fire-rated assemblies must be done in accordance with this Section.
- .4 Fire stopping and smoke seals within mechanical assemblies (i.e. inside ducts, dumpers) and electrical assemblies (i.e. inside cable trays) are specified in Mechanical and Electrical Divisions respectively.

1.2 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (refer to BC Building Code 2012): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
 - .1 Words "tightly fitted" shall ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.
 - .2 Construction details shall accurately reflect actual job conditions.

- .4 Samples:
 - .1 Submit duplicate 12 in. x 12 in. samples showing actual fire stop material proposed for project.
- .5 Quality assurance submittals:
 - .1 Submit following in accordance with Section 01 45 00: Quality Control.
 - .2 Test reports: in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
 - .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .4 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in fire stopping installations with five (5) years documented experience approved by manufacturer.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Consultant to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Review co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 60 00: Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .3 Waste Management and Disposal:
 - .1 Separate waste management materials for reuse and recycling in accordance with Section 01 74 19: Waste Management and Disposal.

1.6 CUTTING AND PATCHING

- .1 Firestop service penetrations as follows:
 - .1 Sleeve single, circular penetrants.
 - .2 Respective trades create multiple penetrations when the individual circular penetrants are no more than 4 in. apart.
 - .1 Trading creating the fire separations form an open, square or rectangular box around the multiple penetrants.
 - .2 Form box maximum 1 in. clear around the outer penetrants.
 - .3 Create multiple penetrations with square penetrants similar to the method for circular penetrants except that:
 - .1 Maximum clearance between penetrant and penetration is 2 in.
 - .2 Provide design specific clearance around fire dampers.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN/ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN/ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
 - .2 Fire stop system rating: F.
- .2 Service penetration assemblies: systems tested to CAN/ULC-S115 and listed in ULC Guide No. 40 U19.
- .3 Service penetration fire stop components: certified by test laboratory to CAN/ULC-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with BCBC, not less than the fire-resistance rating of surrounding floor and wall assembly.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seals at such locations.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use cementitious or rigid seals at such locations.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming, backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

- .10 Sealants for vertical joints: non-sagging.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing and ULC certification.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by Consultant.
- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
- .4 Mechanical pipe insulation: Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

- .1 Inspections: notify Consultant when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.6 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Top of fire-resistance rated masonry and gypsum board partitions.
 - .3 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
 - .6 Openings and sleeves installed for future use through fire separations.
 - .7 Around mechanical and electrical assemblies penetrating fire separations.
 - .8 Rigid ducts: greater than 129 cm²:
 - .1 When specifically permitted by the fire damper manufacturer's detailed installation instructions, fire stopping to consist of bead of firestopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 This section specifies standards for caulking and sealants applied by this and other sections.
- .2 Refer to other sections for additional caulking and sealants.

1.2 RELATED SECTIONS

- .1 Section 07 41 13: Metal Roof Panels
- .2 Section 07 42 44: Phenolic Wall Panels
- .3 Section 07 62 00: Sheet Metal Flashing and Trim
- .4 Section 08 11 00: Steel Doors and Frames
- .5 Section 08 51 13: Aluminum Windows

1.3 REFERENCE STANDARDS

- .1 CAN/CGSB-19.13-M87 Sealing Compound, One-component, Elastomeric, Chemical Curing.
- .2 CGSB 19-GP-14M-76 Sealing Compound, One Component, Butyl-polyisobutylene Polymer Base, Solvent curing.
- .3 CAN/CGSB-19.17-M90 One-Component Acrylic Emulsion Base Sealing Compound.
- .4 CAN/CGSB-19.21-M87 Sealing and Bedding Compound Acoustical.
- .5 CAN/CGSB-19.22-M90 Mildew Resistant, Sealing Compound for Tubs and Tiles.
- .6 CAN/CGSB-19.24-M90 Multi-component, Chemical Curing Sealing Compound.

1.4 ENVIRONMENTAL AND SAFETY REQUIREMENTS

- .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 acceptable to Labour Canada.
- .2 Comply with requirements specified in Section 01 35 43: Environmental Procedures and Section 01 74 19: Waste Management and Disposal.
- .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .4 Sealant and substrate materials to be minimum 5 °C.
- .5 Should it become necessary to apply sealants below 5 °C, consult sealant manufacturer and follow their recommendations.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 PRODUCTS

2.1 SEALANT MATERIALS

- .1 Sealants acceptable for use on this Project must be listed on CGSB Qualified Products List issued by CGSB Qualification Board for Joint Sealants. Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Urethanes One Part:
 - .1 Self-Levelling to CAN/CGSB-19.13, Type 1, colour as selected.
- .2 Urethane one Part:
 - .1 Non-Sag to CAN/CGSB-19.13, Type 2, MCG-2-40, colour as selected.
- .3 Silicones One Part:
 - .1 To CAN/CGSB-19.13.
 - .2 To CAN/CGSB-9.22 (Mildew resistant).
- .4 Silicone Strip Sealant:
 - .1 Preformed low-modulus silicone extrusion, width to suit application, c/w primer/sealer as indicated by manufacturer for designed substrate and use. Standard colour selection by the Departmental Representative.
- .5 Acoustical Sealant:
 - .1 To CAN/CGSB-19.21
- .6 Butyl:
 - .1 To CGSB 19-GP-14M
- .7 Acrylic Latex One Part:
 - .1 To CGSB 19-17.
- .8 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 40 to 50%.
 - .2 Neoprene or Butyl Rubber.
 - .1 Round solid of Shore A hardness 70.
 - .3 High Density Foam.
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg / m³ density, or neoprene foam backer, size as recommended by manufacturer.
 - .4 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape, which will not bond to sealant.

2.3 SEALANT SELECTION

- .1 Perimeters of exterior openings where frames meet exterior façade of building: Sealant type: one component urethane, non-sag.

- .2 Coping joints and coping-to-façade joints and flashing joints:
 - .1 Sealant type: butyl.
- .3 Interior control and expansion joints in floor surfaces:
 - .1 Sealant type: one component urethane self-levelling.
- .4 Countertops (e.g. sinks, urinals, basins, vanities):
 - .1 Sealant type: silicone, mildew resistant.
- .5 Exposed interior control joints in drywall:
 - .1 Sealant type: acrylic latex.
- .6 Concealed joints in sound attenuated walls and ceilings:
 - .1 Sealant type: acoustic.
- .7 Colour of sealants as selected by Departmental Representative from manufacturer's standard range to match adjacent surfaces.
- .8 Joint cleaner: xylol, methylethyleketon or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

2.4 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.

PART 3 EXECUTION

3.1 PREPARATION OF JOINT SURFACES

- .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 in materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.2 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

3.3 BACK UP 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.

3.4 MIXING

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

3.5 APPLICATION

- .1 Sealant:
 - .1 Apply sealant in accordance with manufacturer's written instruction.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- .2 Apply sealant in continuous beads.
- .3 Apply sealant using gun with proper size nozzle.
- .4 Use sufficient pressure to fill voids and joints solid.
- .5 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .6 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .7 Remove excess compound promptly as work progresses and upon completion.

3.6 CURING

- .1 Cure sealants in accordance with sealant manufacturer's instructions.
- .2 Do not cover up sealants until proper curing has taken place.

3.7 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

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Interior and exterior hollow metal doors and frames.

1.2 RELATED SECTIONS

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 07 21 20: Building Insulation
- .3 Section 07 92 00: Joint Sealants
- .4 Section 08 71 00: Door Hardware
- .5 Section 08 80 00: Glazing
- .6 Section 09 90 00: Painting and Coating

1.3 REFERENCES

- .1 CSDFMA – Specification for Commercial Steel Doors and Frames Canadian Steel Door and Frame Manufacturers' Association 1990.
- .2 CAN4-S105-M85 - Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.
- .3 CAN4-S106-M80 - Standard Method for Fire Tests of Window and Glass Block Assemblies.
- .4 NFPA No. 80-1999 - Fire Doors and Windows.
- .5 CAN4-S104M80 - Fire Tests of Door Assemblies.
- .6 Recommended Locations for Architectural Hardware as published by the Door and Hardware Institute.
- .7 Installation of Commercial Steel Doors and Frames as published by the Door and Hardware Institute (DHI).

1.4 PERFORMANCE REQUIREMENTS

- .1 Fire door and frame assembly shall be constructed as tested to CAN4-S105M.

1.5 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Shop Drawings:
 - .1 Clearly indicate each type of door and frame, material core thickness, mortises, reinforcements, anchorages, glazing, location of exposed fasteners and hardware arrangements.
 - .2 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in Door and Frame Schedule.

1.6 QUALITY ASSURANCE

- .1 Conform to the requirements of the CSDFMA standards.
- .2 Fire-rated doors shall conform to CAN4-S104M.

- .3 Fire-rated frame construction shall conform to CAN4-S105M.
- .4 Installed door and frame assembly shall conform to NFPA N° 80 for fire protection rating scheduled.

1.7 REGULATORY REQUIREMENTS

- .1 Doors shall meet the temperature rise limits and glass area limits when installed in locations required by the 2015 National Building Code of Canada (NBCC).

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Store doors and frames in an upright position, protected from the elements and raised above the ground in a manner to prevent corrosion damage.
- .2 Damaged, sprung or twisted doors or frames, or doors with interior cores or frames telegraphing through will be rejected.
- .3 Prepare a coding and identification system for delivery and installation of doors and frames.
- .4 Submit a copy of the coding system to the Departmental Representative. Coordinate coding system with Finish Hardware Schedule and Door and Frame Schedule.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Sheet Steel: ASTM A924, galvanized to ASTM A653, Class ZF075, wiped zinc coated.
 - .1 The sheet to be free of scale, pitting, coil breaks, buckles, waves or other surface blemishes.
- .2 Insulation: Fiberglass, polystyrene or polyurethane for exterior doors;
- .3 Core: Resin impregnated heavy kraft paper, expanded honeycomb, each cell approximately 25 mm across.
- .4 Accessories: Resilient door bumpers, rigid extruded PVC door top closures.
- .5 Glazing Stops: Rolled channel shape, butt corners, prepared for security head style screws.
- .6 Glazing in accordance with Section 08 80 00.

2.2 FRAMES

- .1 Sizes: as scheduled on Door and Frame Schedule on drawings, to suit wall assembly dimensions.
- .2 All exterior H.M. door frames shall be thermally broken.
- .3 Colour: grey to be selected by Architect to match sheet metal flashing and trim.

2.3 DOORS

- .1 Face sheet thicknesses: 1.2 mm CRS.
- .2 Interior Doors: Face sheets pressure laminated to kraft paper core, mechanically interlocked and epoxy sealed vertical edges, top and bottom end channel closures spot welded.
- .3 Exterior Doors: Face sheets, longitudinal edges fully welded, filled and sanded flush, top and bottom end channel closures spot welded, RSI 1.9 min. insulation fill in all voids.
- .4 Fire-Rated Doors: Fabricate fire-rated doors in accordance with underwriter's requirements using material not less than the thickness specified herein unless a greater thickness is stipulated by the labelling authority.
- .5 Glazing in accordance with Section 08 80 00 to configurations as shown on Door and Frame Schedule on drawings.
- .6 Colour: light grey to be selected by Architect to match phenolic wall panels, except for window shutter sliding door (shall be grey to match sheet metal flashing and trim and door frames)

2.4 FABRICATION - FRAMES

- .1 Fabricate frames in accordance with CSDFMA standards and details shown on drawings.
- .2 Fabricate frames as welded unit; knock-down frames are not permitted.
- .3 Finished work shall be neat in appearance, square, and free of defects, warps and buckles. Hollow metal members shall be straight and of uniform profile throughout their lengths.
- .4 Jamb, header, mullion, and sill profiles shall be in accordance with the frame schedule and as shown on the reviewed shop drawings.
- .5 Corner joints shall have contact edges closed tight with faces mitred and stops either butted or mitred. Faces and soffits shall be continuously welded and the faces ground and finished smooth. The use of gussets or splice plates as a substitute for welding will not be acceptable.
- .6 Prepare frames for silencers. Provide three (3) single silencers for single doors [mullions of double doors] on strike side and two (2) single silencers on frame head at double doors without mullions.
- .7 Attach fire-rated label to each frame unit at hinge side.
- .8 Provide floor anchors, not less than 1.7 mm thick, with two holes for fasteners, fastened to the inside jambs with at least four spot welds
- .9 Provide frame anchors of a type suitable for wall construction.
- .10 Provide frames with temporary steel spreader for shipping and handling.
- .11 Protect strike and hinge reinforcements in grout filled frames in masonry walls using guard boxes welded to frames.
- .12 Reinforce head of frames wider than 1200 mm; reinforce exterior frame assemblies to resist wind loading.
- .13 Provide steel channel type glazing stops at all glazed H.M. frame assemblies.

- .14 Glazing in accordance with Section 08 80 00.
- .15 Employ manufacturer's standard thermal break configuration on all exterior H.M. frames.

2.5 FABRICATION - DOORS

- .1 Fabricate doors in accordance with CSDFMA standards. All surfaces shall be smooth and flat, free from dents, warp, wave, buckle. Corners shall be neatly formed and finished without horizontal or vertical seams showing on faces exposed in final installation. Reinforcing, cores or marks telegraphing through flat panels and surfaces will not be accepted.
- .2 Provide extruded PVC top closures on all exterior doors.
- .3 Doors shall be neat in appearance and free from warpage or buckle. Edge bends to be true and straight and of minimum radius for the thickness of metal used.
- .4 Bevel door edges 3 mm in 50 mm on lock and hinge edges.
- .5 Prepare doors to receive glazing and louvres where scheduled. Weld fixed glass molding to the secure side. Provide removable steel channel moldings to secure glazing and secure with security screws.
- .6 Attach fire-rated label to hinge side of door.
- .7 Pairs of fire rated labelled doors shall not require the provision of an overlapping astragal to attain the prescribed fire protection rating.

2.6 HARDWARE PREPARATION

- .1 Doors and frames shall be prepared to receive hardware as specified under Section 08 71 00.
- .2 Unless otherwise shown on the drawings, locate hardware in accordance with the Recommended Locations for Architectural Hardware as published by the Door and Hardware Institute.

2.7 GLASS AND GLAZING

- .1 Refer to Section 08 80 00.

PART 3 EXECUTION

3.1 INSPECTION / PREPARATION

- .1 Confirm site dimensions.
- .2 Ensure glazing stops and all loose parts and assemblies which are supplied by this section are packaged and identified clearly for installation by others.

3.2 INSTALLATION

- .1 The installation of frames in wood stud partitions is specified under Section 06 10 00.
- .2 Install frames in accordance with "Installation of Commercial Steel Doors and Frames" as published by the Door and Hardware Institute (DHI).

- .3 Set frames in concrete block walls in correct location, plumb, square and true. Maximum allowable variation: 1.5 mm out of plumb measured on face of frame, 3 mm twist corner to corner diagonally.
- .4 Brace frames securely. Anchor to floor and walls using anchorage provided. Provide temporary bracing to hold frames true while being built-in.
- .5 Provide temporary spreaders at mid- point of frame, and vertical brace for frames over 1200 mm wide, until building-in work completed.
- .6 Assemble sectional and large size frames to provide smooth flush fitting joints, frame rigid and in line.
- .7 Loose-fill all exterior hollow metal door frames with thermal batt insulation. Refer to Section 07 21 20.

3.3 ADJUSTING AND CLEANING

- .1 Touch up any damaged galvanized finish.
- .2 Remove mortar splatter and leave components ready for finishing by others.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 Engineered design, shop drawings, fabrication and installation of all factory assembled extruded aluminum thermally broken exterior fixed and operating windows complete with glazing, extruded deflection head channels, associated flashings, closures, sill covers, adaptors, coupling trim, caulking, weatherstripping, and all required anchorages, attachments and shims.

1.2 RELATED WORK

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 07 27 13: Exterior Wall Membrane
- .3 Section 07 62 00: Sheet Metal Flashing and Trim
- .4 Section 07 92 00: Joint Sealants
- .5 Section 08 80 00: Glazing

1.3 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product Data Sheets:
 - .1 Submit manufacturer's Product Data Sheets for products proposed for use in the work of this section.
- .3 Shop Drawings:
 - .1 Shop drawings shall be prepared under the supervision of and shall bear the seal of a professional engineer ("specialty engineer") licensed in British Columbia.
 - .2 Further to requirements of Section 01 33 00, indicate with plans, sections, elevations and sufficient full-size details, components and methods of assembly, materials and their characteristics relative to their purpose, and other fabrication information including relationships to adjacent systems.
 - .3 Identify and describe material types being supplied, wall thicknesses of pultrusions, and shapes including connections and grades, dimensions and tolerances (minimum and maximum), attachments, reinforcing, anchorage and locations of fastenings, air barrier transitions to various adjacent building envelope air barrier materials, and provisions for thermal and structural movement between components of this section and adjacent materials.
 - .4 Include description of materials, finishing specifications, and other pertinent information.
 - .5 Design loads, typical reactions and support movement allowances, both vertical and horizontal, shall be placed on the shop drawings.
 - .6 Shop drawings shall clearly indicate the specification of materials and, where applicable, indicate installation methods and coordination with other sections.
- .4 Letters of Assurance:
 - .1 The Engineer who seals the shop drawings shall submit to the Departmental Representative, with the initial shop drawings submission, an Assurance of

'Structural Design' and Commitment for 'Field Review' on HRDC Standard Form Schedule S. Written inspection reports of field review shall be submitted to the Departmental Representative promptly as field reviews are made. On completion of the installation the Specialty Engineer shall submit to the Departmental Representative an Assurance of Field Review and Schedule S.

- .5 Design Calculations:
 - .1 Submit under seal, calculations prepared by the professional engineer responsible for the preparation of the shop drawings that clearly indicate the following:
 - .1 Design assumptions regarding loadings and seismic design, related to the building code.
 - .2 Which codes and standards calculations are based on.
 - .3 Materials proposed and their allowable shear and bending stresses.
 - .4 Maximum, and minimum tolerances for proposed materials including anchors, holes and spacing.
 - .5 Testing data to confirm compliance with thermal performance and condensation resistance criteria.
 - .6 Analysis for dead, wind, snow and guard loads as required and movements caused by temperature changes, support deflections and building sway.
 - .7 Analysis to include anchors, glazing members, structural joints, sealants glass. Show section property computations for framing members and submit full sized drawings.
 - .2 Calculations shall be prepared in a clear and comprehensive manner so that they can be easily reviewed. Incomplete or haphazard calculations will be rejected for resubmission.
- .6 Samples:
 - .1 Submit 450 mm x 450 mm size samples of each type of glass and 300 mm long section of fiberglass framing finish. If requested, submit 200 mm long samples of typical component sections (head, jamb, sill, mullions, and the like), fully assembled, indicating glazing and weatherproof methods.
- .7 Maintenance Instructions:
 - .1 Provide training to the Departmental Representative in the operation and maintenance of the fiberglass window systems. Submit printed copies of maintenance instructions given to the Departmental Representative in accordance with Sections 01 78 00: Closeout Submittals.
 - .2 Submit maintenance data for cleaning and maintenance of aluminum windows for incorporation into the operation and maintenance manuals in accordance with Section 01 78 00.

1.4 DESIGN PERFORMANCE

- .1 Accommodate expansion and contraction within service temperature range of -35 °C to 35 °C.

- .2 Limit deflection of mullion to L/175 of clear span when tested to ASTM E330 under design wind load.
- .3 Design of exterior glazing in accordance with 2015 National Building Code of Canada (NBCC) taking in account wind and interior pressures with maximum deflection of any member not to exceed L/175 under positive or negative live loads. Annual probability factor shall be 1 in 10 for references velocity pressure.
- .4 Glazing to CAN/CGSB 12.20-M89 structural design of glass for buildings.
- .5 Design and install all glazing systems to resist seismic forces in accordance with requirements of NBCC 2015.
- .6 All classification rating to CAN/CSA-A440-98.
- .7 Air infiltration shall not exceed $0.0003M^3 / S - M^2$ when tested in accordance with ASTM E283 at a pressure differential of 75 Pa.
- .8 Water tightness for fixed litres shall have no infiltration when tested in accordance with ASTM E331 with a pressure differential of 720 Pa.
- .9 Water tightness for Opening Vents shall have no infiltration when tested in accordance with ASTM E331 with a pressure differential of 500 Pa.

1.5 MAINTENANCE DATA AND GUARANTEE

- .1 Provide data for maintenance and cleaning in accordance with instructions under Section 01 78 00.
- .2 Provide a written guarantee for the complete installation provided under this section against defective material and workmanship which appears within a period of two (2) years from the date of substantial completion.

1.6 PROTECTION

- .1 Components and frames shall be adequately wrapped to prevent damage during shipping and construction operations.

1.7 COORDINATION

- .1 Coordinate work of this Section with that of Sections 07 27 13.
- .2 Ensure that all adaptors, coupling members and required fitments are provided at above listed interfacing as detailed.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 All materials shall be to CAN/CSA-A440-98 CAN3-S157.
- .2 Extrusions shall be 6063-T5 or T6 alloy and temper. Formed aluminum components shall be sheet of alloy and temper suitable for their application and finish.
- .3 Fasteners shall be 300 / 400 Series stainless-steel or cadmium plated and of sufficient size and quantity to perform their intended function.

- .4 Glazing tapes shall be macro-polyisobutylene, highly adhesive and elastic with continuous built-in shim.
- .5 Weathering and glazing gaskets shall be extruded, black, closed cell or dense elastomer of durometer appropriate to the function.
- .6 Aluminum shall have isolation coating where required using Alkali-resistant Bituminous paint using dialectic separators where required.
- .7 Flashing shall be pre-formed to shapes and profiles shown or as required to insure a waterproof and air tight assembly. Material from aluminum alloy, to match metal roof panels where exposed, mill finish elsewhere.
- .8 Sill flashings shall be back and end damned and caulked into place, minimum 1.6 mm (16-gauge).

2.2 COLOUR / FINISH

- .1 Colour shall be grey to be selected by the Architect to match door frames and sheet metal flashing and trim:
 - .1 Exposed aluminum sections shall be given an anodic oxide treatment in accordance with Aluminum Association Specification AA-M12C22A31.

2.3 FABRICATION

- .1 Construct units from extrusions of size and shape shown on shop drawings.
- .2 All joints shall be drawn together and secured by means of screws driven through section walls into integral screw channels of adjoining extrusions.
- .3 All joints shall be accurately machined, assembled and sealed to provide neat weathertight joints.
- .4 Ventilator sash shall be tubular extrusions with two lines of extruded elastomeric weatherings retained in extruded splines in the window frames.
- .5 Glass stops shall be square lock-in screwless type.
- .6 Shielded drainage and pressure equalization vents shall be provided where required.
- .7 The window shall be exterior glazed and shall incorporate "top load" glass stop glazing.
- .8 Sash units shall be fixed and awning units as shown and scheduled.
- .9 Window profile shall be 51 mm x 83 mm. Thermal break shall be pour and de-bridge type.
- .10 Vented units shall have stainless-steel friction arms, aluminum hinges and cam handles.

2.4 GLAZING

- .1 Sealed double glazing, as scheduled by type on drawings, to standards as specified in Section 08 80 00.

2.5 LOW PROFILE LINEAR ROTATING VENTILATOR

- .1 Linear nom. 50 mm wide opening, aluminum thermally-broken screened operable ventilator, in aluminum window framing, nom. 762 mm long

PART 3 EXECUTION

3.1 WINDOWS

- .1 Install aluminum windows as indicated on drawings and in accordance with manufacturer's recommendations to achieve weathertight installations.
 - .1 Ensure assemblies are plumb, level and free of warp or twist.
 - .2 Maintain dimensional tolerances and alignment with adjacent work.
- .2 Use sufficient corrosion resistant anchorage devices to securely and rigidly fasten windows to building, without causing detrimental effects to shape or performance.
- .3 Set window sills level and uniform.
 - .1 Accurately and rigidly fit together all joints.
 - .2 Ensure joints are flush, hairline and weatherproof.
- .4 Caulking between window sections and materials installed as specified in Section 07 92 00.
- .5 This contractor shall do all necessary sealing within the window frames to ensure a weatherproof installation.
- .6 Aluminum shall be isolated from dissimilar metals with bituminous paint or isolation tape.

3.2 PROTECTION AND CLEANING

- .1 Aluminum windows shall be adequately wrapped and protected to prevent damage during construction.
- .2 At completion of the project, remove protection and clean and polish all surfaces

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 60 10: Product Requirements
- .2 Section 08 11 00: Steel Doors and Frames

1.2 REFERENCES

- .1 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA):
 - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.
- .2 American National Standards Institute (ANSI) / Builder Hardware Manufacturer Association (BHMA) current editions of the following:
 - .1 ANSI/BHMA A156.1, Butts and Hinges.
 - .2 ANSI/BHMA A156.2, Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.4, Door Controls (Closers).
 - .4 ANSI/BHMA A156.5, Auxiliary Locks and Associated Products.
 - .5 ANSI/BHMA A156.6, Architectural Door Trim.
 - .6 ANSI/BHMA A156.13, Mortise Locks and Latches.
 - .7 ANSI/BHMA A156.16, Auxiliary Hardware.
 - .8 ANSI/BHMA A156.18, Materials and Finishes.
- .3 Door and Hardware Institute of Canada (DHI).
- .4 National Building Code of Canada (NBCC) 2015.
- .5 CSA B651-04, Accessible Design for the Built Environment.

1.3 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00.
- .3 Hardware List:
 - .1 Submit contract hardware list in accordance with previous clause.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information. Include catalog cuts of each product.
- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for mechanically-operated and electrified hardware for incorporation into manual specified in Section 01 78 00: Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Test Reports:
 - .1 Certified test reports showing compliance with specified performance characteristics and physical properties. Submit if requested.
- .2 Certificates:
 - .1 Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Standard of Acceptance:
 - .1 Named manufacturer and model number, when listed in this section, are included for the sole purpose of describing hardware function and to further define the level of quality required for a specific hardware item.
 - .2 Products having the same characteristics from another manufacturer's are not excluded.
 - .3 Include technical data on proposed hardware to be supplied as part of the Final Hardware List to be submitted during the shop drawing submittal process.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Section 01 60 00.
 - .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .2 Storage and Protection:
 - .1 Store finishing hardware in clean and dry area.

1.6 WASTE DISPOSAL AND MANAGEMENT

- .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.

1.7 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00.
 - .2 Supply two (2) sets of wrenches and other special tools for door hardware supplied.

1.8 COORDINATION WITH OTHER SECTIONS

- .1 Coordinate certain door hardware items of this Section with interfacing sections including, but not limited to the following:
 - .1 Section 08 11 00: Steel Doors and Frames

PART 2 PRODUCTS

2.1 HARDWARE ITEMS - GENERAL

- .1 Provide door hardware complying with ANSI/BHMA Standards, of heavy-duty institutional grade 1 rating supplemented by additional requirements as specified herein.
- .2 When specified standard does not exist, the hardware item shall be specifically made to suit the specific function, by heavy duty designed for institutional applications and have been proven in use.
- .3 Use products from one manufacturer for all similar items.
- .4 Equip each door with all required door hardware as recommended by DHI best practises and ANSI/BHMA standards to:
 - .1 Allow proper functioning and operation of door to suit building use.
 - .2 Comply with applicable codes having jurisdiction and barrier free requirements of CSA B651.
 - .3 Meet building user's operational and security requirements.
- .5 Finish generally: 630 Satin Stainless Steel.

2.2 DOOR HARDWARE

- .1 Locksets and Latch sets:
 - .1 Heavy-duty commercial / institutional grade one operational mortise locksets with lever handles to ANSI/BHMA A156.13, Series 1000, grade one security, with 25 mm throw on hardened stainless steel dead bolts and 19 mm throw on stainless steel latchbolt with anti-friction tongue.
 - .2 Cylinders: 6 pin mortised unit, high security pick proof and drill resistant in accordance with UL 437 standard, restricted and registered keyway, suitable for keying as specified herein. Provide removable cores.
 - .3 ANSI Functions as scheduled.
- .2 Deadlocks:
 - .1 Mortised type, stainless steel armoured fronts with same features and characteristics as lock / latch sets above.
 - .2 Keyed outside in vandal-proof trim, thumb turn inside.
 - .3 Deadlocks shall be supplied by same manufacturer as lock / latch sets.
- .3 Butts and Hinges:
 - .1 Interior normal use: to ANSI/BHMA M56.1, minimum 2 ball-bearing type.
 - .2 Exterior and interior heavy weight / high use: to CAN/CGSB-69.18 heavy weight, high frequency, five knuckle, four ball bearing.
 - .3 Provide non-removable pins (NRP) on all out-swinging doors and where scheduled. Include security stud that locks the plates of these hinges together when door is closed.
 - .4 Hinge quantity as scheduled.
 - .5 Use wide-throw type hinges on exterior doors.
 - .1 Size shall be sufficient to accommodate clearance of exterior wall cladding and closure trim.

- .6 All hinges shall be stainless steel base.
- .4 Door Closers:
 - .1 To CAN/CGSB-69.20. Arms and brackets to suit application.
- .5 Door Stops:
 - .1 Floor and wall mounted, cast type, heavy-duty, finish to match locksets, complete with appropriate fixings.
- .6 Wind Restrictors:
 - .1 Heavy-duty surface mounted to door top, stainless steel to ANSI 156.8.
 - .2 Mount on all exterior doors and where otherwise scheduled.
- .7 Thresholds / Bottom Sweeps (exterior doors):
 - .1 Extruded aluminum, out-swing type, 152 mm wide by full width of doors with aluminum door shoe containing neoprene draft insert and integral rain deflector.
- .8 Weatherstripping:
 - .1 Bulbous neoprene type inserted into aluminum retainer including twin type to match at meeting stiles.
- .9 Flush Bolts:
 - .1 Heavy-duty stainless steel top and bottom mounted, finished to match lock / latch sets.
- .10 Astragals:
 - .1 Overlapping 3 mm steel with vinyl insert, primed for field-painting with doors.
- .11 Electric Strikes:
 - .1 Programmable heavy-duty electric strike. Controlled remotely from console in office for time of day (active / inactive).
 - .2 Coordinate with timer. Refer to Electrical.

2.3 SLIDING SHUTTER

- .1 Following "Sliding Door" type hardware by Richelieu, Stanley, Richards-Wilcox, etc.:
 - .1 Steel Box Rail, End Caps and Hangers.
 - .2 Flush Handles.
 - .3 Dust Proof Door Keeper.
 - .4 Intermittent T-Guides.
 - .5 Track Stops.
- .2 Finish: Galvanized

2.4 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices shall match finish of hardware.
- .4 Use fasteners compatible with materials through which they pass.

- .5 Use tamperproof fasteners in high security hardware.
- .6 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 QUALITY CONTROL

- .1 Use only qualified installers having knowledge and past experience in door hardware installation.
- .2 Upon request, submit written affidavit of worker qualifications and past experience.
- .3 Coordinate the supply and installation of door hardware with the building security system and with the electrical door access control system being provided by other sections.

3.3 INSTALLATION

- .1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .2 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .3 Use only manufacturer's supplied fasteners. Failure to comply may void manufacturer's warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer is unacceptable.

3.4 ADJUSTING

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

3.5 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.

- .3 Remove protective material from hardware items where present.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.6 DEMONSTRATION

- .1 Keying System Setup:
 - .1 Set up key control system with file key tags, duplicate key tags,
 - .2 Turn over key data and keys to Departmental Representative.
- .2 Maintenance Staff Briefing:
 - .1 Brief Departmental Representative regarding:
 - .1 Proper care, cleaning, and general maintenance of project's complete hardware.
 - .2 Description, use, handling, and storage of keys.
- .3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.7 HARDWARE SCHEDULE

- .1 Quantities shown in schedule are for one opening only. Include all hardware for each door listed in Door and Frame Schedule on drawings. See drawings for door layout and arrangement.
- .2 Refer to "Hardware Set" column in Door and Frame Schedule on drawings for location of each hardware group:
 - Set N° 1: ANSI F05 lockset, 1-½ pair NRP butts, door stop, closer with wind restrictor, weatherstripping, threshold, astragal.
 - Set N° 2: ANSI F07 lockset, programable electric strike, 1-½ pair NRP butts, door stop, D/A closer with wind restrictor, weatherstripping, threshold, astragal.
 - Set N° 3: ANSI F07 lockset, 1-½ pair NRP butts, smoke seals, automatic door bottom with flat saddle, door stop, door closer.
 - Set N° 4: ANSI F07 lockset (active leaf), 3 pair NRP wide-throw butts, flush bolts, astragal, weatherstripping, threshold.
 - Set N° 5: ANSI F07 lockset, 1-½ pair NRP butts, threshold, astragal.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 08 11 00: Steel Doors and Frames
- .2 Section 08 51 13: Aluminum Windows

1.2 REFERENCES

- .1 American National Standards Institute (ANSI) / American Society for Testing and Materials (ASTM) current editions of the following:
 - .1 ANSI/ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- .2 Canadian Standards Association (CAN) / Canadian General Standards Board (CGSB) current editions of the following:
 - .1 CAN/CGSB-12.1, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.3, Float Glass.
 - .3 CAN/CGSB-12.4, Heat Absorbing Glass.
 - .4 CAN/CGSB-12.5, Mirrors, Silvered.
 - .5 CAN/CGSB-12.8, Insulating Glass Units.
- .3 Laminators Safety Glass Association (LSGA): Standards Manual.
- .4 Glass Association of North America (GANA): Glazing Manual, Engineering Standards, Manual and Laminated Glazing Reference Manual.
- .5 Model National Energy Code for Buildings (NECB) 2011.
- .6 National Building Code of Canada (NBCC) 2015.

1.3 QUALITY ASSURANCE

- .1 Professional Engineering:
 - .1 This section shall be responsible for providing engineering design necessary to supply glass thicknesses required to safely span openings indicated.
 - .2 A professional Engineer (Specialty Engineer), registered in British Columbia shall prepare, seal and sign all shop drawings and perform field reviews.
- .2 Standards:
 - .1 Comply with recommendations in the following publications, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section:
 - .1 GANA Glazing Manual.
 - .2 GANA Engineering Standards Manual.
 - .3 GANA Laminated Glazing Reference Manual.
 - .2 Exterior fenestration assemblies shall comply with the energy conservation requirements of NECB 2011, prescriptive Path.

- .3 Manufacturing:
 - .1 Fabrication processes, including low emissivity and reflective coatings, insulating, laminated, silk-screening and tempering shall be manufactured by a single manufacturer with a minimum of ten (10) years of fabrication experience and meet ANSI / ASQC 9002, latest version.
- .4 Installation:
 - .1 Provide the work of this section executed by specialist Contractor who shall be thoroughly trained and experienced in skills required, be completely familiar with referenced standards and requirements of the work of this section, and personally direct installation performed under this Section.
- .5 Conduct quality control in accordance with Section 01 45 00: Quality Control.

1.4 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product data sheets:
 - .1 Submit manufacturer's product data sheets for products proposed for use in the work of this section
- .3 Shop drawings:
 - .1 Submit signed and sealed engineered shop drawings.
 - .2 Show details of each type of glazing system in conjunction with the framing system indicating type of glass, sizes, shapes, glazing material and quantity. Show details indicating glazing material, glazing thickness, bite on the glass and glass edge clearance.
- .4 Samples:
 - .1 Submit 305 mm (\pm) square samples of each type of glass indicated except for clear monolithic glass products, and 305 mm long samples of each colour required, except black, for each type of sealant or gasket exposed to view.
 - .1 Submit 3 control samples for each glass type showing maximum range of visible difference between units for the project, if requested.
- .5 Submit test and evaluation reports:
 - .1 Obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealant as well as other glazing materials including insulating units.
- .6 Manufacturer Reports:
 - .1 Submit glass fabricator's product information and structural calculations indicating compliance with glazing standards established by the Glass Association of North America (GANA). Submittal to include thermal stress and structural load analysis of the proposed glass types, configuration and sizes.
- .7 Submit sample glazing warranty.
- .8 If requested, submit copy of letter from IGMAC or a test report prepared by independent testing company confirming insulating glass units of the types required have been successfully tested in accordance with CAN/CGSB 12.8-97 and will withstand design loads specified herein.

- .9 Closeout Submittals:
 - .1 Submit closeout submittals in accordance with Section 01 78 00: Closeout Submittals.
 - .2 Submit maintenance and cleaning instructions for glass and glazing for incorporation into the operating and maintenance manuals.

1.5 PERFORMANCE / DESIGN CRITERIA

- .1 Glass strength:
 - .1 Provide glass products in the thickness and strengths (annealed or heat-treated) required to meet or exceed the following criteria based on project loads and in-service conditions.
 - .1 Analysis shall comply with CAN/CGSB 12.20, latest edition.
 - .2 Minimum thickness of annealed or heat-treated glass products shall be selected so that worst case probability of failure does not exceed the following:
 - .1 8 breaks per 1000 for glass installed vertically less than 15 degrees from the vertical plane and under wind action.
 - .2 1 break per 1000 for glass installed 15 degrees or more from the vertical plane and under action of wind and/or snow.
 - .3 Maximum lateral deflection sealed double vision glass units: for insulating glass units supported on four edges, limit centre-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 19 mm maximum.
- .2 Safety and Building Code:
 - .1 At locations subjected to human impact loads and where required by NBCC, 2015: provide safety glass in accordance with the latest revisions to CAN/CGSB 12.1 and 12.20.
 - .2 Glass thicknesses and glass types specified, indicated, or scheduled are minimums required.
 - .1 Glazing "Specialty Engineer" shall modify as required to satisfy design and building code requirements, and any such modifications shall be clearly indicated on shop drawings.
- .3 Thermal and Optical performance:
 - .1 Provide glass products with performance properties published by glass manufacturer. Performance properties shall be manufacturer's published data as determined according to the following procedures:
 - .1 Centre of glass U-Value: National Fenestration Rating Council (NFRC) 100 methodology using LBNL WINDOW 5.2 computer program.
 - .2 Centre of glass solar heat gain coefficient: NFRC 200 methodology using LBNL-35298 WINDOW 5.2 computer program.
 - .3 Solar optical properties: NFRC 300.

- .4 Sealed Double Vision Glass Units:
 - .1 IGMAC Certified, hermetically sealed, to CAN/CGSB 12.8 (latest) minimum 12 mm air space, 90% argon / 10% air filled, double sealed edges (primary: polyisobutylene, secondary: polysulphide), desiccant filled stainless steel spacer bar.
 - .1 There shall be no voids or skips in the primary seal or the secondary seal.
 - .2 Performance requirements: for glass units; based on above description:
 - .1 Visible light transmittance (VLT): within 68 – 70%.
 - .2 Winter night-time U-value: 0.24.
 - .3 Low 'E' soft coating (equal to Cardinal "LoE-366") on No. 2 surface.
 - .4 Solar heat gain coefficient (SHGC): 0.40.
 - .5 Exterior pane: uncoated green tinted glass with average daylight transmittance of 75%.

1.6 STORAGE AND HANDLING

- .1 Protect glass from edge damage during handling.
- .2 For insulating units exposed to substantial altitude changes, comply with insulating glass manufacturers written recommendations for venting and sealing to avoid hermetic seal ruptures.
- .3 Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.

1.7 SITE CONDITIONS

- .1 Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation or other causes.
- .2 Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 4.4 °C.

PART 2 PRODUCTS

2.1 GLASS TYPE DESCRIPTIONS

- .1 Type "1" – Sealed Double Vision Glass:
 - .1 Sealed double vision glazing, pane thicknesses as determined by "Specialty Engineer" to NBC Code requirements. Clear lites with Low "E" coating on No. 2 surface.
 - .2 Outboard lites: use Type "2" – Safety Glass for all windows and exterior doors, and as required by Code, typical

- .2 Type "2" – Safety Glass:
 - .1 Single glazed, clear tempered safety glass, Engineer-verified thicknesses for spans indicated, transparent tempered float glass to CAN2-12.1 (latest), Type 2, Class B.
 - .2 Tempering shall be performed using convection type furnace.
 - .3 Tempered and heat strengthened glass shall be treated prior to applying reflective or paint coatings.
 - .4 Tempering shall be performed using the horizontal tong-free method.
 - .5 Orient tempered glass in manner to produce consistence appearance.

2.2 GLAZING MATERIALS

- .1 Select glazing sealants, tapes, gaskets and additional glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
- .2 Glazing gaskets:
 - .1 Moulded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - .1 Performed, EPDM, silicone compatible, to ASTM C864-05.
- .3 Setting blocks:
 - .1 Silicone material with Shore, Type A durometer hardness of 85, plus or minus 5.
- .4 Spacers:
 - .1 Silicone blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- .5 Edge blocks:
 - .1 Silicone material of hardness needed to limit glass lateral movement (side walking).
- .6 Cleaners, Primers and Sealers:
 - .1 Type recommended by sealant or gasket manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Examine framing, glazing channels, and stops, with glazing installer present, for compliance with the following:
 - .1 Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - .2 Inspect butt and mitre joints in framing. Seal joints found to be open with a compatible sealant prior to glazing.
 - .3 Glazing pockets and surfaces are free of dust, construction debris, and contaminants.

- .4 Presence and functioning of weep systems.
 - .5 Minimum required face and edge clearances.
 - .6 Effective sealing between joints of glass-framing members.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- .2 Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.
- .3 Clean contact surfaces with solvent and apply primers to surfaces to receive tapes and sealants in accordance with the manufacturer's instructions. Ensure surfaces are free of moisture and frost.

3.3 GLAZING - GENERAL

- .1 Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- .2 Adjust glazing channel dimensions as required by conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- .3 Protect glass edges from damage during handling and installation. Remove damaged glass from project site and legally dispose of off project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- .4 Clean glazing rebate surfaces of traces of dirt, dust, or other contaminants.
- .5 Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- .6 Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in the same course of compatible sealant suitable for heel bead.
- .7 Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- .8 Provide spacers for glass lites where length plus width is greater than 1270 mm.
 - .1 Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - .2 Provide 3.2 mm minimum bite of spacers on glass and use thickness equal to sealant width.
- .9 Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel.

- .10 Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- .11 Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- .12 Hollow Metal Doors and Frames: Specified under work of Section 08 11 00. Install glazing as scheduled. Fixed stop bedding, glazing tape, removable stops, glazing tape.

3.4 GASKET GLAZING (DRY)

- .1 Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- .2 Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- .3 Installation with drive-in wedge gaskets: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centres of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .4 Installation with Pressure-Glazing Stops: Centre glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .5 Install gaskets so they protrude past face of glazing stops.

3.5 SEALANT GLAZING (WET)

- .1 Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure.
 - .1 Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- .2 Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- .3 Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 PROTECTION

- .1 Provide safety markings to installed glass by attaching streamers or tape to face of sash.
 - .1 Do not apply tape directly to the glass.
 - .2 Do not mark the glass with paint or any other substance that is hard to remove or could leave permanent stains.
- .2 Take all precautions necessary to protect stored glass and installed glass from lime mortar, water run-off from concrete or copper, weld spatter, acids, roofing tar, solvents, abrasive cleaners, careless handling of construction machinery and equipment, and any other activities that could permanently damage the glass.
- .3 Install protective cover to glass where there is a high risk of damage.

- .1 Use plywood, heavy kraft paper, or non-staining transparent plastic sheet.
- .2 Do not let protective materials contact surface of glass.
- .4 Do not rely on use of adhesive plastic films to protect installed glass.
 - .1 When plastic sheeting is used, it must be transparent, suspended away from the surface of the glass, and be provided with adequate ventilation holes to prevent heat build-up.

3.7 FINISHING

- .1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.
- .2 Final cleaning of glass in accordance with Section 01 74 13: Progress Cleaning.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 07 42 44: Phenolic Wall Panels
- .2 Section 07 62 00: Sheet Metal Flashing and Trim
- .3 Section 07 92 00: Joint Sealants
- .4 Division 23: HVAC

1.2 REFERENCES

- .1 The Aluminum Associate Inc. (AAI)
 - .1 AAI DAF-45-2003, Designation System for Aluminum Finishes – 9th Edition.
- .2 Canadian General Standards Board (CGSB).
- .3 M85, Sheet Aluminum Alloy, Prefinished, Residential.

1.3 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS – Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Indicate fabrication and erection details, including anchorage, accessories, and finishes.
- .4 Samples:
 - .1 Submit duplicate samples of each type of louvre showing colour and finish if requested.
 - .2 Show frame detail, screening and finish.
- .5 Submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedure.
- .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for louvres for incorporation into manual specified in Section 01 78 00: Closeout Submittals.

1.4 DELIVER, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 60 00: Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition.

- .2 Storage and Protection:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Protect louvres from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .3 Waste Management and Disposal:
 - .1 Separate waste management materials for reuse and recycling in accordance with Section 01 74 19: Waste Management and Disposal.

1.5 COORDINATION

- .1 Coordinate design, fabrication and installation of this section with Division 23 as well as with all other interfacing sections.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Aluminum extrusions: Aluminum Association alloy AA 6063-T5, ASTM B221/B221M
- .2 Fasteners: 304 / 316 stainless-steel.
- .3 Gaskets: vinyl.
- .4 Screens: Intercrimped aluminum wire cloth secured to 1.4 mm thick extruded aluminum frame mitered at corners and secured with corner locks, 18 x 14 mesh. Integrate with bird screen.
- .5 Continuous blade "storm proof" extruded aluminum louvres:
 - .1 Construct louvres from 6063-T5 alloy aluminum extrusions of minimum 3 mm thickness to sizes and shapes indicated. Total louvre depth: 100 mm & 150 mm
 - .2 Arrange blades, mullions and frame extrusions as indicated.
 - .3 Design mullions as weather protected and with sliding interlock and integral internal drains.
 - .4 Install concealed vertical stiffeners spaced to meet required loads.
 - .5 Blades shall be curved configuration with integral water baffle.
 - .6 Complete louvre assembly shall have minimum 50% free area, unless otherwise noted (refer to Division 23).
- .6 An example of the accepted product is "Hi-Pro Stormproof 2420/2425" by Ventex. Other products having the same characteristics will not be excluded.

2.2 FINISHES

- .1 Finish shall be grey to be selected by the Architect to match door frames, metal flashing and trim and aluminum fenestration colors.

- .1 All exposed areas of components shall have an anodic oxide deposit in accordance with the Aluminum Association AA-M12-C22-A41/A31 Arch Class 1 & 2 AAMA Guide Spec. AAMA 607.1.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.2 INSTALLATION

- .1 Install louvres where indicated.
- .2 Set adjustable louvre blades for uniform alignment in open and closed positions.
- .3 Adjust louvres so moving parts operate smoothly.
- .4 Attach bird screen to inside face of louvre or vent.
- .5 Repair damage to louvres to match original finish.
- .6 Install wall louvres using fasteners as appropriate for wall construction and in accordance with manufacturer's recommendations.

3.3 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 PROTECTIONS

- .1 Where aluminum contacts metal other than zinc, paint dissimilar metal with primer and two coats of aluminum paint.
- .2 Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 Interior steel studs, miscellaneous metal framing, metal furring channels, including floor and ceiling track and associated accessories, including design and engineering.
- .2 Installation of hollow metal door frames in steel stud partitions.

1.2 RELATED WORK

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 06 20 00: Finish Carpentry and Millwork
- .3 Section 07 92 00: Joint Sealants
- .4 Section 08 11 00: Steel Doors and Frames
- .5 Section 09 29 00: Gypsum Board

1.3 STANDARD SPECIFICATIONS

- .1 Unless otherwise shown or specified, materials and workmanship shall meet the standards detailed in the Specification Standards Manual of the British Columbia Wall and Ceiling Industry.
- .2 Where standards are outlined herein, it will not preclude the use of other standards included in the Specification Standards Manual where such standards are approved in writing by the Consultant.
- .3 Reference in these project specifications to Section numbers, Parts, and Item numbers, means those within Section 9.7 of the Specification Standards Manual.

1.4 DESIGN OF STEEL STUDS SYSTEMS

- .1 This section shall be responsible for the engineering design of the steel stud systems.
- .2 Steel stud systems and connections shall be designed in strict accordance with CAN/CSA S136-01 and the Structural drawings.
- .3 The stud wall system shall be designed to support lateral & gravity loadings as prescribed in the BC Building Code (BCBC) 2012.

PART 2 PRODUCTS

2.1 INTERIOR STEEL STUDS

- .1 As specified in BCWC Section 9.7, Part 2, Items 1 and 2 to ASTM C645-76.
- .2 Galvanized steel studs, width as shown on drawings.
- .3 Use min. 20-gauge galvanized steel studs (doubled) at door jambs.
- .4 Supply special extended leg head track on walls subjected to deflection of the structure above.

- .5 Use heavy gauge metal studs where noted on Structural drawings.

2.2 FURRING CHANNELS

- .1 As specified in BCWC Section 9.7, Part 2, Item 3.
- .2 Min. 25-gauge galvanized steel hat shaped channels with knurled face 22 mm thick.

PART 3 EXECUTION

3.1 INSTALLATION INTERIOR STEEL STUDS

- .1 Install steel and stud partitions in accordance with BCWC Section 9.7, Part 3, Item 2. Studs 16" o.c. maximum.
- .2 Use doubled 20 Ga. thick studs each side of door frames.
- .3 Erect new hollow metal door frames in steel stud partitions.
- .4 Use double walls where required to accommodate piping, ducts, exist. wall thicknesses, etc.
- .5 Install access panels for other trades where directed.
- .6 Screw-fix security plywood to metal studs as shown and scheduled.
- .7 Use extended leg ceiling track in areas where deflection of structure will be present.
- .8 Provide metal stud bracing assemblies, where required, to stabilize walls, ceilings, door track and other building elements, as per Structural drawings.

3.2 INSTALLATION VERTICAL & HORIZONTAL FURRING

- .1 Install vertical and horizontal furring in accordance with BCWC Section 9.7, Part 3, Item 4 spaced 16 in. o.c. maximum.

3.3 INSTALLATION CEILING SUSPENSION SYSTEM

- .1 Install ceiling suspension system in accordance with BCWC Section 9.2, Part 3, Item 5 and with Structural drawings.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 07 21 00: Building Insulation
- .2 Section 07 92 00: Joint Sealants
- .3 Section 09 22 00: Non-structural Metal Framing
- .4 Section 09 31 00: Ceramic Tiling

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM C 473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
 - .2 ASTM C 518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .3 ASTM C 630 Standard Specification for Water-Resistant Gypsum Backing Board.
 - .4 ASTM C 840 Standard Specification for Application and Finishing of Gypsum Board.
 - .5 ASTM C 1396 Standard Specification for Gypsum Board.
 - .6 ASTM C 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - .7 ASTM C 84 Standard Test Methods for Surface Burning Characteristics of Building Materials.
- .2 Unless otherwise shown or specified, materials and workmanship shall meet the standards detailed in the Specification Standards Manual of the British Columbia Wall and Ceiling Industry and printed matter issued by the product manufacturers.
- .3 Where standards are outlined herein it will not preclude the use of other standards included in the Specification Standards Manual where such standards are approved in writing by the Consultant.
- .4 Reference in these project specifications to Section numbers, Parts, and Item numbers means those within Section 9.6 of the Specification Standards Manual.

1.3 QUALITY ASSURANCE

- .1 Provide gypsum board materials that comply with the following limits for surface burning characteristics when tested as per ASTM E 84:
 - .1 Flame spread: 25, maximum.
 - .2 Smoke developed: 450, maximum.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 PRODUCTS

2.1 STANDARD GYPSUM BOARD

- .1 Standard: non-combustible core of not less than 65% gypsum as determined by CAN/CSA-A82.20.1, ½ in. and ⅝ in. thickness and as indicated and scheduled, 4'-0" wide x maximum practical length, ends square cut, edges tapered.
- .2 Fire-Resistant: To CAN/ULCS 101 or ASTM E119, ⅝ in. thick x 4'-0" wide x maximum practical length, ends square cut, edges tapered.
- .3 Moisture Resistant (in washrooms, not showers): Board shall have a water resistant core such that when tested in accordance with CAN/CSA-A82.20.3, the average absorption shall not exceed 5% by mass after 2 hours of immersion; and shall have a surfacing such that when tested in accordance with CAN/CSA-A82.20.3, the average absorption shall not exceed 1.6g on either the face or back surface. Face papers shall have a green-tinted colour. Board shall be suitable for taping, filling, finishing and painting. Thickness as indicated and scheduled. Provide fire-resistant (Type 'X') where indicated and scheduled.

2.2 PAPERLESS GYPSUM BOARD (INTERIOR)

- .1 For use as wall board behind interior hydroponic vegetated wall assembly and where scheduled elsewhere.
- .2 Gypsum wallboard faced with FRP glass mats in lieu of paper producing moisture and mold resistance when tested by ASTM C1178/C1178M-06 procedures. Use fire-resistant (Type 'X'), to ASTM C1658/C1658M-06, where indicated and required for fire resistance rating.
- .3 Physical properties of board:
 - .1 Thickness: ⅝ in.
 - .2 Width: 4'-0".
 - .3 Length: longest practical length available.
 - .4 Weight: 2020 pounds per square foot.
 - .5 Edges: Tapered.
 - .6 Surfacing: Coated glass mat on face, back, and long edges.
 - .7 Flexural Strength, Parallel (ASTM C473, ASTM C1177): Not less than 80 pounds.
 - .8 Flexural Strength, Perpendicular (ASTM C473, ASTM C1177): Not less than 100 pounds.
 - .9 R-Value (ASTM C518): Not less than 0.56.
 - .10 Nail Pull Resistance (ASTM C473, ASTM C1177): Not less than 80 pounds.
 - .11 Hardness, Core, Edges, and Ends (ASTM C473, ASTM C1396): Not less than 15.
 - .12 Water Absorption (ASTM C473, ASTM C630 and AASTM C1396): Less than 5% of weight.

2.3 CERAMIC TILE BACKER BOARD

- .1 For use in shower rooms and where scheduled: to ASTM C1178.1178M and AWCC Section 9.6 – Part 2, Item 1.6.2, ½ in. thick standard and ⅝ in. thick Type X fire rated water-resistant gypsum board with chemically reacted (siliconized) gypsum core and faces bonded to an inorganic fiberglass mat wrapping treated with one face coated with a heat cured copolymer water and vapour retardant coating.
- .2 Joint tape: 2 in. wide, 10 x 10 glass mesh.
- .3 Approved product: “Dens-Shield” tile backer by Georgia Pacific.

2.4 EXTERIOR SHEATHING BOARD

- .1 Exterior grade fiberglass mat faced on front and back sides and long edges, silicone-treated water-resistant gypsum core, to ASTM C1177/C1177M-06, fire rated where indicated.
- .2 Exposure to weather: Comply with manufacturer’s printed instructions. Provide protection prior to exposure for periods greater than manufacturer’s recommendations and warranty.
- .3 Acceptable products:
 - .1 CertainTeed ‘GlasRoc Sheathing’.
 - .2 CGC ‘Securock Glass-Mat Sheathing’.
 - .3 Georgia-Pacific ‘Dens-Glass Gold’.

2.5 METAL FURRING & SUSPENSION SYSTEMS

- .1 Metal furring runners, hangers, tie wires, inserts, anchors: to CSA A82.30-M1980, galvanized.
- .2 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .3 Resilient clips drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

2.6 ADHESIVES

- .1 Laminating compound: to CSA A82.31.

2.7 ACCESSORIES

- .1 Casing Beads: 0.5 mm base thickness commercial grade sheet steel with G90 zinc finish to ASTM A525-80A, perforated flanges; one-piece length per location.
- .2 Acoustic Sealant: to CGSB 19-GP-21M. Sealants acceptable for use on this project must be listed on CGSB Qualified Products List issued by CGSB Qualification Panel for Joint Sealants.
- .3 Joint Compound: to CSA A.82-31-M1980, asbestos free.
- .4 Corner Beads: 1-¼ in. x 1-¼ in., 6063-T5 aluminum alloy.

2.8 FASTENING AND FINISHING

- .1 Nails, screws, tape, joint compound, and taping compound as specified in Section 9.5, Part 2, Item 2 of the Specification Standards Manual and the board manufacturer’s printed instructions.

- .2 Corner beads, casing beads as specified in Section 9.6, Part 2, Item 3 of the Specification Standards Manual and the board manufacturer's printed instructions.

2.9 FASTENING

- .1 Nails, screws, and staples: to ASTM C380.

PART 3 EXECUTION

3.1 GYPSUM WALLBOARD APPLICATION

- .1 Apply drywall in accordance with ASTM C 840, Section 9.6, Part 3, Item 6 of the Specification Standards Manual and printed instructions issued by the board manufacturer.
- .2 Gypsum wallboard shall be attached to metal studs, furring or ceiling channels by screw application.
- .3 Gypsum wallboard shall be attached to concrete or masonry by adhesive.
- .4 Use fire resistant gypsum wallboard (Type X) for fire rated walls and ceilings applied in accordance with U.L.C. design for fire rating required.

3.2 CORNER BEADS & CASING BEADS

- .1 Install corner beads and casing beads in accordance with Section 9.6, Part 3, Item 11 of the Specification Standards Manual.

3.3 FINISHING AND JOINT TREATMENT

- .1 Finish field joints, internal angles, screw heads, beads and trim in accordance with Section 9.6, Part 3, Item 4.1 of the Specification Standards Manual for a Level 5 finish.

3.4 SOUND RETARDANT APPLICATION

- .1 Where scheduled and detailed:
 - .1 Install foam gasket tape in joint between ceiling track and ceiling soffit.
 - .2 Install sound insulation blankets between studs full height of partition, tightly fitted to studs, electrical boxes, ducts and other penetrations.
 - .3 Install a 10 mm continuous bead of acoustical sealant between joint of gypsum wallboard and floors or abutting vertical surfaces.

3.5 PATCHING AND POINTING

- .1 Point and patch drywall and leave work complete and ready for painting.

3.6 ACCESSORIES

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical.
- .2 Make joints tight, accurately aligned and rigidly secured.
- .3 Mitre and fit corners accurately, free from rough edges.
 - .1 Secure at 150 mm o.c. using contact adhesive for full length.

- .4 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

3.7 TRIM

- .1 Minimize joints; use corner pieces and splicers.

3.8 ACCESS DOORS

- .1 Install access doors to electrical and mechanical fixtures specified in respective sections, and where noted.
- .2 Rigidly secure frames to furring or framing systems.

3.9 EXTERIOR WALL SHEATHING APPLICATION

- .1 Fasten wall sheathing board to structural metal studs and framing in compliance with board manufacturer's written instructions and BCBC 2012

3.10 CLEAN-UP

- .1 Clean-up rubbish daily and take care to avoid defacing adjoining work.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 06 20 00: Finished Carpentry and Millwork
- .2 Section 07 92 00: Joint Sealants
- .3 Section 09 29 00: Gypsum Board
- .4 Section 10 28 13: Washroom Accessories

1.2 REFERENCE STANDARDS

- .1 ANSI A108/A136.1-2005 – Specifications for the Installation of Ceramic Tile:
 - .1 ANSI A108-17 – Installation of Crack Isolation Membranes for Thin-Set Tile and Dimension Stone.
 - .2 ANSI A118.6 – Specifications for Ceramic Tile Grouts.
 - .3 ANSI A118.12 – Crack Isolation Membranes.
- .2 ANSI A137.1 – Standard Specifications for Ceramic Tile.
- .3 ASTM F-1896 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs.
- .4 Terrazzo, Tile and Marble Association of Canada (TTMAC), latest edition, Specification Guide – Tile and Terrazzo Installation Manual.

1.3 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.

1.4 SAMPLES

- .1 Submit duplicate 12 in. x 24 in. sample panels of each colour, texture, size and pattern of tile.
- .2 Adhere tile samples to ½ in. thick plywood and grout joints to represent project installation.

1.5 MAINTENANCE MATERIALS

- .1 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.
- .2 Maintenance material to be of same production run as installed material.

1.6 ENVIRONMENTAL CONDITIONS

- .1 Maintain air temperature and structural base temperature at ceramic tile installation area above 10 °C for twenty-four (24) hours before, during, and twenty-four (24) hours after installation.

PART 2 PRODUCTS

2.1 WALL TILE

- .1 Type "T-1": 4 in. x 8 in. white ceramic tile, ¼ in. thick, satin finish, half offset installation.
 - .1 An example of accepted product is "Color by Numbers" by Crossville. Colour: WT03 – "Three Hour Tour". Finish: SAT – satin. Other products having the same characteristics will not be excluded.

2.2 MORTAR AND ADHESIVE MATERIALS

- .1 Cement: white to CAN3-A5-M93, type 10
- .2 Sand: to C.S.A. A82.57
- .3 Lime: to C.S.A. A82.43-M1950 (R1971)
- .4 Latex: formulated for use in cement mortar
- .5 Water: potable and free of minerals which may discolour mortar
- .6 Colour Pigment: non-fading mineral oxides, unaffected by lime or cement and which will not stain tile.
- .7 Organic Adhesive: to C.G.S.B. 71-GP-22M.
- .8 Acrylic Thin set mortar for adhesion in all areas.

2.3 GROUT

- .1 Polymer modified high latex grout for all shower rooms and wet areas. Standard Portland cement elsewhere.
- .2 Colour: white.
- .3 An example of accepted product is "Kerapoxy" by Mapei. Colour: 00 – White. Other products having the same characteristics will not be excluded.

2.4 UNCOUPLING UNDERLAYMENT (IF REQUIRED)

- .1 Polyethylene membrane with a grid structure of square cavities, each cut back in a dovetail configuration, and an anchoring fleece laminated to the underside.
- .2 Accepted product: "Ditra" Membrane by Schluter.
- .3 Include in Tender Price as if required.

2.5 CRACK ISOLATION MEMBRANE (IF REQUIRED)

- .1 Underlayment membrane employed to dissipate effects of minor cracks in concrete slab substrates.
- .2 Include in Tender Price as if required.

2.6 METAL EDGE TRIM

- .1 Type "TR-1": finishing profile for tile edges with anodized aluminum finish, model as appropriate to accommodate installation.
 - .1 An example of accepted product is "Schluter-Schiene" by Schluter Systems. Finish: Anodized Aluminum. Other products having the same characteristics will not be excluded.

2.7 PROPRIETARY SHOWER WATERPROOFING ASSEMBLY

- .1 Thin-set apply all ceramic tile where scheduled and required in shower rooms and other wet areas over waterproofing system consisting of the following:
 - .1 Waterproofing wall membrane
 - .2 Waterproofing reinforcing strips and premoulded corners.
 - .3 Sealant and bonding compound.
 - .4 Waterproofing floor tray assembly.
- .2 An example of approved product is “Kerdi-Shower-ST” (K-SH-F-10) by Schluter. Other products having the same characteristics will not be excluded.

PART 3 EXECUTION

3.1 PREPARATION AND TESTING

- .1 Perform vapour emission tests on concrete floors regardless of the age or grade level.
 - .1 Verify concrete substrate is dry in accordance with the Industry Standards Slab Moisture Test Method (Calcium Chloride Method), in strict accordance with instructions.
- .2 Perform moisture conditions test in each major area.
 - .1 A minimum of one test per 93 m² per 24 hours via the Calcium Chloride Test Method (ASTMF-1896).
 - .2 If sub-floor moisture exceeds the allowable maximum for installing ceramic tile (thin-set), install underlayment or uncoupling membrane.
- .3 If vapour emission of concrete slab is within acceptable limits, install crack isolation membrane only.

3.2 WORKMANSHIP

- .1 Apply tile or backing coats to clean and sound surfaces.
- .2 Fit tile around corners, fitments, fixtures, drains and other built-in objects.
 - .1 Maintain uniform joint appearance.
 - .2 Cut edges smooth and even.
- .3 Maximum surface tolerance 1:800 for walls, and floors.
- .4 Make joints between floor and wall tile uniform and approximately 1.5 mm wide, plumb, straight, true, even and flush with adjacent tile.
 - .1 Ensure sheet layout is not visible after installation.
- .5 Lay out tiles so perimeter tiles are minimum ½ size.
- .6 Sound tiles after setting and replace hollow sounding units to obtain full bond.
- .7 Make internal angles square, external angle bullnosed.

- .8 Use bullnose edged tiles at termination of wall tile panels, except where panel butts projecting surface or differing plane.
- .9 Install divider strips at junction of tile flooring and dissimilar materials.
- .10 Allow minimum twenty-four (24) hours after installation of tiles, before grouting.
- .11 Clean installed tile surfaces after installation and curing of grout.

3.3 WALL TILE

- .1 Install tiles on wall board walls in accordance with TTMAC detail 304W, wall tile installed over wall board on interior dry surfaces only using thin set bond coat and dry curing wall grout.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 This section of work shall include all labour, materials, tools, scaffolds and other equipment, services and supervision required to prepare surfaces and to cover them with paint and/or transparent finish as herein specified and as shown on the "Finish Schedule", to the full intent of the specifications.

1.2 WORK EXCLUDED

- .1 All factory and pre-finished items not scheduled and specified for painting.
- .2 Shop-finished millwork and other components shall conform to these specifications.

1.3 RELATED SECTIONS

- .1 Section 05 50 00: Metal Fabrications
- .2 Section 06 16 00: Sheathing
- .3 Section 06 20 00: Finish Carpentry and Millwork
- .4 Section 08 51 13: Steel Doors and Frames

1.4 REFERENCES

- .1 The Master Painters Institute (MPI) Maintenance Repainting and Architectural Painting Specification Manuals, current edition.
- .2 Shop-finished millwork shall conform to these specifications.

1.5 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 If requested by the Consultant, provide for approval a 300 mm x 300 mm sample of each colour on the actual base material. Colours shall be exact shade, texture and gloss value.
- .3 All colours shall be as selected by Departmental Representative.

1.6 QUALITY ASSURANCE

- .1 The paint products of the Paint Manufacturer shall be as listed in the MPI Architectural Painting Specification Manuals (latest edition), under "Paint Product Recommendation" section, or approved equivalent.
- .2 This contractor shall have a minimum of five (5) years proven satisfactory experience and shall maintain a qualified crew of painters throughout duration of the work who shall be qualified to fully satisfy the requirements of this specification.
 - .1 Only qualified journeymen (and apprentices) shall be engaged in painting and decorating work who have a provincial Tradesman Qualification certificate of proficiency.
- .3 This work section requires full cooperation at all times with the MPDA (MPI) in the performance of its duties.

1.7 PRODUCT HANDLING

- .1 Paint materials shall be delivered to the job site in sealed original labeled containers bearing manufacturer's name, type of paint, brand name, designation and instruction for mixing and/or reducing.
- .2 The Contractor shall provide adequate storage facilities. Paint materials shall be stored at a minimum ambient temperature of 7°C in a well ventilated and heated single designated area.
- .3 Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion.
- .4 Where toxic materials and both toxic and flammable solvents are used, appropriate precautions shall be taken and no smoking allowed as a regular procedure.

1.8 ENVIRONMENTAL CONDITIONS

- .1 Temperature, humidity and moisture content shall conform to the following:
 - .1 Temperature: no painting shall be performed when temperature on the surfaces, or the air in the vicinity of the painting work are below 5 °C (41 °F) for interior work and 10 °C (50 °F) for exterior work.
 - .2 Relative Humidity: shall not be higher than 85%.
 - .3 Moisture of Surfaces: tests shall be done by electronic "Moisture Metre".
 - .4 Plaster and Wallboard: maximum moisture content 12%.
 - .5 Masonry / Concrete: maximum moisture content 12% for solvent type paint. Masonry surfaces may be tested for alkalinity.
 - .6 Wood: maximum moisture content 12%.
- .2 Proper lighting shall be the Contractor's responsibility.
- .3 All areas where painting and coating work is proceeding require adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 7 °C (45 °F) for 24 hours before and after paint application. Required heat and ventilation shall be provided by the Contractor.

1.9 PROTECTION

- .1 Adequately protect other surfaces from paint and damage and make good any damage caused by failure to provide suitable protection, but this section will not be responsible for any damage caused by others.
- .2 Furnish sufficient drop cloths, shields and protective equipment to prevent spray of dropping from fouling surfaces not being painted and in particular, surfaces within the storage and preparation area.
- .3 Cotton waste, cloths and material, which may constitute a fire hazard, shall be placed in closed metal containers and removed daily from the site.
- .4 Remove all surface hardware, electrical plates, fittings, fastenings, etc. prior to painting operation.
 - .1 These items shall be carefully stored, cleaned and replaced on completion of work in each area.

1.10 SCHEDULING

- .1 Schedule painting operations to prevent disruption of and by other trades.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Paint, varnish, stain, enamel, lacquer, and fillers used shall be of a type and brand herein specified and listed under "Paint Product Recommendations" as covered in the MPI Architectural Painting Specification Manuals, latest edition, for specific purposes.
- .2 Paint materials such as linseed oil, shellac, turpentine, etc. and any of the above materials not specifically mentioned herein but required for first class work with the finish specified shall be of the highest quality product of an approved manufacturer.
- .3 All coating material shall be compatible.
- .4 All materials shall be lead, hex. chromium, cadmium and mercury free and shall have low VOC content.
- .5 Preference should be given to ISO 2002 registered manufacturers.
- .6 Only qualified products with E2 "Environmentally Friendly" rating are acceptable for use on this project.
 - .1 Provide paint products meeting MPI "Environmentally Friendly" E2 ratings based on VOC (EPA Method 24) content levels.
 - .2 Use MPI listed materials having minimum rating where indoor air quality (odour) requirements exist.
- .7 All material shall be premium Architectural grade unless otherwise specified.
- .8 Where required, paints and coatings shall meet the flame spread requirements of local authorities having jurisdiction.

2.2 GLOSS

- .1 Paint gloss is defined as the sheen rating of applied paint, in accordance with the following values:
 - .1 Gloss Level 1: Flat or matt: max. 5 units @ 60 degrees to a maximum of 10 units @ 85 degrees.
 - .2 Gloss Level 2: High Sheen Flat (Velvet-like): max. 10 units @ 60 degrees to a maximum of 10 – 35 units @ 85 degrees.
 - .3 Gloss Level 3: Eggshell: max. 10 – 25 units @ 60 degrees to a maximum of 10 – 35 units @ 85 degrees.
 - .4 Gloss Level 4: Satin-like Finish: max. 20 – 35 units @ 60 degrees to a minimum of 35 units @ 85 degrees.
 - .5 Gloss Level 5: Semi-gloss Finish: max. 35 – 70 units @ 60 degrees.
 - .6 Gloss Level 6: Gloss Finish: max. 70 – 85 units @ 60 degrees.
 - .7 Gloss Level 7: High Gloss Finish: more than 85 units @ 60 degrees.

PART 3 EXECUTION

3.1 GENERAL

- .1 Method of paint application shall be generally by the accepted trade method. Painting coats specified are intended to cover surfaces satisfactorily when applied in strict accordance with recommendations.
- .2 Apply each coat at the proper consistency.
 - .1 Each coat of paint shall be slightly darker than preceding coat unless otherwise approved.
- .3 Sand lightly between coats to achieve the required finish.
 - .1 Each coat of finish should be dry and hard before a following coat is applied unless the manufacturer's directions state otherwise (4 hours for latex; 8 hours for alkyd).
- .4 Tint filler to match wood when clear finished are specified; work filler well into the grain and before it has set wipe the excess from the surface.
- .5 Application of paint shall be in strict accordance with MPI Architectural Painting Specification Manual requirements.
- .6 Complete hiding is required on all finishes, including deep tone colours.
- .7 Contractor shall employ sufficient tradesmen to carry out the job with no interruption, slow down or inconvenience to the project schedule and operations.

3.2 CONDITION OF THE SURFACES

- .1 Prior to commencement of work of this section, thoroughly examine all surfaces scheduled to be painted.
- .2 Report to Departmental Representative any condition adversely affecting this work.
- .3 No painting work shall proceed until all defects have been corrected and surfaces are acceptable for painting.
- .4 Commencement of work shall be held to imply acceptance of surfaces.
- .5 All preparation work shall be the responsibility of this section.

3.3 PREPARATION OF SURFACES

- .1 Prior to commencement of work of this section, thoroughly examine all surfaces scheduled to be painted. Report to Departmental Representative any conditions adversely affecting this work. Prepare all interior surfaces for repainting in accordance with MPI Manual requirements.
- .2 No painting work shall proceed until all defects have been corrected and surfaces are acceptable for painting.
- .3 Prepare all surfaces in accordance with the requirements in Chapter 3 of the MPI Architectural Painting Specification Manuals (latest edition) and as herein specified.

- .4 Remove and securely store all miscellaneous surface fittings / fastenings (eg: electrical places and frame stops), removable rating/hazard/instruction labels, prior to painting and replace upon completion.
 - .1 Carefully clean and replace all such items upon completion of repainting work in each area.
 - .2 Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (eg: lacquer finishes).
- .5 All surfaces shall be sanded prior to the application of any coatings.
- .6 Allow full drying between coats, as per manufacturer's recommendations.
 - .1 Sand in between coats.
- .7 Repair all water damaged surfaces and spot prime with a stain blocking primer.
- .8 Surface defects, such as nail / screw popping, paper tears, nicks and scratches, line gauges caused by chair back seat rests, tables, etc., shall be filled, sanded and spot primed with an approved primer and shall be considered normal surface preparation.
- .9 Units severely contaminated with grease, smoke and tar – hand wash with detergent and rinse thoroughly prior to any surface preparation.
- .10 All surfaces: applications shall be by brush / roller, including smooth ceilings.
- .11 Allow full drying between coats, as per manufacturer's recommendations. Sand in between coats.
- .12 Surface defects such as old paint runs on walls and wood works must be sanded smooth prior to the applications of any coating (s).
- .13 Tape fill, sand and spot prime all minor cracks.
- .14 Remove clear tape from walls, ceilings, doors, etc.
- .15 Remove felt pen graffiti from doors, walls, etc. before priming.
 - .1 Prepare and paint all mechanical and electrical services with the appropriate primers, as per MPI Architectural Specification Manual, latest edition.
- .16 Ensure that a transition primer is applied over alkyd surfaces where waterborne systems have been specified.

3.4 FIELD QUALITY CONTROL

- .1 In strict accordance with the MPI Architectural Painting Specifications Manuals requirements.

3.5 PAINTING SCHEDULE

- .1 The following titles, grades and code numbers refer to those listed in the Master Painters Institute (MPI) Architectural Painting Specifications Manual, latest edition.
- .2 Exterior Systems (Refer to Chapter 2, MPI Manual):
 - .1 Metal Fabrication (non-galvanized) – (Premium Grade):
 - .1 EXT 5.1 L (gloss level 3) Pigmented polyurethane over inorganic zinc-rich primer and high build epoxy.

- .2 Galvanized Metals (Premium Grade):
 - .1 EXT 5.3G WB light industrial coating, (gloss level 3) (modify by cleaning / etching first with MPI product #25).
 - .2 Use this finish on exterior galvanized steel including but not necessarily limited to structural connections, hollow metal doors and frames, louvers and vents, piping and other galvanized metal as indicated and as specified.
- .3 Glulam Members, Dressed Lumber and Wood Paneling (Premium Grade) – transparent finish:
 - .1 Special three (3) application process: stain (colour as selected by Architect), basecoat and topcoat.
 - .2 Use this finish on PSL beams, exposed joists and other glulam members and lumber as indicated and as specified.
 - .3 Example of approved wood basecoat and topcoat are “Cetol 1” and “Cetol 23 Plus” by Sico Proluxe.
- .4 Dimension Lumber (Premium Grade):
 - .1 EXT 6.2 P WB stain, semi-transparent (gloss level 3).
 - .2 Use this finish on the T&G roof decking.
 - .3 Sample required; pickled finish.
- .3 Interior Systems (Refer to Chapter 3, MPI Architectural Painting Specifications Manual):
 - .1 Dressed Lumber for Painted Finish (Premium Grade) – wood window & door trims:
 - .1 INT 6.3 A High-performance architectural latex (level 5 sheen).
 - .1 Sand with 320 grit.
 - .2 Second coat: approved lacquer, 20% sheen.
 - .3 Sand with 320 grit.
 - .4 Third coat: approved lacquer, 20% sheen.
 - .2 Wood Paneling (Premium Grade) – transparent finish:
 - .1 INT 6.4 U WB varnish, clear (gloss level 4), over stain (color as selected by Architect).
 - .2 Use this finish on interior plywood panels.
 - .3 Wood Millwork (Premium Grade) – bench, desk, cabinets, shelving, etc.:
 - .1 INT 6.4 U WB varnish, clear (gloss level 4), over stain (color as selected by Architect).
 - .2 Use this finish on wood millwork including but not necessarily limited to work bench, work desk, cabinets, shelving and other millwork as indicated and as specified.

- .4 Galvanized Metal (Premium Grade):
 - .1 Two (2) finish coats of MPI Product n° 169 water-based modified alkyd over approved shop-applied galvanized metal prep / primer.
 - .2 Touch-up shop primer after erection but prior to finish coats.
 - .3 Use this finish on interior galvanized steel including but not necessarily limited to hollow metal doors and frames and other galvanized metal as indicated and as specified.
- .5 Concrete Floors:
 - .1 Clear sealer applied using either roller or low-pressure spray at rate of 7.5 m² / L.
 - .2 Example of approved products are "702 Acrylic Cure" by ELSRO and "Florseal-Clear" by Sterson's.

3.6 MECHANICAL AND ELECTRICAL EQUIPMENT – GENERAL

- .1 Paint exposed metalwork including but not necessarily limited to conduits, pipes, hangers and other mechanical and electrical equipment in connection with mechanical and electrical trades within finished areas of the building. Paint as follows:
 - .1 One (1) coat of approved metal primer (galvanized primer where applicable), two (2) coats of enamel (semi-gloss) in accordance with INT 5.1 R.
 - .2 Paint covered and insulated pipes and ducts with three (3) coats: one (1) coat PVA sealer and two (2) coats enamel (semi-gloss).
 - .3 Paint inside of ducts behind grilles and registers with one (1) coat flat black paint.
 - .4 Colour: white.

3.7 PAINT COLOUR SCHEDULE

- .1 To be issued as a separate document.

3.8 ADJUST AND CLEAN

- .1 On completion of the work, remove all paint where spilled, splashed or splattered.
- .2 During the progress of the work, keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.
- .3 At the conclusion of the work leave the premises neat and clean to the satisfaction of the Consultant.

3.9 FIELD QUALITY CONTROL

- .1 Painting surfaces will be considered to lack uniformity and soundness if any of the following defects are apparent:
 - .1 Runs, sags, hiding or shadowing by inefficient application methods.
 - .2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - .3 Damage due to touching before paint is sufficiently dry or any other contributory cause.
 - .4 Damage due to contamination of paint due to airborne particles.

3.10 PROTECTION

- .1 Protect all newly painted exterior surfaces from rain and snow, condensation, contamination, dust, salt spray and freezing temperatures until paint coatings are completely dry.
- .2 Curing periods shall exceed the manufacturer's recommended minimum time requirements.
- .3 Erect barriers or screens and post signs to warn of or limit or direct traffic away or around work area as required.

3.11 CLEANING

- .1 Promptly as the work proceeds and on completion of the work, remove all paint where spilled, splashed or spattered using methods that are not detrimental to affected surfaces.
- .2 Keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.
- .3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.
- .4 Clean equipment and dispose of wash water / solvents as well as all other cleaning and protective materials (ie. rags, drop cloths, masking papers) paints, thinners paint removers/strippers in accordance with the safety requirements of authorities having jurisdiction.
- .5 At the conclusion of the work, leave the premises neat and clean.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 05 50 00: Metal Fabrications
- .2 Section: 08 11 00: Steel Doors and Frames

1.2 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings for work of this section.
 - .2 Identify and describe material types being supplied, wall thicknesses of extrusions, and shapes including all connections and grades, attachments, reinforcing, anchorage and locations of fastenings, and provisions for thermal and structural movement between components of work of this section and adjacent materials.
 - .3 Include description of materials, finishing specifications, and all other pertinent information.
 - .4 Clearly indicate fabrication details, plans, elevations, hardware, and installation details.
 - .5 Digital proofs:
 - .1 Submit one complete set of colour digital proofs showing placement and typography of final graphic components and images.
 - .2 Proofs shall show final text and images, in place, scaled to accurately assess type spacing, overlay text on images, illustrations and graphic effects such as bleeds, graded colour, etc.
- .3 Samples:
 - .1 Submit 305 mm x 305 mm sample for each sign type, each fastener type and finish specified.
- .4 Mock-Up:
 - .1 Provide when requested, at the Consultant's discretion, mock-ups of items as requested by Consultant.
- .5 Product Data Sheets:
 - .1 Submit manufacturer's product data sheets for Products proposed for use in the work of this section.
 - .2 Submit manufacturers' installation instructions.
- .6 Templates:
 - .1 Submit templates to Contractor for use by installers and fabricators as required for proper location and installation of signage.
- .7 Closeout Submittals:
 - .1 Submit closeout submittals in accordance with Section 01 78 00: Closeout Submittals.

- .2 Operation and maintenance data:
 - .1 Submit operation and maintenance data instructions for signage and finishes.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Package or crate, and brace and wrap Products to prevent damage during shipment and handling.
- .2 Label packages and crates according to signage numbers as listed in the signage schedule and protect finish surfaces from environmental conditions where required.
- .3 Deliver Products to location at building site designated by Contractor.
- .4 Provide methods for lifting or hoisting units into place without causing damage.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Exterior sign system: Individual Stainless-Steel Reverse Channels Letters.
 - .1 Anchor system: BM-3B single back bar mount.
 - .2 Colour: grey to match door frame.
 - .3 Font: Tahoma.
 - .4 Size: 250 mm high.

2.2 FABRICATION

- .1 General: produce smooth, even, level sign panel surfaces, constructed to remain flat when installed within a tolerance of ± 1.5 mm measured diagonally from corner to corner.
- .2 Laminated sign panels where utilized:
 - .1 Permanently laminate face panels to backing sheets, of material and thickness indicated, using manufacturer's standard process.
- .3 Copy application:
 - .1 Edges of letters, numbers or symbols shall be smooth with corners sharp and true.
 - .2 Forms shall be free of ticks, line waver, discontinuous curves and other imperfections.
 - .3 Submit samples of the range of colours and fonts available for signage for approval.
 - .4 Minimum font size shall be 18 mm.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Examine surfaces to which signage is to be anchored and report any unacceptable conditions.
 - .1 Commence work only after surfaces are acceptable.
- .2 Install in accordance with signage manufacturer's specifications and templates as required for installation of work of this section.
- .3 Install signage level and secure at locations indicated.

3.2 COORDINATION WITH OTHER SECTIONS

- .1 Coordinate mounting requirements of signage with Section 05 50 00.

3.3 ADJUSTMENT AND CLEANING

- .1 Verify under work of this section that installed Products function properly and adjust them accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible.
 - .1 Refinish work at site only if acceptable.
- .3 Remove excess materials from the site.
- .4 Upon completion of the work of this section, or at such time or times as the Consultant shall direct, remove protective coverings and clean down the finished work.
- .5 Clean adjacent surfaces which have been soiled or otherwise marred, in an acceptable manner, to completely remove evidence of material causing same.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 06 10 00: Rough Carpentry
- .2 Section 09 30 13: Ceramic Tiling
- .3 Division 22: Plumbing

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM):
 - .1 ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM B456, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian Standards Association (CSA):
 - .1 CAN/CSA-B651, Barrier-Free Design.

1.3 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Shop Drawings:
 - .1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in frame, building-in details of anchors for grab bars.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for washroom accessories for incorporation into manual specified in Section 01 78 00: Closeout Submittals.

1.4 EXTRA MATERIALS

- .1 Provide special tools required for accessing, assembly/disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00.
- .2 Deliver special tools to Consultant.

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 WASHROOM ACCESSORY MATERIALS

- .1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A167, Type 302 with N° 4 finish.
- .3 Stainless steel tubing: Type 304 commercial grade, seamless welded, 1.2 mm wall thickness.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields, fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.
- .5 All washroom accessories shall be the same design line of the same manufacturer.
- .6 Minimum standard for washroom accessories shall be Bobrick "Contura Series". Other products having the same characteristics will not be excluded.

2.2 WASHROOM ACCESSORY COMPONENTS

- .1 Toilet tissue dispenser: surface mounted, double roll type, stainless steel.
- .2 Feminine napkin disposal: surface mounted, stainless steel, continuous hinged door, self closing.
- .3 Grab bars: 32 mm o.d. x 1.2 mm wall tubing of stainless steel, concealed attachment, with steel back plates and accessories, anchored to withstand downward pull of 2.2 kN, anti-slip finish.
- .4 Mirror: 610 mm x 910 mm, stainless steel channel frame.
- .5 Soap dispenser: one hand operation, maximum force of 22.2 N to dispense soap, minimum 1.0 litre capacity, wall mounted.
- .6 Waste receptacle: foot-operated, heavy-gauge or reinforced stainless steel, removable galvanized steel or plastic waste receptacle, minimum waste capacity 45 litres.
- .7 Paper towel dispenser: surface mounted, stainless steel door with tumbler lock.
- .8 Hook: stainless steel.
- .9 Diaper change table: wall mounted, polypropylene cabinet and bed, retractable type, white.

2.3 FABRICATION OF TOILET ACCESSORIES

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

- .9 Provide steel anchor plates and components for installation on wall framing and components.
- .10 Lettering:
 - .1 For identification of accessories and operation instructions shall be silk screened using international symbols unless otherwise specified.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- .1 Verification of conditions:
 - .1 Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .2 Do not proceed until unsatisfactory conditions have been corrected.
- .2 Surface preparation:
 - .1 Prior to installation, clean substrate to remove dirt, debris and loose particles.
 - .2 Perform additional preparation procedures as required by manufacturer's instructions.
- .3 Protection:
 - .1 Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.

3.2 GENERAL INSTALLATION

- .1 Install all components in strict accordance with manufacturer's written instructions.

3.3 COORDINATION / COOPERATION

- .1 Coordinate work of this Section with Section 06 10 00 for wood blocking.
- .2 Coordinate work of this Section with Section 09 21 13 for wall framing.
- .3 Coordinate work of this Section with that of Division 22 for plumbing.

3.4 INSTALLATION OF WASHROOM ACCESSORIES

- .1 Install and secure accessories rigidly in place as follows:
 - .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
 - .2 Hollow masonry units: use toggle bolts drilled into cell / wall cavity.
 - .3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.
 - .4 Toilet compartments: use male / female through bolts.
- .2 Install accessories to permit operable parts and controls to be accessed in accordance with accessibility requirements of NBCC 2010.
- .3 Use tamper proof screws / bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.

3.5 WASHROOM ACCESSORY LOCATION SCHEDULE

- .1 Locate washroom accessories where indicated. Exact locations determined by Consultant.

3.6 CLEANING AND PROTECTION

- .1 Immediately upon completion of installation, clean materials in accordance with manufacturer's recommended cleaning method.
- .2 Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.
- .3 Protect installed materials to prevent damage by other trades.
 - .1 Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 Perform work in accordance with the recommendations and requirements of:
 - .1 National Fire Protection Association, NFPA 10 – Standard for Portable Fire Extinguishers.
 - .2 National Building Code of Canada 2010

1.2 SUBMITTALS

- .1 All submittals shall be in accordance with Section 01 33 00: Submittal Procedures.
- .2 Submit shop drawings (showing locations and mounting details) and product data for the extinguishers.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into the Mechanical Operation and Maintenance Manuals, as per Section 01 78 00: Closeout submittals.

PART 2 PRODUCTS

2.1 PRODUCTS

- .1 Semi-recessed cabinet with extinguisher:
 - .1 230mm wide x 610mm high x 152mm deep cabinet.
 - .2 Full length semi-concealed piano hinges for 180 degree swing.
 - .3 Flush stainless steel door latch with no exposed fasteners.
 - .4 22 gauge steel tub.
 - .5 16 gauge steel door and trim with optional 5 mm clear tempered glass.
 - .6 Grey prime coated finish ready for field painting.
 - .7 4.5 kg (10 lb) ABC dry chemical multipurpose fire extinguisher.
- .2 An example of accepted product is NFE model CE-950-3-2 (semi-recessed) extinguisher cabinet. Other products having the same characteristics will not be excluded.

2.2 QUANTITY AND LOCATIONS

- .1 The Fire Extinguisher supplier shall determine the type, quantity and location of the cabinets based on NFPA 10, NBCC 2010, the Building Occupancy Classification and mechanical drawings. Locations shall be approved by the Consultant.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install fire extinguishers in cabinets at locations as directed by Consultant.
- .2 Coordinate locations of fire extinguisher cabinets with Sections 06 10 00: Rough Carpentry, Section 09 21 13: Non-Structural Metal Framing and Section 09 29 00: Gypsum Board in order to facilitate recessed and semi-recessed installations, as well as the provision of solid wood blocking in stud spaces.
- .3 Mount fire extinguishers and cabinets such that the top of the extinguisher is at 1200mm above the floor.
- .4 Install fire extinguisher cabinet doors, glazing panels and fire extinguishers in the cabinets prior to the project substantial completion review by the Consultant.

3.2 IDENTIFICATION

- .1 Identify fire extinguishers in accordance with the recommendations to NFPA 10.
- .2 Attach a tag or label to all fire extinguishers, indicating the month and year of installation, with space for recording subsequent service dates.

END OF SECTION

PART 1 GENERAL**1.1 SECTION SCOPE**

- .1 Piping, valves and specialties serving building water distribution systems to 1m (36") outside the building
- .2 Sanitary and vent piping, equipment and accessories between plumbing fixtures to 1m (36") from the building.

1.2 RELATED REQUIREMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts. For general conditions refer to Section 23 05 02 Heating, Ventilation and Air Conditioning.

1.3 CODE COMPLIANCE

- .1 All work shall comply with current editions of the National, Provincial and Municipal Plumbing Codes, Standards, Acts and Bylaws and will meet the requirements of the Authority having jurisdiction.

1.4 CLEANOUTS

- .1 Provide cleanouts on all sanitary piping at all changes in direction, at the ends of all horizontal runs, at the base of every stack, where drains leave the building; where shown on the drawings and in compliance with the local plumbing code, bylaws and ordinances.
- .2 Provide caulked or threaded type cleanouts extended to finished floor wall surface.

PART 2 PRODUCTS**2.1 PIPING**

- .1 Pipe Material
 - .1 Sanitary and Vent (above grade).
 - .1 DWV Copper
 - .2 Cast Iron Class 4000
 - .2 Sanitary and Vent (below grade inside building to 1m outside).
 - .1 Cast Iron Class 4000
 - .3 Domestic Water (above grade inside building).
 - .1 Type "K" Hard Copper for hot and cold water

- .2 Polypropylene (PP-R), SDR7.4 fusion weld pipe and fittings complying with $^{25}/_{50}$ requirements of CAN/ULC S102.2
- .4 Domestic Water (below grade inside building to 1m outside).
 - .1 Type "K" Soft Copper to 4 NPS diameter
- .5 Domestic Water Service (below grade, outside service).
 - .1 Type "K" Soft Copper

2.2 VALVES

- .1 General:
 - .1 Wherever possible all valves shall be of one manufacturer.
 - .2 Grooved valves shall be of the same manufacturer as the adjoining couplings.
 - .3 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body. All valves must be suitable in all respects for service used.
 - .4 All valves shall have a Provincial CRN number which is current.
 - .5 Use non-rising stem valves only where there is insufficient clearance for stem to rise.
- .2 Ball Valves 2 NPS and under
 - .1 Low lead forged brass body, 2 piece body, full port, chrome plated ball, PTFE seats, blow out proof stem, adjustable packing nut, for domestic water service.
 - .2 Class 4140 kPa (600 psi) W.O.G.
 - .1 Soldered: Toyo/Red & White 5544DAB or equal.
 - .2 Screwed: Toyo/Red & White 5549DAB or equal.
- .3 Gate Valves 2 NPS and under:
 - .1 Lead free bronze body, solid wedge disc, bronze or stainless steel trim, non-rising stem, for domestic water service.
 - .2 Class 1380 kPa (200 psi) W.O.G.
 - .1 Soldered: Toyo/Red & White 207AB or equal.
 - .2 Screwed: Toyo/Red & White 206AB or equal.
- .4 Globe Valves 2 NPS and under:

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- .1 Lead free bronze body, swivel type stainless steel disc, union bonnet, for domestic water service.
- .2 Class 1380 kPa (200 psi) W.O.G.
 - .1 Screwed: Toyo/Red & White 211AB or equal.
- .5 Check Valves 2 NPS and smaller:
 - .1 Lead free bronze swing check with bronze disc capable of being reground, Y pattern, suitable for domestic water use.
 - .2 Class 1380 kPa (200 psi) W.O.G.
 - .1 Soldered: Toyo/Red & White 237AB or equal.
 - .2 Screwed: Toyo/Red & White 236AB or equal.

2.3 PLUMBING PIPING SPECIALTIES

- .1 Vacuum Relief Valve: (for hot water tanks installations)
 - .1 $\frac{1}{2}$ - $\frac{3}{4}$ NPT, low profile, all brass construction, protective cap, tested to ANSI Z21.22, CSA certified, 860 kPa (125 psi) rating, maximum temperature 121°C (250°F).
- .2 Pressure Reducing Valve:
 - .1 1 NPS and smaller:
 - .1 Lead free copper silicon alloy body or low lead bronze body, SS integral strainer, renewable SS seat, serviceable inline, built in bypass check valve, suitable for hot and cold water potable water. Rated at maximum inlet pressure of 2100 kPa (305 psi) and 82°C (180°F) temperature.
 - .2 $1\frac{1}{4}$ NPS to 2 NPS screwed ends:
- .3 Backflow Preventers Double Check Valve Assembly (DCVA)
 - .1 2 NPS and smaller, lead free cast copper silicone alloy body, twin positive seat check modules, captured springs, replaceable check module seats and discs, two isolation valves, test cocks and a bronze strainer. Comply with CSA B64.5 and AWWA C510
 - .1 Maximum working pressure: 1206 kPa (175 psi)
 - .2 Watts LF007 or equal
- .4 Reduced Pressure Backflow Assembly (RPBA)

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- .1 2 NPS and smaller, lead free cast copper silicone alloy body, pressure differential relief valve, replaceable check module seats and discs, two isolation valves, test cocks and a strainer. Comply with CSA B64.4 and AWWA C511.
 - .1 Maximum working pressure: 1206 kPa (175 psi)
 - .2 Watts LF009 or equal
- .5 Water Hammer Arrestors
 - .1 Bellows type with welded stainless steel nesting bellows or piston style and stainless steel casing.
 - .2 Air chambers are unacceptable.

2.4 PREFORMED PIPE INSULATION

- .1 Low to Intermediate Temperature, 5°C to 315°C (41°F to 599°F)
 - .1 Preformed insulation, fine fibrous glass or formed mineral fibre pipe insulation with all service jacket vapour retarder (ASJ). ASJ shall be re-enforced with glass fibre, factory applied with pressure sensitive lap closure. Maximum "K" value at 38°C (100°F) = 0.035 W/m.°C (0.24 Btu.in/hr.ft².°F)
 - .2 Finish Jackets
 - .1 Thermocanvas Jacket: fire rated, 170g (6 oz) fire retardant canvas jacket for covering mechanical insulation indoors, ²⁵/₅₀ fire class, plain wave cotton, no dyes.

2.5 CLEANOUTS

- .1 Floor - Unfinished Area: Cast iron floor level cleanout assembly with extra heavy duty, round, adjustable, scoriated, secured cast iron top and no-hub outlet. Suitable for heavy traffic
- .2 Floor - Finished Area:
 - .1 General areas: Cast iron cleanout with extra heavy duty round, adjustable, scoriated, secured nickel bronze top, and no-hub outlet
 - .2 Foot traffic areas with sheet goods flooring: Cast iron floor level cleanout assembly with a square adjustable nickel bronze top with 6mm (1/8") tile recess, and no-hub outlet.
 - .3 Carpeted floor area subject to foot traffic: Cast iron floor level cleanout assembly with round, adjustable, scoriated, nickel bronze top and carpet clamping frame.
- .3 Wall – Finished Area:

- .1 Concealed drainage line in a finished wall: Cast iron cleanout tee and cast iron countersunk plug with stainless steel round cover and screw.

2.6 FLOOR DRAINS

- .1 Provide trap seal priming connections on all drains
- .2 Finished Area Drains
 - .1 Floor Drain "FD1" (washroom,)
 - .1 Heavy duty polished nickel bronze round strainer, 75mm (3") diameter
 - .2 [Vandal proof secured top]
 - .3 Watts FD-100 CA or equivalent

2.7 TRAP SEAL PRIMERS

- .1 Provide flow actuated type priming device, vacuum breaker ports and internal back-flow protection, lead free brass body, stainless steel screen, factory pre-set, activation by a minimum flow rate of 0.03l/s @ 138 kPa (0.5 GPM @ 20 psi). ½ NPS inlet and outlet, capable of serving 1 to 4 traps.
- .2 Provide a timer / solenoid activated priming system.
 - .1 Solenoid: ½ NPT Slow closing solenoid valve, forged brass body, Buna "N" disc, stainless steel parts, enclosure to suit environmental conditions, UL and CSA approved, 120 volt.
 - .2 Provide ½ NPT globe valve upstream of the solenoid valve for throttling.
 - .3 Provide a relay and building automation system interface. Coordinate with Division 25 to provide the DDC connection and an adjustable schedule such that the valve is actuated for 3 minutes (adjustable) once a week.
- .3 Coordinate with Division 26 for solenoid power requirements and location.

2.8 SAFES, FLASHING AND VENT TERMINALS

- .1 Metal Flashing: 26 gage galvanized steel. Metal Counter flashing: 22 gage galvanized steel.
- .2 Lead Flashing: Waterproofing: 5 lb/sq ft sheet lead
- .3 Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- .4 Floor Drain Flashing: 40 mil thick chlorinated polyethylene (CPE), equivalent to Chloraloy.
- .5 Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.9 EXPANSION TANKS – DOMESTIC HOT WATER

- .1 Diaphragm or bladder type expansion tank, welded steel tank, internal butyl/EPDM diaphragm or butyl bladder, rigid polypropylene liner. Integral floor stand for vertical installation. Listed for potable water systems.
- .2 ASME rated for a working pressure of 861 kPa (125psi)
- .3 Amtrol Therm-x-trol model ST-5 Cseries or equal

2.10 PLUMBING FIXTURES -

- .1 Water Closet (WC1) – Tank Type
 - .1 Bowl: Floor mount tank type toilet, colour white, vitreous china, 6 L (1.6 US Gal) per flush, two (2) piece, lined tank, close coupled flushometer tank , 305 mm (12") rough-in, elongated bowl, MAP rating 1000, bolt caps.
 - .1 American Standard Cadet Right Height 419 mm high or equal.
 - .2 Seat: Heavy duty toilet seat, elongated bowl, white solid plastic, open front less cover, stainless steel check hinges, stainless steel posts and nuts.
 - .1 American Standard #5901100 or equal
- .2 Lavatory (L1) – Wall Mount
 - .1 Basin: Wall mounted, vitreous china, white, front overflow, faucet ledge 102mm (4") centre set.
 - .1 American Standard Lucerne Universal Access or equal
 - .2 Trim: two-handle faucet, lead free chrome plated brass construction, volume control and Hot Water Limit Stop cartridge, 4.5 LPM (1.2 GPM), 117 mm (4⁵/₈") projection rigid cast brass spout, single metal lever handle.
 - .1 American Standard #7075.800 or equal
 - .3 Point Of Use Mechanical Water Mixing Valve, bronze body, temp. adjustment, 10 mm (3/8") connections, thermostatic limit stop, shut-off with automatic reset when temperature exceeds 48.8 °C (120 °F), integral checks.
 - .1 Lawler #TMM-1070 or equal
 - .4 Open Grid Drain, cast brass one piece top, tubular 32 mm (1¹/₄") tailpiece.
- .3 Sink (S1) – Single Bowl Stainless Steel
 - .1 Basin: Counter mount sink, 1 hole, 543 mm (21-3/8") wide x 406 mm (16") x 229 mm (9") ,stainless steel, satin finish, undercoated.

- .1 American Standard Portsmouth #18sb9231800s or equal
- .2 Trim: Two Handle top mount faucet, lead free brass body, 5.7 LPM (1.25 GPM) pressure compensating aerator, 203 mm (8") goose knecksput, lever handles
 - .1 American Standard #6409170 or equal.
- .4 Domestic Water Heater (Point of Use)
 - .1 Electric hot water heater, $\frac{3}{4}$ NPS connections, anode rod, T & P relief valve, Capacity: 23L (6gal)38L (10gal)76L (20gal)114L (30gal)
 - .2 Water heaters furnished standard with 120 volt AC, 1500 watt single element.
 - .1 Bradford White lowboy LE120I3-3 or equal
- .5 Hot Water Dispenser (Instantaneous Hot Water Heater)
 - .1 Provide an Instant hot water dispenser with 2.5L ($\frac{2}{3}$ gal) stainless steel tank, adjustable temperature from 71°C (160°F) to 99°C (210°F) and instant self closing hot valve. Electrical 115 volts, 750 Watts.
 - .1 In-Sink-Aerator Model H-770 or equal.

PART 3 EXECUTION

3.1 PIPING

- .1 Water pipe connections unless noted otherwise:
 - 1½ NPS and less: soldered or screwed joint
- .2 Use dielectric type couplings when joining dissimilar metal pipes.
- .3 Use lead free solder for soldering domestic water copper pipe.
- .4 Pipe Hangers and Supports
 - .1 Provide hangers and supports to secure equipment in place, prevent vibration, protect against damage from earthquake, maintain grade, provide for expansion and contraction and accommodate insulation.
 - .2 Provide galvanized hangers and supports for all piping except hangers and supports shall be copper plated or epoxy coated for copper piping.
 - .3 Use of perforated straps is not permitted for pipe hangers.
 - .4 Power actuated fasteners and "drop-in" anchors shall not be used.
 - .5 Provide ring type hangers for piping up to NPS 1½

3.2 PIPE SUPPORT SPACING

| Material | Maximum Pipe Size NPS | Minimum Rod Diameter mm (in) | Maximum Rod Length mm (in) | Maximum Spacing m (ft) |
|----------|--------------------------|---------------------------------|-------------------------------|---------------------------|
| copper | up to 3/4 | 9 (3/8) | n/a | 1.5 (5) |
| | 1 | 9 (3/8) | n/a | 1.85 (6) |
| | 1 1/4 | 9 (3/8) | n/a | 2.15 (7) |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

- .1 Plastic or glass pipe
 - .1 Refer to manufacturers recommendations for maximum spacing requirements.
 - .2 Utilize the minimum rod diameter and maximum rod length for the corresponding pipe size of steel pipe.
- .2 For rod lengths in excess of the tabulated maximum rod length, reinforcing is required per SMACNA Seismic Restraint Manual or the Seismic Engineers written instruction.

3.3 VALVES

- .1 Install all valves in accordance with manufacturer’s recommendations.
- .2 Install valves in accessible locations with stems upright or angled 45° above horizontal unless approved otherwise. Valves must be accessible without removing adjacent piping.
- .3 Install control valves with their stems upright unless approved otherwise and with adequate clearance for removal of actuators.
- .4 Provide stem extensions on all insulated valves.
- .5 Provide full port ball valves in piping 50 mm (2”) and smaller
- .6 Throttling valves are not to be used for shut-off; additional valves shall be installed for isolation purposes.
- .7 Provide isolation valves at branch take-offs, to isolate each piece of equipment, upstream of all meters, gauges, automatic air vents, and as indicated.

3.4 PIPING INSULATION MINIMUM THICKNESS SCHEDULE

| Type of System | Design Operating Temperature Range °C (°F) | Thermal Conductivity of Insulation | | Nominal Pipe Diameter (NPS) | | | | |
|----------------------|--|------------------------------------|---------------------------------|---|-----------|----------|--------|-----|
| | | Conductivity Range W/m.°C | Mean Rating Temperature °C (°F) | Runouts ≤ 1 | 1 to 1.25 | 1.5 to 3 | 4 to 6 | ≥ 8 |
| | | | | Minimum Thickness of Piping Insulation (mm) | | | | |
| Above Grade Exterior | All | 0.046-0.049 | 121 (250) | 40 | 65 | 65 | 75 | 90 |
| Hot Water Systems | 61-93 (142-200) | 0.036-0.042 | 52 (126) | 40 | 40 | 50 | 50 | 50 |
| | 41-60 (106-141) | 0.035-0.040 | 38 (100) | 25 | 25 | 40 | 40 | 40 |
| Cold Water Systems | 5-13 (41-55) | 0.033-0.039 | 24 (75) | 25 | 25 | 25 | 25 | 25 |
| | <5 (41) | 0.029-0.037 | 10 (50) | 25 | 25 | 25 | 25 | 40 |

Note: Where the thermal conductivity of a proposed insulation is greater than the range specified above, the thickness will be increased by the ratio of U_2/U_1 .

U_2 = proposed insulation "k" value at the table mean rating temperature.

U_1 = upper range limit "k" value from the table above.

Note: Where thermal conductivity of proposed insulation is less than the range specified above, the thickness may be decreased by the ratio of U_2/U_1 .

U_2 = proposed insulation "k" value at the table mean rating temperature.

U_1 = lower range limit "k" value from the table above.

3.5 PIPING FINISH SCHEDULE

- .1 Indoors concealed; factory finish
- .2 Indoors exposed; canvas jacket

3.6 SAFES, FLASHING AND VENT TERMINALS

- .1 Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls and floors.
- .2 CPE, Chloraloy 240 lining or lead material may be used at floor drains and cleanouts. Chloraloy shall be solvent welded to manufacturer's installation instructions. Lead shall not be used on roofs where the roofing material is applied by a torch-on method.
- .3 Flash floor drains in floors with topping over occupied areas with lead or CPE membrane, a minimum of 300mm (12") clear on sides with minimum 900mm x 900mm (36" x 36") sheet size. Fasten flashing to drain clamp device.

END OF SECTION

PART 1 GENERAL**1.1 RELATED REQUIREMENTS**

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 GENERAL SCOPE

- .1 'Provide' shall mean 'supply and install'.
- .2 'Consultant' shall mean AME Group Consulting Professional Engineers
- .3 Provide complete, fully tested and operational systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .4 Contract documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality but are not detailed installation instructions.
- .5 Follow manufacturers' recommended installation instructions, details and procedures for equipment, supplemented by requirements of the Contract Documents.
- .6 Make reference to electrical, mechanical, structural and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

1.3 CODE COMPLIANCE, PERMITS AND FEES

- .1 All work shall comply with current editions of the National, Provincial and Municipal Codes, Standards, Acts and Bylaws and will meet the requirements of the Authority having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the scope of work. Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.

1.4 TENDER PRICE BREAKDOWN

- .1 Submit a tender price breakdown within thirty (30) days of tender closing and before first progress claim, in a format agreed to with the Consultant. As a minimum, include the following in the tender price breakdown:
 - .1 Mechanical: Equipment, materials, labour
 - .2 Plumbing: Equipment, materials, labour

- .3 Sheet Metal: Equipment, materials, labour
- .4 Fire protection: Equipment, materials, labour
- .5 Controls: Equipment, materials, labour

1.5 SUBMITTALS

- .1 Comply with Division 1 – Submission and Closeout Procedures and in addition the following:
 - .2 Contractor shall provide and submit to the Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic engineering.
 - .3 Shop drawings: Submit shop drawings for all equipment as electronic files (file format: .dwg, .dxf, pdf, or comparable). When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall include a complete bill of materials of equipment to be used indicating quantity, manufacturer, model number, and other relevant technical data
 - .4 Closeout Submittals: Provide a minimum of four (4) mechanical operation and maintenance manuals and one digital copy, prepared by the TAB Contractor.
 - .1 Operation and maintenance manual approved by, and final copies deposited with the Consultant a minimum of 7-days before final inspection.
 - .2 Operation and maintenance manual to include but not limited to:
 - .1 Layman's description of the systems and associated controls.
 - .2 Operational instructions, servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .3 Warranties
 - .4 Equipment manufacturer's performance datasheets indicating point of operation as left after commissioning is complete.
 - .5 Testing, adjusting and balancing reports.
- .5 Record Drawings:

- .1 Consultant will provide 1 set of white prints at contractors cost to mark changes as work progresses and as changes occur. Use different colour waterproof ink for each service. Do not use pencil or black ink. Transfer information weekly to show work as actually installed. Drawings shall be available on a weekly basis for review by the Consultant.
- .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
- .3 Submit to Consultant for approval and make corrections as directed.
- .4 Submit completed CAD record drawings with final Operating and Maintenance Manuals within two (2) weeks of substantial completion. Failure to submit drawings will result in the work being undertaken by the Owner and deducted from the Contractor's hold back amount.
- .5 Cost to transfer record information onto reproducible media & Auto-CAD disks are this contractor's responsibility. Consultant will release drawings to contractor after signing a copyright form. Should the Contractor choose to utilise this consultant for transferring as built information, allow \$400 / sheet for all drawings in the construction set. This will cover costs for drafting time & printing costs.

1.6 QUALITY OF WORK

- .1 All work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Consultant. Work which does not conform to standards accepted by the Consultant and the trade may be rejected by the Consultant. The Contractor shall redo rejected work to the accepted standard at no cost to the Owner.

1.7 METRIC CONVERSION

- .1 All units in this division are expressed in SI units.
- .2 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.
- .3 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
 - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.
 - .2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

| EQUIVALENT NOMINAL DIAMETER OF PIPES | | | | | |
|--------------------------------------|-----------------|-----|-----------------|-----|-----------------|
| mm | Inches (NPS) | mm | Inches (NPS) | mm | Inches (NPS) |
| 3 | 1/8 | 40 | 1-1/2 | 200 | 8 |
| 6 | 1/4 | 50 | 2 | 250 | 10 |
| 10 | 3/8 | 65 | 2-1/2 | 300 | 12 |
| 15 | 1/2 | 75 | 3 | 375 | 15 |
| 20 | 3/4 | 100 | 4 | 450 | 18 |
| 25 | 1 | 125 | 5 | 500 | 20 |
| 30 | 1-1/4 | 150 | 6 | 600 | 24 |

.4 Metric Duct Sizes:

- .1 The Metric duct sizes are expressed as 25 mm = 1 inch.

1.8 DRAWINGS AND SPECIFICATIONS

- .1 Should any discrepancy appear between drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of the plans and specifications, obtain written clarification from the Consultant during the tender period. Without a written clarification the better quality and/or greater quantity of work or materials shall be estimated, performed and furnished within the tendered price.
- .2 Examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work is satisfactorily carried out and equipment will fit within the proposed locations without changes to building.

1.9 CUTTING, PATCHING AND CORING

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves. All work shall be coordinated with other trades.
- .2 Obtain written approval from the Structural Consultant before cutting or burning structural members.
- .3 Provide X-ray of all required penetrations of the floor. X-ray use for locating in floor rebar and conduit to be done after normal working hours. Take necessary precautions to protect computer equipment when X-raying floors. Coordinate with Owner.

1.10 COMPLIANCE WITH ENERGY BY-LAW

- .1 All equipment installed on this project shall comply with:
- .1 National Energy Code of Canada for Buildings - 2011
- .2 ASHRAE Standard 90.1 - 2010

1.11 INSTALLATION OF EQUIPMENT

- .1 Pipe all equipment drains to building drains except systems containing glycol.
- .2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.
- .3 Maintain permanent access to equipment for maintenance.

1.12 CONNECTIONS TO EXISTING SERVICES

- .1 Maintain liaison with the Owner and provide a mutually acceptable schedule to interrupt, reroute or connect to existing building services with the minimum of interruption of those services.

1.13 SELECTIVE DEMOLITION

- .1 Remove from site all equipment, ducting or piping which is no longer required because of work under this Contract.
- .2 Cease operations and notify the Prime Consultant immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work in this Section.
- .3 Except as otherwise stated, salvageable materials from area of demolition shall become the property of the Owner at his discretion. All material not taken over by the Owner or removed from the building under this contract shall be removed from this site and disposed of as required by any applicable disposal regulations.
- .4 Turnover to and deliver to the Owner's storage area all items which have been determined to have salvage value and has been removed due to the Work.

1.14 EQUIPMENT AND MATERIALS

- .1 Where two or more products of the same type are required, products shall be of the same manufacturer.
- .2 Notify the Consultant in writing ten (10) days prior to the tender close, any materials or equipment specified which is not currently available or will not be available for use as called for herein. Failing this, the contract will assume that the most expensive alternate has been included in the tender price.
- .3 All equipment supplied to the project will meet efficiencies as defined in ASHRAE Standard 90.1 2004.

1.15 DELIVERY, STORAGE AND HANDLING

- .1 Storage and Handling Requirements:

- .1 Store materials and equipment in accordance with the manufacturer's recommendations; in a clean, dry, well-ventilated area.
- .2 Store and protect equipment from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .2 Protect equipment and open end duct with polyethylene covers and maintain equipment on crates until installation.
- .3 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.16 ESCUTCHEONS AND PLATES

- .1 Provide escutcheons and plates on all piping and ductwork passing through finished walls, floors and ceilings.

1.17 GUARANTEE / WARRANTY

- .1 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance.

1.18 BALANCING

- .1 The approved balancing agencies are: Western Mechanical; K.D. Engineering, Flotech Mechanical
- .2 Balance terminal boxes, exhaust fans and air outlets to air quantities indicated on the drawings and in this specification. Where outlet quantities are not indicated, divide box capacity equally among all outlets.
- .3 Submit two (2) copies of the report to the Consultant within two (2) weeks after substantial completion. Failure to submit the report within the specified time will result in the work being done by the Owner and the costs deducted from final payment.
- .4 Balancing shall be performed to the following:
 - .1 Air-Terminal Outlets: $\pm 10\%$
 - .2 Air-Central Equipment: $\pm 5\%$
- .5 Provide a drop test of all fire dampers and a letter/certificate confirming this work.
- .6 Cooperate with the Balancing Agency as follows:
 - .1 Make any corrections as required by Balancing Agency.

- .2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings and specifications for their use.
- .3 Operate automatic control system and verify set points during balancing.
- .4 Provide and install balancing valves, dampers, and other materials requested by the Balancing Agency and/or necessary to properly adjust or correct the systems to design flows, without additional cost to Owner.
- .5 Provide and install pulleys and sheaves for rotating equipment, as required to properly balance the systems to design flows, without additional cost to Owner.
- .6 Allow in the contract price shaving of impellers as required to balance the pumps to design flow at operating condition.

1.19 SYSTEM CLEANING AND CHEMICAL TREATMENT

- .1 Employ services of the existing building's water treatment firm or if there isn't one, a firm specializing in hydronic system chemical treatment. This firm shall submit a schedule of work to be performed, chemical types and quantity to be used. At the completion of the chemical treatment a report shall be submitted to outline the work performed, quality of water before and after the chemical treatment, amount and types of chemicals added. The report shall also include the details of procedures to be used by the building operator for water quality testing and chemical treatment.
- .2 Provide test kits as required along with adequate chemicals and reagents for one year of testing. Appropriate test kits will be provided to properly test each system installed under this contract.
- .3 Disinfect and flush all domestic cold, hot and recirculation water systems, provide a certificate for this work

1.20 FLASHING AND ROOF CURBS

- .1 Provide curbs, flash and counter flash as required where mechanical equipment passes through weather or waterproofed walls, floors and roofs.

1.21 SEISMIC CONTROL

- .1 Provide seismic restraints for all required equipment, piping and ductwork.
- .2 The Contractor shall retain the services of a qualified professional seismic engineer (Seismic Engineer) registered in the Province of British Columbia. The Seismic Engineer shall design and review the installation of all seismic restraints as well as mechanical equipment and mechanical system supports. The restraints and supports shall be specifically designed to fasten to the structure indicated in the contract documents and installed in the field. The complete design for these systems shall comply with all applicable building code requirements.

- .3 Seismic Engineer shall provide and submit to the Owner's Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic engineering.
- .4 Piping ductwork and equipment shall be restrained in accordance with the latest edition of the Seismic Restraints Manual for Mechanical Systems produced by SMACNA, and the latest edition of the ASHRAE Application Handbook Chapter 49, Seismic Restraints.
- .5 Submit shop drawings of all seismic restraint details prepared and sealed by the seismic engineer. Prior to substantial completion, the seismic engineer shall visit the site and verify the seismic restraint installation as required to satisfy the Assurance of Professional Field Review and Compliance Schedule C-B of the Building Code.
- .6 The contractor shall obtain approval for the location of all restraint fixing points from the structural engineer, on site, prior to installation.
- .7 Where equipment is mounted on spring or resilient mounts for vibration isolation it shall be the responsibility of the manufacturer of the mount to incorporate seismic restraint. These restraints shall be multi-directional as described in the guidelines specified above. Provide steel frame bases where necessary to achieve this and also avoid overturning. The manufacturer shall supply certificates, signed by a Professional Engineer registered within the jurisdiction, verifying the design of the seismic restraints in accordance with this section.

1.22 VIBRATION ISOLATION

- .1 Provide neoprene isolators for deflections 6mm ($\frac{1}{4}$ ") and under.
- .2 Provide either neoprene or steel spring isolators for deflections between 6mm and 12mm ($\frac{1}{2}$ ").
- .3 Provide steel spring isolators for deflections of 12mm ($\frac{1}{2}$ ") and over.
- .4 Provide adjustable limit stops for spring isolation mounts on equipment with operating weights substantially different from the installed weights
- .5 All spring isolators shall be "open spring" unless otherwise stated. Seismically rated housed spring isolators may be used in lieu provided that they meet this project's requirements for seismic restraint.
- .6 Select isolators in accordance with equipment weight distribution to allow for an average deflection meeting or exceeding the specified deflection requirements and so that no isolator has a deflection less than 80% of the static deflection specified. A minimum of 4 isolators are required for each piece of equipment, unless specified otherwise. Refer to the minimum static deflection table contained in this Section

1.23 MATERIALS AND EQUIPMENT

- .1 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, and meet the space, capacity, and noise requirements outlined.
- .2 The Contractor shall be fully responsible for any additional labour and materials required by any trades or other Contractors to accommodate the use of other than specified materials or equipment. The Contractor shall bear any and all costs for design/system modifications to accommodate the "alternate" equipment. Extras will not be approved to cover such work.

PART 2 PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- .1 Listed manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed manufacturers/suppliers.
- .2 It remains the responsibility of the Contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.
- .3 The contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers listed.

2.2 DEMOLITION

- .1 All coring, patching and removal of existing equipment, pipes, and ductwork which may affect the operation of occupied areas of the building shall be carried out outside of regular office hours or as scheduled with the Owner.

2.3 ASBESTOS

- .1 The intent is for a Haz-Mat Contractor to remove all asbestos containing material prior to the proposed project work taking place. Notify the Consultant if asbestos containing material is suspected to remain on site.

2.4 DUCTWORK AND ACCESSORIES

- .1 Provide ductwork constructed, reinforced, sealed and installed to withstand 1-1/2 times the working static pressure
- .2 Low Pressure Ductwork 500 Pa (2" W.G.) and under
 - .1 Supply ductwork and plenums on systems without terminal mixing boxes or air valves.

- .2 Supply ductwork downstream from terminal mixing boxes or air valves.
 - .3 Outdoor air ductwork and plenums, unless noted otherwise.
 - .4 Return air ductwork and plenums, unless noted otherwise.
 - .5 Exhaust and relief air ductwork and plenums, unless noted otherwise.
 - .6 Low pressure insulated flexible ductwork shall be equal to Thermaflex Type M-KC.
 - .7 Connect outlet terminals to low pressure ducts with 900mm (36") maximum length of stretched flexible duct. Hold in place with strap or clamp, caulk sealed. Do not use flexible duct to change directions.
 - .8 Provide a flexible connection where low pressure ducts are connected to fan equipment, terminal boxes or any other apparatus. Joint shall be screwed or bolted flexible gasketed joint, minimum 50mm (2") wide.
- .3 Duct Hangers
- .1 Hangers and Supports to SMACNA standards
 - .2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .3 Maximum size duct supported by strap hanger: 500 mm.
 - .4 Hangers: Galvanized steel angle with galvanized steel rods to SMACNA.
 - .5 Toggle hangers and/or strap hangers shall not be used.
 - .6 Power actuated fasteners and "drop-in" anchors shall not be used for tension load applications such as pipe and duct hangers.
- .4 Duct Sealing
- .1 Low Pressure Ductwork 500 Pa (2" W.G.) and under shall be SMACNA seal class A. Seal all supply, return and exhaust duct joints, longitudinal as well as transverse joints as follows:
 - .1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm ($1/16$ ") use heavy mastic type sealant.
 - .2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.
 - .3 Other Joints: Heavy mastic type sealant.

- .2 Duct tapes as sealing method are not permitted, except on residential ductwork – minimum 2 wraps of 2" wide (50mm) foil duct tape is acceptable.
- .3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.
- .4 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application, by the Consultant.

2.5 IDENTIFICATION

- .1 Identify piping with labels and flow arrows. Provide identification at 15m (50ft) maximum intervals, before and after pipes passing through walls, at all sides of tees, behind access doors. Use Brady B-500 vinyl cloth labels for non insulated pipes and B-350 for insulated pipes.
- .2 Provide 20mm ($\frac{3}{4}$ ") diameter brass tags, secure to valve stems with key chain. Provide a valve directory at all mechanical rooms, in the O&M manuals and a digital copy cross referenced with any associated controls nomenclature.
- .3 Each piece of equipment shall be identified with its equipment schedule identification, e.g. supply fan HRV, DWH, Recirc Pump, etc. with lamacoid plates having 6mm ($\frac{1}{4}$ ") minimum letter size

2.6 DUCT AND BREECHING INSULATION

- .1 Exposed Rectangular Ducts: External rigid Insulation, service temperature 5°C to 232°C (41°F to 450°F), mineral fiber board for low and medium temperature applications, all service aluminum foil-scrim kraft (FSK) vapour barrier jacket with glass fibre reinforcement, factory applied.
 - .1 Density 36kg/m³ (2.25 PCF), Minimum RSI 0.76/25mm (R 4.3/in)
- .2 Round Ducts and Concealed Rectangular Ducts: External flexible insulation, service temperature 5°C to 232°C (41°F to 450°F), glass fiber or mineral fiber flexible blanket for low and medium temperature applications, all service aluminum foil-scrim kraft (FSK) vapour barrier jacket with glass fibre reinforcement, factory applied.
 - .1 Density 12kg/m³ (0.75PCF), Minimum RSI 0.49/25mm (R 2.8/in) (installed)
- .3 Finish Jackets
 - .1 Thermocanvas Jacket: fire rated, 170g (6 oz) fire retardant canvas jacket for covering mechanical insulation indoors, 25/50 fire class, plain wave cotton, no dyes.

2.7 SEISMIC CABLE RESTRAINTS

- .1 Galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.
- .2 Cables must be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement.

2.8 VIBRATION ISOLATION

- .1 Neoprene Washer/Bushing
 - .1 A one piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal to metal contact. Use washer/bushing only on light-weight equipment.
 - .1 Mason HG hemi grommet or equal
 - .2 Neoprene Pad Isolators
 - .1 Neoprene or neoprene / steel / neoprene pad isolators. Minimum static deflection 2.5 mm (0.1") or greater.
 - .1 Mason WMSW or equal
- .3 Spring Hangers
 - .1 Hangers shall consist of rigid steel frames containing minimum 32mm (1 1/4") thick neoprene elements at the top and a steel spring seated in a steel washer reinforced neoprene cup on the bottom.
 - .2 Provide a combination rubber and steel rebound washer as the seismic upstop for suspended piping, ductwork and equipment. Rubber thickness shall be a minimum of 6mm (1/4"). Colour coded springs, rust resistant, painted box type hangers.
 - .3 To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring.
 - .1 Mason HD, HS or equal
- .4 Acceptable Manufacturers, Korfund, Vibro-Acoustics

PART 3 EXECUTION

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Division 09 - Interior Painting.

- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.
- .4 Clean exposed bare metal surfaces supplied under Divisions 21, 22, 23 and 25. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.

3.2 DEMONSTRATION

- .1 Supply tools, equipment and personnel to demonstrate and instruct the operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Use operation and maintenance manual, record drawings, and audio visual aids as part of instruction materials.

3.3 DUCTWORK AND ACCESSORIES

- .1 Fabricate ductwork in accordance with:
 - .1 SMACNA Duct Construction Standards – metal and flexible
 - .2 NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems
 - .3 NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
- .2 Prior to fabrication of ductwork, check all ceiling spaces and heights and conflicts with other trades.
- .3 Duct sizes indicated are inside clear dimensions. For acoustically lined or internally insulated ducts allow for insulation thickness and maintain interior clear dimensions indicated.
- .4 Provide fire dampers where ducts cross fire separations. Fire dampers shall be ULC listed. Refer to architectural drawings for fire separation ratings and locations.
- .5 Provide balancing dampers where indicated on drawings and at points on low pressure supply, return and exhaust ducts where branches are taken from larger ducts.
- .6 Provide return air openings and/or insulated sound traps where indicated.
- .7 Modify ceiling system where required to accommodate grilles and diffusers.
- .8 Size round ducts, installed in place of rectangular ducts, from ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by permission from the Consultant.

- .9 Exposed round ductwork to be spiral lock seam type only.
- .10 Provide duct hangers and supports in accordance with SMACNA manuals.
- .11 Confirm the existing base building standards prior to submitting tender.
- .12 Ductwork shall be galvanized steel unless noted otherwise.
- .13 Duct support shall be:
 - .1 Up to 750mm duct size: angle size 25x25x3 mm with 6mm rod size
 - .2 751 to 1050mm duct size: angle size 40x40x3 mm with 6mm rod size
 - .3 1051 to 1500mm duct size: angle size 40x40x3 mm with 10mm rod size
 - .4 1501 to 2100mm duct size: angle size 50x50x3 mm with 10mm rod size
 - .5 2101 to 2400mm duct size: angle size 50x50x5 mm with 10mm rod size
 - .6 2401 and over duct size: angle size 50x50x6 mm with 10mm rod size
- .14 Upper hanger attachments shall be:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp.
 - .3 For steel beams: manufactured beam clamps.

3.4 DUCT INSULATION MINIMUM THICKNESS TABLE (ASHRAE 90.1 ZONE 5, 6, 7)

| RIGID EXTERIOR DUCT INSULATION | | | | |
|--|-------------|-------------------|---------------------|----------|
| Duty | Plenum(4) | Duct Location | | |
| | | Interior | | Exterior |
| | | Conditioned Space | Unconditioned Space | |
| Minimum Insulation Thickness in mm (in.) | | | | |
| Cooling Only Air Supply | 25 (1") | 25 (1") | 25 (1") | 50 (2") |
| Heating or H/C Air Supply | 38 (1-1/2") | 38 (1-1/2") | 38 (1-1/2") | 50 (2") |
| Outdoor Air Supply | 38 (1-1/2") | 38 (1-1/2") | 38 (1-1/2") | 0 |
| Return Air | 25 (1") | 0 | 25 (1") | 50 (2") |
| Exhaust Air (1)(2) | 25 (1") | 0 | 25 (1") | 25 (1") |
| See note (3) for internal duct liner | | | | |

| FLEXIBLE EXTERIOR DUCT INSULATION | | | | |
|--|-------------|-------------------|---------------------|-------------|
| Duty | Plenum(4) | Duct Location | | |
| | | Interior | | Exterior |
| | | Conditioned Space | Unconditioned Space | |
| Minimum Insulation Thickness in mm (in.) | | | | |
| Cooling Only Air Supply | 38 (1-1/2") | 38 (1-1/2") | 38 (1-1/2") | 75 (3") |
| Heating or H/C Air Supply | 50 (2") | 50 (2") | 50 (2") | 75 (3") |
| Outdoor Air Supply | 50 (2") | 50 (2") | 50 (2") | 0 |
| Return Air | 38 (1-1/2") | 0 | 38 (1-1/2") | 75 (3") |
| Exhaust Air (1)(2) | 38 (1-1/2") | 0 | 38 (1-1/2") | 38 (1-1/2") |
| See note (3) for internal duct liner | | | | |

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 38mm (1-1/2") flexible insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Where an internal duct liner is used the thickness shall be selected to match the RSI value specified for external insulation. Internal acoustic duct liner shall be a minimum 25mm (1") where external insulation is not required.

3.5 DUCT FINISHES TABLE

.1 Conform to the following:

| Duty | Rectangular Duct | | Round Duct | |
|--|------------------|-----------|---------------|-----------|
| | Type | TIAC Code | Type | TIAC Code |
| Indoor concealed | None | None | None | None |
| Indoor exposed in mechanical room and elsewhere except utility areas | Canvas Jacket | CRF/1 | Canvas Jacket | CRD/1 |
| | | | | |
| | | | | |

3.6 VIBRATION ISOLATION

.1 Neoprene Washer/Bushing

.1 Isolate variable frequency drive controller using neoprene washer/bushing isolators or soft grommets such that structure borne noise transmission to occupied space is less than airborne noise transmission.

.2 Rubber Floor Mounts

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- .1 Mount in-line pumps on two (2) rubber floor mount isolators under each support foot.
 - .2 For equipment mounted on a slab on grade mount on rubber floor mount isolators unless otherwise specified.
 - .3 Provide protection of the rubber element from contact with oil in the mechanical room.
- .3 Spring Floor Mounts
- .1 Isolate all floor or pier mounted equipment on spring floor mount isolators, unless otherwise specified.
- .4 Spring Hangers
- .1 Locate isolation hangers as near to the overhead support structure as possible.
 - .2 Installation shall permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
 - .3 All discharge ductwork runs for a distance of 15m (50') from the connected equipment shall be isolated from the building structure by means of spring hangers. Spring deflection shall be a minimum of 19mm (0.75").
- .5 Minimum Static Deflection Schedule

| EQUIPMENT | Equipment Supported By: | |
|--|---------------------------|---------------------------|
| | Slab on Grade | Elevated Slab |
| Hot Water Boilers | Nil | 3mm ($\frac{1}{8}$ ") |
| Heat Pumps (see Note 5) | 9mm ($\frac{3}{8}$ ") | 38mm (1 $\frac{1}{2}$ ") |
| Pumps: | | |
| In-line under 1.5kW (2HP) | 1mm ($\frac{1}{16}$ ") | 3mm ($\frac{1}{8}$ ") |
| In-line 1.5kW (2 HP) to 11.5kW (15 HP) | 3mm ($\frac{1}{8}$ ") | 5mm ($\frac{1}{4}$ ") |
| In-line over 11.5kW (15 HP) | 3mm ($\frac{1}{8}$ ") | 9mm ($\frac{3}{8}$ ") |
| Base mounted under 5.5kW (7.5 HP) | 5mm ($\frac{1}{4}$ ") | 19mm ($\frac{3}{4}$ ") |
| Base mounted 5.5kW (7.5 HP) and greater | 19mm ($\frac{3}{4}$ ") | 38mm (1 $\frac{1}{2}$ ") |
| Fans, Blowers & Packaged H & V Units: | | |
| Under 0.5 HP | 1mm ($\frac{1}{16}$ ") | 1mm ($\frac{1}{16}$ ") |
| 0.5 HP to 7.5 HP | 25mm (1") | 25mm (1") |
| 7.5 HP to 40 HP - up to 400 rpm | 38mm (1 $\frac{1}{2}$ ") | 38mm (1 $\frac{1}{2}$ ") |
| 7.5 HP to 40 HP - over 400 rpm | 25mm (1") | 25mm (1") |

NOTES:

- .1 Table indicates required static deflection of isolators for all fans regardless of power rating and for all other motor driven equipment over 0.37kW (0.5 HP).

- .2 Advise consultant of equipment not contained in this table and obtain clarification as to the isolation performance requirements.
- .3 Steel spring isolators shall be used for all deflections 12mm ($\frac{1}{2}$ ") and over.
- .4 Neoprene isolators shall be used for deflections 6mm ($\frac{1}{4}$ ") and under.
- .5 Use housed spring isolators for heat pump.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This Section describes the Common Work Results applicable to electrical disciplines.

1.2 GENERAL

- .1 The general conditions and general requirements together with all amendments and supplements contained in the General Specifications shall form an integral part of the electrical specification and will be made part of this contract.
- .2 Reference to "Electrical Divisions" shall mean all Divisions 26, 27, 28, 33, 34 and 48 in the Master Format or the Canadian Master Specifications.
- .3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .4 Confirm with the architectural plans and specifications the extent and nature of the work and how it will affect the electrical work. Include in the tender sum for any complications or additional work described therein.
- .5 Review mechanical plans and specifications for the extent of electrical work required to make mechanical systems complete and include this work in the tender sum.
- .6 Review structural plans for limitations of penetrations or inclusions of electrical equipment. In the tender sum, allow for avoiding critical areas with electrical equipment.
- .7 Review existing record plans and site conditions for limitations of penetrations or inclusions of electrical equipment. In tender sum, allow for avoiding critical areas with electrical equipment.
- .8 Comply with the requirements of the General Contract, and coordinate the installation with all other trades on site.
- .9 Confirm on-site the exact location of equipment, outlets, and fixtures and the location of outlets for equipment supplied by other trades.

1.3 WORK INCLUDED

- .1 This work shall include the supply and installation of all the necessary materials and apparatus for complete operating systems as indicated on the plans or mentioned in this specification, with the exception of materials or apparatus specifically mentioned to be omitted or to be supplied by owner.
- .2 Items obviously necessary or reasonably implied to complete the work, shall be included as if shown on drawings and noted in the specifications.
- .3 All materials, tools, appliances, scaffolding, apparatus and labour necessary for the execution, erection and completion of the systems described herein shall be furnished. This includes providing lighting and power for own work.
- .4 This contract shall include, but is not confined to, the following scope of work:
 - .1 Underground services
 - .2 All electrically related civil works, trenching, backfilling, resurfacing
 - .3 Underground ducts including concrete encasement, pullboxes, manholes
 - .4 Main power service
 - .5 Power distribution equipment
 - .6 Power connections and outlets
 - .7 Metering system
 - .8 Mechanical equipment connections
 - .9 Lighting system
 - .10 Lighting controls system

- .11 Emergency lighting
- .12 Data/Communications system
- .13 Card reader/door access system
- .14 CCTV system
- .15 As built drawings
- .16 Intrusion Alarm system
- .5 Complete all electrical connections to equipment and accessories pertaining to this contract and leave all in operating condition to the electrical Consultant's satisfaction.
- .6 Remove all existing electrical equipment and material made redundant by this contract or in conflict with work to be carried out. Reroute, reinstall or replace existing electrical material that becomes necessary due to work carried out by this contract so a complete working electrical system will be retained in all areas affected by this installation.
- .7 The electrical contractor must visit site prior to submitting tender. No extras will be allowed for conditions that could be foreseeable. Afflict the contract price to the attention of the consultant prior to submitting tender.

1.4 WORK EXCLUDED

- .1 The contract scope of work shall not include the following:
 - .1 Low voltage mechanical systems control wiring where indicated in electrical and mechanical specifications to be done by controls contractor shall be excluded from the electrical contractor work as noted.

1.5 DRAWINGS AND SPECIFICATIONS

- .1 The drawings and specifications compliment each other and what is called for by one is binding as if called for by both. If there is any doubt as to meaning or true intent due to a discrepancy between the electrical drawings and specifications, and all other contract documents, obtain written ruling from Consultant prior to tender closing. **Failing this, the most expensive alternative is to be allowed for.**
- .2 The plans show the approximate location of outlets and apparatus but the right is reserved to make such changes in location as may be necessary to meet the emergencies of construction in any way. No extra will be allowed for such changes to any piece of electrical equipment unless the distance exceeds 3 metres, or if the relocation is required after initial installation is complete.
- .3 It is imperative that the contractor visit the site and completely familiarize himself as to the work to be undertaken.

1.6 CODES AND STANDARDS

- .1 All electrical work shall be carried out in accordance with the latest edition of the CEC C22.1 (Canadian Electrical Code) as amended and adopted by the Province of British Columbia and to the satisfaction of the Electrical Inspection Authority having jurisdiction, except where specified or specifically stated otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 latest edition, except where specified or specifically stated otherwise.
- .3 All work shall be carried out in accordance with the National Building Code current edition (including all local amendments) to the satisfaction of local building inspector authority having jurisdiction.
- .4 Any electrical material and/or equipment supplied by any contractor or sub-contractor for installation on this project must bear evidence of CSA approval or special CSA certification acceptable to the Chief Electrical Inspector for the Province of [British Columbia].

1.7 CARE, OPERATION AND START-UP

- .1 Instruct Consultant [and Operating Personnel] in the operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.8 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235 latest edition.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.9 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay all associated fees.
- .3 Fees will cover all routine inspections by the District Electrical Inspector. Any fees for follow-up inspections found to be necessary by the District Electrical Inspectors as a result of incorrect work shall be borne by this contractor without any cost to the owner.
- .4 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.
- .5 Furnish Certificates of Acceptance from Electrical Inspection Department [authorities having jurisdiction] on completion of work to Consultant.
- .6 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain electrical permit and pay associated fees.
- .7 Consultant will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost to the Contractor.
- .8 Furnish to Consultant on completion of work Certificates of Acceptance from Electrical Inspection Department.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with the Construction Waste Management Plan as established by the Construction Manager.
- .2 Remove from site and dispose of all 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 metal and wiring materials from landfill to metal recycling facility approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

1.11 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with these specifications and as indicated on the Architectural and Electrical drawings.

- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.
- .5 Provide 120 volt power to all Direct Digital Control (DDC) panels indicated on Mechanical Drawings and Specifications, where shown or not on Electrical Drawings.

1.12 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise on the Architectural and Electrical drawings.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 400 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 400 mm.
 - .5 Pay Telephone Outlets: 1194mm mounted telephone and interphone outlets: 1500 mm.

1.13 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads (lighting and mechanical) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State voltage, time and date at which each load was measured.

1.14 CONDUIT AND CABLE INSTALLATION

- .1 Install flashing and gooseneck assembly for all roof penetrations for running cables to serve roof mounted equipment.
- .2 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be [schedule 40 steel pipe] [plastic] [sheet metal], sized for free passage of conduit, and protruding 50mm each side.
- .3 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .4 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .5 For all stacked communications rooms, provide 100mm square STI EZ-PATH 2-hour rated sleeves for running communications cables through floors. Also provide a minimum of two spare sleeves.

1.15 EXTRA WORK

- .1 Any extra work ordered to be done shall be governed by this specification unless specific instructions or clauses are contained in the Change Order. In such cases, these instructions or clauses shall supersede those of the specification for this particular application only.

1.16 FIELD QUALITY CONTROL

- .1 All electrical work to be carried out by qualified, licensed electricians or supervised apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks. The activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this division to be carried out by a contractor who holds a valid Master Electrical Contractor License as issued by the Province that the work is being conducted.
- .3 Conduct and pay for following tests:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and lighting control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system, communications.
- .4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .5 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
 - .2 Megger 350V - 600 V circuits, feeders and equipment with a 1000V instrument.
 - .3 Check resistance to ground before energizing.
- .6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .7 Submit test results for Consultant's review.

1.17 CO-ORDINATION OF TRADES

- .1 Consult with Construction Manager and all subtrades involved to confirm the location of the various outlets and equipment, and cooperate fully to ensure that no conflict arises during the installation.
- .2 Special care shall be taken that equipment, outlets, junction boxes or pullboxes will not be obstructed by other structure, equipment, pipes or ducts installed under this general contract by other trades.
- .3 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Owner, without the Consultant's written approval.
- .4 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building

lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

- .5 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Architect and the Consultant and all affected parties.
- .6 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Consultant of space problems before installing any material or equipment. Demonstrate to the Consultant on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.18 SUBSTITUTIONS

- .1 Unless otherwise noted on the plans or specifications, substitutions may be approved by the Consultant if requested by the contractor or by equipment suppliers, for items specified by the manufacturer's catalogue number.
- .2 Requests for approval of such substitutions shall be submitted at least five (5) working days prior to the tender closing date.
- .3 Complete description and data sheets of proposed substitution shall accompany the application and supplier must be prepared to submit samples for approval on short notice.
- .4 Proposed substitutions must be at least of equal quality to that of the specified item. The manufacturer's specification of the specified item shall apply for comparison if no other clause of this specification applies. The decision of the Consultant to accept or reject shall be final.
- .5 Off-the-shelf items such as standard boxes, EMT, which are specified by description only or indicated on the drawings, without any manufacturer, model, type or catalogue number, do not require approval prior to the tender closing date.
- .6 Submit list of alternates used, within one week after acceptance of tender.

1.19 PROTECTION OF EQUIPMENT

- .1 This contractor shall provide and ensure maximum protection of electrical equipment on the site. Electrical equipment, including existing electrical equipment, shall be kept clean and dry at all times and caution shall be taken to ensure no mechanical damage is done to the equipment. Equipment shall not be delivered to the site until it can be stored safely or placed in final position and the space is clean.

1.20 DAMAGES

- .1 If the finish of electrical equipment is damaged either when received or during installation, have such equipment completely refinished and restored to its original condition at no cost to the owner.
- .2 Irreparably damaged equipment shall be replaced at no cost to the owner.

1.21 SHOP DRAWINGS

- .1 Submit shop drawings, product data and samples in accordance with the contract specifications.
- .2 Shop drawings and product data shall indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing interconnection with work of other sections.
- .5 Prior to manufacture of any item made specifically for this job, submit detailed drawings of the item through the Construction Manager.
- .6 Shop drawings must be received by the Consultant at a date early enough to permit reasonable study prior to approval and manufacture, or to permit alterations where necessary. Late submissions of shop drawings will be sufficient reason for a stoppage of construction pending approval, or removal and replacement of any unsatisfactory item at the contractor's expense.
- .7 Shop drawings/product data content:
 - .1 Shop drawings submitted title sheet.
 - .2 Data shall be specific and technical.
 - .3 Identify each piece of equipment.
 - .4 Information shall include all schedule data.
 - .5 Advertising literature will be rejected.
 - .6 The project and equipment designations shall be identified on each document.
 - .7 The shop drawings/product data shall include:
 - .1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights and mounting point loads.
 - .2 Mounting arrangements.
 - .3 Control explanation and internal wiring diagrams for packaged equipment.
 - .4 A written description of control sequences relating to the schematic diagrams.

1.22 CUTTING AND PATCHING

- .1 This contractor is responsible for all cutting or blocking out required to install electrical equipment.
- .2 If this contractor makes excessive cuts or does not coordinate work so that finished work requires cutting or patching, then this contractor shall pay for all patching to original condition.
- .3 Any dispute resulting from this shall be referred to the Consultant for decision.
- .4 Prior to any major cutting of walls or floor, review the proposed location, size and method with the Consultant. This includes notification when cutting or coring into any fire rated construction.

1.23 FIRE STOPPING

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00.
- .2 Submit material safety data sheets provided with product delivered to job-site.
- .3 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary training to install manufacturer's products per specified requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- .4 The work is to be installed by a contractor with at least one of the following qualifications:
 - .1 FM 4991 Approved Contractor
 - .2 UL Approved Contractor

- .3 Hilti Accredited Fire Stop Specialty Contractor
- .5 Installer shall have minimum 3 years of experience with fire stop installation.
- .6 Seal all openings for conduit or sleeve penetrations in fire rated and smoke rated separations using approved materials.
- .7 All block outs and access slots to be sealed using approved fire stopping assembly. Provide full details for all fire stopping applications as they relate to each application.
- .8 Provide shop drawings for all fire stopping products, including assembly details as it relates to each application. Products shall be ULC approved as an assembly.
- .9 Allow for the destructive testing of 10% of fire stopping applications. Should installations not conform to manufacturer's details, an additional 25% of installation will be destructively tested and should there be more failures, the contract OR will be responsible to remove all fire stopping products and reinstall products correctly, at no additional cost to the owner.

1.24 PROTECTION OF EXPOSED LIVE EQUIPMENT

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

1.25 INSPECTIONS AND TESTS

- .1 Notify the Consultant and authorities having jurisdiction at least five (5) working days in advance when the installations will be ready for inspection or testing.
- .2 Test reports, signed by all attending authorities, shall be submitted to the Consultant through the General Contractor after successful completion of an inspection or test.
- .3 Conduct all tests in a thorough and complete manner to the satisfaction of the Consultant and pay for any fees incurred to complete tests.
- .4 Furnish the Consultant with a copy of Certificate of Inspection from B.C. Electrical Safety Branch indicating that all work has been satisfactorily completed and issued prior to final connection.

1.26 CLEAN UP

- .1 Vacuum clean all new raceways and any electrical equipment. Ensure that no debris or spare parts are left in any electrical equipment.
- .2 Any scrap material shall be removed from the site and disposed of by the Contractor.
- .3 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

1.27 SURPLUS MATERIALS

- .1 All material removed from existing site and not being reused in this contract shall be the property of the owner and delivered as directed by the owner's representative. Material as it becomes surplus shall be reviewed by the owner or owner's representative and that part considered of value to the owner shall be classed as surplus material, all other becomes scrap material, and shall be disposed of by the contractor.

1.28 SPARE PARTS

- .1 This contract calls for spare parts or material. These are to be provided new in unopened cartons to the owner at the time of substantial completion of the contract.
- .2 Provide owner with spare lamps in unopened cartons. Quantity of each lamp source type to be 10% of total project amount.

- .3 Obtain a signed receipt from the owner's representative for all these parts or materials and include a copy in the front of the maintenance manual. Without this receipt these items will be treated as a deficiency and the cost withheld at twice the estimated value by the Consultant.

1.29 AS BUILT DRAWINGS

- .1 Obtain two (2) sets of white prints for the sole purpose of recording changes in installation as they occur. One (1) set is to be used in the field for day-to-day recording, and one (1) set for submittal after completion.
- .2 These plans shall be kept up-to-date as changes occur and shall be available to be inspected by the Consultant.
- .3 Arrange and pay for the incorporation of any "as-built" changes to digital PDF plans and AutoCAD plans on disks. These changes shall be of similar quality of presentation as the original plans. NOTE: All plans whether requiring as-built changes or not, shall be included in this disk.
- .4 These amended drawings shall be given to the Consultant at time of final inspections.
- .5 "As-built" drawings shall include the location and circuit numbers of junction boxes in ceiling spaces, and all conduit placed in or under poured concrete. Note normal depth of conduits below top of concrete slab.

1.30 OPERATING AND MAINTENANCE MANUALS

- .1 Submit **four sets** of operating and maintenance manuals for equipment or as requested by the general section of the contract. Include descriptive and technical data, all shop drawings, operating procedures, routine and preventative maintenance, wiring diagrams, spare parts lists, warranties, service companies, suppliers for replacement parts, test results, fire alarm certificate of verification, electrical inspection authority certificate and contract guarantee.
- .2 Submit documentation in **green colored** heavy duty three ring binders, with lettering on spine identifying: "OPERATING AND MAINTENANCE MANUAL", project title and system names.
- .3 Submit one copy for approval by Consultant prior to assembly of final sets.

1.31 DEMONSTRATION OF SYSTEMS

- .1 Instruct Consultant and operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service Consultant to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.32 WARRANTY

- .1 Within a period of one year from the date of final acceptance of work, replace or repair at own expense any defect in workmanship or material. Reused material shall be operating satisfactorily at the time of final acceptance but subsequent failures are not the responsibility of this contractor.
- .2 Warranties for equipment having more than one year guarantee shall be made out to owner, and copies shall be provided in the maintenance manuals.
- .3 Maintenance from manufacturer and contractor of all equipment shall be included for first year, including all lamps except incandescent.

1.33 PAINTING

- .1 Arrange and pay for the painting of the devices noted in these specifications, in particular:
 - .1 exposed conduits and conduit fittings.

- .2 Painting shall be to match colour and finish of adjacent walls, with at least two coats of sprayed enamel paint to the satisfaction of the Consultant and architect.
- .1 maintenance manuals.

Part 2 PRODUCTS

2.1 SUSTAINABLE REQUIREMENTS

- .1 Refer to Section 01 11 00 of the Summary of Work.

2.2 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible, after equipment is installed.

2.3 MATERIALS AND EQUIPMENT

- .1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .2 Factory assemble control panels and component assemblies.

2.4 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on the electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule.
- .2 Control wiring and conduit is specified in [Division 16] [Divisions 26, 27, 28, 33, 34 and 48] except for conduit, wiring and connections below 50 V which are related to control systems specified in Mechanical Specifications and shown on mechanical drawings.

2.5 WARNING SIGNS

- .1 As specified and to meet the requirements of the BC Electrical Inspection Authority and the Consultant.
- .2 Decal signs, minimum size 175mm x 250mm.

2.6 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

2.7 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with [nameplates] [and] [labels] as follows:
- .2 Nameplates:
 - .1 Lamicoid 3mm thick plastic engraving sheet, mechanically attached with self tapping screws.
 - .2 Nameplate colors shall be as follows:
 - .1 Normal power: Black face with white letters;
 - .2 Life safety emergency power: Red face with white letters;
 - .3 Standby power: Blue face with white letters.

| | | | | |
|----|-------------------------------------|-------------|---------|--------------------|
| .3 | Nameplate sizes shall be as follows | | | |
| | Size 1 | 10 x 50 mm | 1 line | 3 mm high letters |
| | Size 2 | 12 x 70 mm | 1 line | 5 mm high letters |
| | Size 3 | 12 x 70 mm | 2 lines | 3 mm high letters |
| | Size 4 | 20 x 90 mm | 1 line | 8 mm high letters |
| | Size 5 | 20 x 90 mm | 2 lines | 5 mm high letters |
| | Size 6 | 25 x 100 mm | 1 line | 12 mm high letters |
| | Size 7 | 25 x 100 mm | 2 lines | 6 mm high letters |

- .3 Labels:
 - .1 Embossed plastic labels with 6mm high letters unless specified otherwise.
- .4 Wording on nameplates and labels to be approved by Consultant prior to manufacture.
- .5 Allow for average of twenty-five (25) letters per nameplate and label.
- .6 Identification to be English
- .7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .8 *Identify equipment with Size 3 labels engraved "ASSET INVENTORY No. [___]".* Number as and if directed by Consultant.
- .9 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .10 Terminal cabinets and pull boxes: indicate system and voltage.
- .11 Transformers: indicate capacity, primary and secondary voltages.

2.8 WIRING IDENTIFICATION

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

2.9 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at [15] m intervals.
- .3 Colours: [25] mm wide prime colour and [20] mm wide auxiliary colour.

| | | |
|-----------------------------|--------|-----------|
| | Prime | Auxiliary |
| up to 250 V | Yellow | |
| up to 600 V | Yellow | Green |
| up to 5 kV | Yellow | Blue |
| up to 15 kV | Yellow | Red |
| Telephone | Green | |
| Other Communication Systems | Green | Blue |
| Fire Alarm | Red | |
| Emergency Voice | Red | Blue |
| Other Security Systems | Red | Yellow |

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for seismic restraint systems for electrical installations.

1.2 REGULATORY REQUIREMENTS

- .1 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.
- .2 The Seismic Engineer shall be able to provide a proof of professional insurance and the related practice credentials, upon request. The Seismic Engineer shall be familiar with SMACNA, ECABC & NFPA guidelines as well as the BC Building Code requirements.
- .3 The Contractor's Seismic Engineer shall submit original signed BC Building Code "Letters of Assurance" "Model Schedules S-B and S-C" to the Prime Consultant or Electrical Consultant.
- .4 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.3 SCOPE

- .1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Division 01.
- .3 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.
- .4 The total electrical seismic restraint design and field review and inspection will be by a BC registered professional structural engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This Engineer, herein referred to as the Seismic Engineer, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.
- .5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.
- .6 The Seismic Engineer shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.
- .7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.
- .8 The Seismic Engineer shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.
- .9 Include all costs associated with the Seismic installation and certification in the base tender.

1.4 SHOP DRAWINGS & SUBMITTALS

- .1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the Seismic Engineer.
- .2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Engineer.

Part 2 PRODUCTS

2.1 SLACK CABLE SYSTEMS

- .1 Slack cable restraint systems shall be as designed and supplied by Vibra-Sonic Control or equal.
- .2 Slack cable restraints shall be provided on suspended and shelf mounted transformers along with associated equipment and assemblies connected to them at the points of vertical support (4 points). The restraint wires shall be oriented at approximately 90° to each other (in plan), and tied back to the ceiling slab or its structure at approximately 45° to the slab or basic structure. The restraints shall be selected for a 1 g earthquake loading, i.e. each wire shall have a working load capacity equal to the weight of the transformer. The anchors in the structure shall be selected for a load equal to the weight of the transformers at a 45° pull.
- .3 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the engineer and inspection authority having jurisdiction.
- .4 Coordinate requirements of slack cables with suppliers prior to installation.

Part 3 EXECUTION

3.1 GENERAL

- .1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

3.2 CONDUITS

- .1 Provide restraint installation information and details on conduit and equipment as indicated below:
- .2 Vertical Conduit:
 - .1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.
 - .2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m [30 ft] o.c.
 - .3 Riser joints shall be braced or stabilized between floors.

- .3 Horizontal Conduits:
 - .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
 - .2 EMT tubing - tubing shall be supported at approximately 1.2 m [4 ft] intervals for tubing.
- .4 Provide transverse bracing at 12.2 m [40 ft] intervals maximum unless otherwise noted. Provide bracing at all 90° bend assemblies, and pull box locations.
- .5 Provide longitudinal bracing at 24.4 m [80 ft] intervals maximum unless otherwise noted.
- .6 Do not brace conduit runs against each other. Use separate support and restraint system.
- .7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.
- .8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.
- .9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
- .10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.
- .11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic Engineer and submit shop drawings to consultants for their reference.

3.3 FLOOR MOUNTED EQUIPMENT

- .1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Design anchors and bolts for seismic force applied horizontally through the center of gravity to a seismic force of 0.5g. For equipment which may be subject to resonances, use a nominal 1.0 g seismic force.
- .2 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

3.4 LIGHT FIXTURES

- .1 Fluorescent fixtures in suspended ceilings shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by at least two seismic cables which are connected to the fixture at diagonal points.
- .2 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by seismic cables.
- .3 Fixtures which are hung independently of ceiling systems shall have minimum of one seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.
- .4 Cables shall be corrosion resistant and approved for the application.
- .5 Fixtures which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section includes materials and installation for tested firestopping systems as follows:
 - .1 Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
 - .2 Openings between structurally separate sections of wall or floors.
 - .3 Gaps between the top of walls and ceilings or roof assemblies.
 - .4 Expansion joints in walls and floors.
 - .5 Openings and penetrations in fire-rated partitions or walls containing fire doors.
 - .6 Openings around structural members which penetrate floors or walls.

1.2 REFERENCES

- .1 Test Requirements: ULC-S115-M or CAN4-S115-M, "Standard Method of Fire Tests of Through Penetration Fire Stops".
- .2 Test Requirements: UL 2079, "Tests for Resistance of Building Joint Systems" or ASTM E 1966, "Standard test method for Fire Resistive Joint Systems" . These test requirements provide more guidelines for testing moving joints than that given in CAN4-S115-M. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory
- .3 Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Fire Stops."
- .4 Test Requirements: ASTM E 2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus"
- .5 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
- .6 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .7 All major building codes: NBC, BCBC, and VBBL.
- .8 NFPA 101 - Life Safety Code
- .9 Canadian Electrical Code

1.3 QUALITY ASSURANCE

- .1 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- .2 Firestop System installation must meet requirements of CAN4-S115-M, ULC S-115-M or UL 2079 tested assemblies that provide a fire rating as shown in Section 2.03 Clauses P, Q & R below.
- .3 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .4 Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

1.4 SUBMITTALS

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00.
- .2 Submit material safety data sheets provided with product delivered to job-site.

1.5 INSTALLER QUALIFICATIONS

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary training to install manufacture's products per specified requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- .2 The work is to be installed by a contractor with at least one of the following qualifications:
 - .1 FM 4991 Approved Contractor
 - .2 UL Approved Contractor
 - .3 Hilti Accredited Fire Stop Specialty Contractor
- .3 Installer shall have minimum 3 years of experience with fire stop installation. Submit project names.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- .2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- .3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged or expired materials.

1.7 PROJECT CONDITIONS

- .1 Do not use materials that contain flammable solvents.
- .2 Scheduling
 - .1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - .2 Schedule installation of Drop-In firestop devices after placement of concrete but before installation of the pipe penetration. Diameter of sleeved or cored hole to match the listed system for the device
 - .3 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- .3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- .4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- .5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

Part 2 PRODUCTS

2.1 FIRESTOPPING, GENERAL

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- .3 Firestopping Materials are either “cast-in-place” (integral with concrete placement) or “post installed.” Provide cast-in-place firestop devices prior to concrete placement.

2.2 ACCEPTABLE MANUFACTURERS

- .1 Hilti (Canada) Corporation
- .2 EZ-Path

2.3 MATERIALS

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

Part 3 EXECUTION

3.1 PREPARATION

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .5 Do not proceed until unsatisfactory conditions have been corrected.

3.2 COORDINATION

- .1 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- .2 Responsible trade is to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interference.

3.3 INSTALLATION

- .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory or Omega Point Laboratories Directory.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
 - .1 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.

- .2 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
- .3 Protect materials from damage on surfaces subjected to traffic.

3.4 FIELD QUALITY CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by authority having jurisdiction.
- .3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 IDENTIFICATION

- .1 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - .1 The words: "Warning -Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - .2 Contractor's Name, address, and phone number.
 - .3 Through-Penetration firestop system designation of applicable testing and inspecting agency.
 - .4 Date of Installation.
 - .5 Through-Penetration firestop system manufacturer's name.
 - .6 Installer's Name.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Remove all redundant or abandoned electrical equipment, devices, wiring, cabling, raceways, wireways, and luminaires in those portions of the existing building or site that are being renovated or demolished. This shall include all electrical equipment outside the area of actual renovation or demolition that serves the renovated area, except breakers that become surplus in existing panels. These breakers shall be labeled as spares, unless specifically stated to be reused.
- .2 The Electrical Division shall take note that the demolition and renovation will be done in an occupied building that is normally occupied during the day. Maintain electrical and communication systems as required to minimize services disruption.
- .3 The Electrical Division shall also take note of the dust containment requirements as outlined in the architectural and front end specification.
- .4 Electrical tender documents do not show all existing luminaires, wiring devices, conduit, boxes or wire. Conduit routing and wire grouping is not known. During demolition, the Electrical trade(s) are to deactivate all existing electrical and communication systems affected in such a manner that complete systems are not deactivated and system circuits affected in party wall partitions to be reactivated immediately on a temporary or permanent basis as site conditions dictate.
- .5 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Consultant who will provide instruction.
- .6 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.
- .7 **All** existing branch circuits for **existing panelboards** designated “**existing circuit**” as noted in Panelboard Schedules in specifications are to be tested and traced to source/termination point to confirm circuit is currently in use and in operation. **All existing unused redundant branch circuits wiring shall be completely removed and the related breakers labelled as “spare”**. Provide upgraded typed panel directories to the satisfaction of the Engineer.
- .8 **All** existing branch circuits re-connected to **new panelboards** designated “**Reconnected Exist. Re-Used Circuit**”, as noted in panelboard schedules in specifications, are to be tested and traced to source/termination point to conform circuit is currently in use and in operation. **All** existing unused redundant or abandoned branch circuits wiring, outlets, and devices shall be completely removed, and the associated breakers are to be re-labelled as “**spares**”.
- .9 All surplus electrical equipment, devices, and luminaires shall be considered Owner’s property. Determine from the Owner which materials are required to be retained, and transport and store such items at a location as directed by the Owner. All other surplus materials such as conduit, wiring, devices, etc. shall be removed from the site. Request a signed receipt for surplus material turned over to the Owner and provide a copy of same to engineer.
- .10 Identify each individual ballast that contains PCB’s in luminaires made redundant by renovations. Label each ballast as per Worker’s Compensation Board requirements. Place ballasts in storage drums and transport to storage area as directed by Owner.
- .11 Continuity of power and communication shall be maintained or restored promptly where services to other portions of a site are affected by renovation or demolition that is outlined on the architectural, structural, mechanical or electrical plans or specifications.

- .12 Remove and reinstall electrical equipment that becomes necessary due to renovation of architectural finishes or resurfacing. Include for extension rings, new junction boxes or outlet boxes, etc. to accommodate such changes.
- .13 Where new receptacles, switches, or outlets are added to existing areas, replace the remainder of receptacles, switches, and outlets in that area to match new.
- .14 Test all concrete slabs requiring cutting or coring by **x-ray testing** and opening a small sample area to obtain the depth of conduit runs. Avoid excessive cutting of slabs to depths that may interfere with existing conduits that are to be retained. Repair all damaged conduits and wiring that are to be retained. Allow for such repair in tender sum. The engineer may consider an extra if an unexpected large number of conduits are unavoidably damaged.
- .15 When any cutting of walls, ceiling, or floor in electrical rooms is part of the contract **all** electrical equipment shall be sealed from dust. At completion of work the room and all electrical components shall be fully vacuumed out, except primary voltage gear (exceeding 750 volts). Primary gear shall be cleaned out if the project requires that the gear be de-energized. At time of cleaning, a visual check shall be made of all terminations, and any discolouring brought to the attention of the engineer.
- .16 Wash and wipe clean all existing luminaires, reflectors, and lenses in areas adjacent to new renovation work.
- .17 Include in contract sum for complete removal of **all** existing redundant or abandoned data and telephone cabling and related equipment and devices located in existing T-bar ceiling space in area of renovations to the satisfaction of the engineer.
- .18 For all existing 347 volt lighting fixtures, whether remaining or relocated, supply and install luminaire disconnects, as required by CEC C22.1 (latest edition).

1.2 RELATED SECTIONS

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

1.3 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Division 01 Sustainable Requirements: Construction.
- .2 Do verification requirements in accordance with Division 01 Sustainable Requirements: Contractor's Verification.

1.4 PRODUCTS

- .1 Some electrical equipment and devices are to be retained or relocated and reused where indicated on plans. Provide for cleaning and refurbishing this equipment to the satisfaction of the engineer. For luminaires, refurbishment means provide complete new lamps, replace existing lenses if broken and replace non-functioning ballasts. For wiring devices, refurbish means replace existing device and faceplate with new.
- .2 Existing components may be reused only where specifically indicated on the drawings or in the specifications.

1.5 COMPLETENESS

- .1 The electrical installation and reinstallation shall be carried out to present codes and to at least as good a workmanship level as the original.
- .2 Test the completed installation to ensure all aspects are fully functional. Unless noted in writing to the Engineer before the work is commenced, all systems are assumed to function fully and correctly and must do so at completion of contract.
- .3 All existing branch circuits made redundant by removals of branch circuit wiring as a result of renovation work are to be identified at the respective panelboards with the redundant breakers being labelled as "spare".

1.6 ASBESTOS

- .1 If during renovations / demolition, asbestos is discovered (or material suspected to be asbestos), all work in that area shall immediately cease and the General Contractor advised. The General Contractor shall take appropriate action without delay to verify presence of friable asbestos and shall be responsible for the removal of all friable asbestos.

1.7 PCB (Polychlorinated Biphenyls)

- .1 Carefully remove any electrical items containing PCB's (eg light fixture ballasts) from equipment or fixtures to be renovated or demolished. Removed items (containing PCB's) shall be catalogued and stored on site in approved labelled storage containers in accordance with regulations.

Part 2 PRODUCTS

2.1 STANDARDS

- .1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

Part 3 EXECUTION

3.1 DEMOLITION

- .1 Demolition shall be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the BC Building Code current edition.
- .2 All redundant electrical components in the areas of demolition excluding those specifically identified in the following clauses shall become the property of the Electrical Division and shall be removed from site.
- .3 The following existing electrical components shall be disconnected by the Electrical Contractor, cleaned and suitably packaged where applicable, and turned over to the Owner at designated location established on site. If the Owner refuses these items they become property of the Electrical Contractor and are to be removed from site:
 - .1 All fluorescent luminaires complete with lamps and ballasts.
 - .2 Fire alarm components.
 - .3 Call system and components.
 - .4 Communication racks and rack accessories.
 - .5 Security devices.
 - .6 Speakers.
 - .7 Or as otherwise indicated on drawings.

3.2 DISRUPTION TO OPERATIONS

- .1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before startup.
- .2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.
- .3 Contractor to coordinate carefully around tenants who will remain during construction and arrange temporary power to ensure no downtime to operations.

3.3 INTERRUPTION TO EXISTING SERVICES

- .1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, shall be made good immediately. The Electrical Contractor shall identify these circuits to the Consultant. Specific tasks involving the demolition of essential circuits will require that the contractor obtain permission from the Owner before proceeding.
- .2 Circuits disrupted by floor cutting or drilling (ie. buried cables) to be brought to the attention of the consultant. Obvious systems disturbed because due care and attention was not followed, shall be repaired immediately at no additional cost to owner.
- .3 Where interruption of existing services is necessary as a part of the renovation, contractor must coordinate timing with base building maintenance 10 working days prior to interruption.

3.4 ABANDONED SERVICES

- .1 All abandoned conduit and wire shall be removed and disposed of by the Electrical Contractor.
- .2 Remove all accessible (eg. Surface) wiring and cables back to source.
- .3 Remove abandoned outlets and raceway, even if in or behind drywall, where they are located behind millwork or in locations unsuitable for reuse i.e. not at standard heights for switches or outlets.
- .4 All remaining circuits to be rerouted as required and suitably secured to the building structure.
- .5 Any cabling, including voice/data wiring, presently resting on any suspended ceiling system to be removed as part of the renovation process and shall be neatly bundled, protected and permanently secured to building structure. No cabling is permitted to rest on the ceiling system.

3.5 FIRE ALARM SYSTEM

- .1 Construction/demolition activities in existing building may require that select fire alarm devices are protected from construction dust, damage etc. Coordinate with the Owners representative as required to protect components of the fire alarm system to prevent nuisance operation and alarms.
- .2 Provide, install and test temporary heat detectors in the area of construction where the construction area is not protected by an active supervised fire protection sprinkler system. The "construction" detectors shall be removed and discarded at the end of the project.
- .3 Provide temporary replacement of smoke detectors with heat detectors including interim programming and testing and final re-verification where deemed necessary to minimize false alarms and to ensure other occupants of the building are protected.
- .4 Maintain existing fire alarm system in areas under construction where practical. Relocate, rewire and provide interim connections as required while installing the new system to replace the existing. Provide temporary fire alarm devices and audible signals to suit any temporary exiting provisions.
- .5 Contractor shall check in with the Owners representative at the start and end of each working day to confirm the fire alarm status in the area of work. Arrange for the related fire alarm zone card or area to be deactivated either to suit the progress of the work and/or where dust will be present on a day to day basis. Bag and protect fire detectors in dusty areas during construction. Remove any bagging at the end of the work day. Any existing detectors subject to construction dust shall be immediately vacuumed and marked to be replaced at the end of the project. Any fire alarm devices subject to moisture shall be replaced immediately.

- .6 The fire alarm system is to be fully functional in the area of construction when the Contractor is neither on site nor after the Contractors normal work hours. (ie overnight, holidays, weekends).
- .7 If the fire alarm system is not functioning when site is unoccupied, a fire watch shall be provided.
- .8 Where project phasing requires multiple fire verification, the Electrical Contractor shall include this in the contract bid amount.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies copper, ACM alloy and aluminum conductors rated 0-1000 Volts and the most common electrical insulation and covering materials.
- .2 This section does not include fire rated building wire to ULC S139 and CSA C83, marine, hazardous, mining, instrumentation, communication and fire alarm wiring.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3 latest edition, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131 latest edition, Type TECK 90 Cable.

1.3 GENERAL REQUIREMENTS

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated.
- .2 Aluminium conductors only permitted where indicated on drawings and then typically only for feeder conductors larger than 100 A. All conductor sizes indicated on drawings are based on copper conductors unless otherwise noted.
- .3 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-4 flame spread rating.
- .4 Flexible AC90 armoured cabling (BX) shall not be used for the general wiring system other than final drops to recessed light fixtures in concealed locations.
- .5 Cabling indicated to be 2-Hour Fire-Rated shall be compliant to CAN/ULC-S139 and CSA 38-95 (Draka Lifeline, Raychem RHW, or Shawflex). Cabling shall be low smoke halogen free. Conduit to be sized and installed as per manufacturers' requirements for these specialized cables and assemblies regardless of the size indicated on drawings.
- .6 Provide all control wiring except HVAC controls as specified in Mechanical Divisions.
- .7 Refer to Equipment Schedule(s) for detailed responsibilities.
- .8 Non-metallic sheathed wiring is not to be used on this project.

Part 2 PRODUCTS

2.1 WIRE AND CABLE GENERAL

- .1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.
- .3 Use RWU90XLPE for underground installations.
- .4 Site services sub-circuits, including site lighting, to be minimum #10 AWG for power and #12 for controls. Increase wiring size for lengthy and/or loaded circuits so that system will not exceed the maximum voltage drop as recommended by the Canadian Electrical Code CSA 22.1 [latest edition].
- .5 Main feeders to be conduit and copper insulated wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.
- .6 Armoured AC90 (BX) cable may only be utilized for recessed tee bar luminaire drops from ceiling mounted outlet boxes. "Tite Bite" connectors and their counterparts of other manufacturers shall not be used. Use anti-short connectors. Cable from luminaire to

luminaire is discouraged. Allow nominally 900mm [3'] extra cable looped and supported in the ceiling space to permit fixture relocations of one tile space.

- .7 TBS90 #14 AWG stranded shall be used in all switchgear assemblies. Current transformer secondary wiring shall be #12 AWG stranded. Current transformer leads shall incorporate ring type tongues for termination purposes.
- .8 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and conduit fittings. Conductors not to be painted.

2.2 TECK CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131 [latest edition].
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Type: [ethylene propylene rubber].
 - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, [600] [1000] V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel or aluminum.
- .6 Overall covering: [thermoplastic [polyvinyl chloride]] material.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1000 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors:
 - .1 [Watertight], [explosion-proof] approved for TECK cable.

2.3 MINERAL-INSULATED CABLES

- .1 Conductors: solid bare soft-annealed copper, size as indicated.
- .2 Insulation: compressed powdered magnesium oxide to form compact homogeneous mass throughout entire length of cable.
- .3 Overall covering: annealed seamless copper sheath, Type M1 rated 600 V, 250°C.
- .4 Outer jacket: [PVC] applied over sheath.
- .5 Two hour fire rating.
- .6 Connectors: as recommended by cable manufacturer.
- .7 Termination kits: as recommend by manufacturer.

2.4 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from galvanized steel or aluminum strip.

2.5 ARMoured FIRE ALARM CABLE

- .1 Use flexible armoured fire alarm cable from junction box to ceiling mounted fire alarm device.
- .2 Type: SECUREX® II cable, fire rated to CSA FT4 requirements.
- .3 Armour: interlocked aluminum tape armour. Cable armour shall be colour coded "red".

2.6 ARMoured CABLES (PATIENT CARE AREAS)

- .1 Conductors: insulated with low temperature Exelene insulation (RW90), copper, rated 600 volt, sized to meet all requirements of CSA Z32.2 latest edition but not smaller than #10.
- .2 Type: AC90 CSA Standard C22.2 N0:51. ISO-BX.
- .3 Armour: interlocked aluminum tape armour.
- .4 Three-conductor cable contains red, black and white circuit conductors, green isolated ground conductor, and a bare copper bonding conductor.
- .5 Isolated Ground Conductor covered with green (RW90) XLPE.

2.7 CONTROL CABLES

- .1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.
- .2 Low energy 300 V control cable: solid annealed copper conductors sized as indicated, with TWH over each conductor and overall covering of PVC jacket.
- .3 600 V type: stranded copper conductors, sizes as indicated with R90 (x-link) ethylene-propylene rubber insulation type over each conductor and overall covering of PVC jacket.

2.8 NON-METALLIC SHEATHED CABLE

- .1 Non-metallic sheathed copper cable type: NMW-90, size as indicated.
- .2 For heating circuits, use minimum #12 conductors.
- .3 Use only in wood stud construction in residential buildings only unless specifically approved for use by the Engineer.

Part 3 EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section [16133] [26 05 34 - Conduits, Conduit Fastenings and Fittings].
 - .2 In cable trays for electrical systems in accordance with Section [16114] [26 05 36 - Cable Trays for Electrical Systems].
 - .3 In underground ducts in accordance with Section [16133] [26 05 34 - Conduits, Conduit Fastenings and Fittings].
 - .4 In trenches in accordance with Section [16133] [26 05 34 - Conduits, Conduit Fastenings and Fittings].
 - .5 In underfloor distribution system in accordance with Section [16113] [26 05 39 - Underfloor Raceways for Electrical Systems].
 - .6 In cellular floor raceways in accordance with Section [16117] [26 05 38].
 - .7 In surface and lighting fixture raceways in accordance with Section [16112] [26 05 35 - Surface and Lighting Fixture Raceways].
 - .8 In wireways and auxiliary gutters in accordance with Section [16116] [26 05 37 - Wireways and Auxiliary Gutters].

- .9 Overhead service conductors in accordance with Section [16121] [26 05 14 - Power Cables & Overhead Conductors (1001 V)].
- .10 All wires are to be pulled in together in a common raceway, using liberal amounts of Compound 77 lubricant.
- .11 All power circuits connected to isolated ground type receptacles are to have individual separate neutral c/w insulated bonding conductor.
- .12 No combining of circuits onto common neutral will be permitted. Use 2 pole or 3 pole breakers for combined circuits, no connector clips will be allowed.
- .13 Ensure that all single phase loadings are reasonably closely balanced over the main feeders.
- .14 All dimmer circuits are to have individual neutral conductors for each circuit.

3.2 INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels.
- .2 Install cable in trenches in accordance with Section [16133] [26 05 34 - Conduits, Conduit Fastenings and Fittings].
- .3 Lay cable in cable trays for electrical systems in accordance with Section [16114] [26 05 36 - Cable Trays for Electrical Systems].
- .4 Terminate cables in accordance with Section [16151] [26 05 20 - Wire and Box Connectors - 0 - 1000 V].

3.3 INSTALLATION OF MINERAL-INSULATED CABLES

- .1 Install cable in trenches in accordance with Section [16133] [26 05 34 - Conduits, Conduit Fastenings and Fittings].
- .2 Run cable concealed where possible, securely supported by straps.
- .3 Support 2 h fire rated cables at 1m intervals.
- .4 Make cable terminations by using factory-made kits.
- .5 At cable terminations use thermoplastic sleeving over bare conductors.
- .6 Install cable in cable trays for electrical systems in accordance with Section [16114] [26 05 36 - Cable Trays for Electrical Systems].
- .7 Where cables are buried in cast concrete or masonry, sleeve for entry and exit of cables.
- .8 Do not splice cables.

3.4 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Install cable in trenches in accordance with Section [16133] [26 05 34 - Conduits, Conduit Fastenings and Fittings].
- .3 Lay cable in cable trays for electrical systems in accordance with Section [16114] [26 05 36 - Cable Trays for Electrical Systems].
- .4 Terminate cables in accordance with Section [16151] [26 05 20 - Wire and Box Connectors - 0 - 1000 V].

3.5 INSTALLATION OF ALUMINUM SHEATHED CABLE

- .1 Group cables wherever possible on channels.
 - .1 Install cable in trenches in accordance with Section [16133] [26 05 34 - Conduits, Conduit Fastenings and Fittings].

- .2 Lay cable in cable trays for electrical systems in accordance with Section [16114] [26 05 36 - Cable Trays for Electrical Systems].
- .3 Terminate cables in accordance with Section [16151] [26 05 20 - Wire and Box Connectors - 0 - 1000 V].

3.6 INSTALLATION OF CONTROL CABLES

- .1 [Control cable and conduit will be supplied and installed by Mechanical Contractor. Controls wiring must be installed in conformance with Electrical Specifications] Install control cables in conduit.
- .2 Ground control cable shield.

3.7 INSTALLATION OF NON-METALLIC SHEATHED CABLE

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section includes materials and installation for connectors and terminations.

1.2 REFERENCES

- .1 CSA C22.2 No.41- Grounding and Bonding Equipment.

Part 2 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper compression connectors as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.
- .3 Joint boxes in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.

Part 3 EXECUTION

3.1 INSTALLATION

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

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies the materials and installation for grounding electrical systems rated 750V or less.

1.2 REFERENCES

- .1 ANSI/IEEE 837- 2004 – Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA C22.2 No. 41 - 2007 – Grounding and Bonding Equipment.

Part 2 PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 3 6 m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated.
- .3 Rod electrodes: copper clad steel 19 mm diameter by 3 m long.
- .4 Grounding conductors: bare stranded copper, soft annealed, size [as indicated].
- .5 Ground bus: copper, size as required, complete with insulated supports, fastenings, connectors.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where conduit is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install separate ground conductor to outdoor lighting standards.
- .10 Connect building structural steel and metal siding to ground.
- .11 Make grounding connections in radial configuration only. Avoid loop connections.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end and load end.
- .13 Ground secondary service pedestals.

3.2 ELECTRODES

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water meter shunt.
- .3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- .4 Install rod electrodes and make grounding connections.
- .5 Bond separate, multiple electrodes together.
- .6 Use size 3/0AWG copper conductors for connections to electrodes.
- .7 Make special provision for installing electrodes that will give resistance to ground values that meet CEC requirements where rock or sand terrain prevails. Ground as indicated.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.4 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.5 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, fire alarm, intercommunication systems as indicated.

3.6 PERMAFROST

- .1 Bond non-current carrying metal parts together with size #30 AWG copper equipotential conductor. Run conductor from separate lug or service neutral bar to, but not necessarily limited to, following indoor systems and equipment:
 - .1 Hot water heating system.
 - .2 Main water pipe.
 - .3 Main building drain.
 - .4 Telephone, radio/TV, emergency and fire alarm lead-in or service conduits, near panels.

- .5 Make connections to pipes on building side of main valves and tanks. Connect jumpers across boilers to supply and return hot water heating pipes.
- .2 Drive three -19 mm diam. x 3 m copper clad ground rods at least 1.8 m apart in original undisturbed ground. If rods will not penetrate permafrost, drive at angle not more than 60° from vertical, and in same direction. Rods must be driven, not trenched.
- .3 Install ground wire from service neutral bar to rods and where buried use bare copper not smaller than size #1 AWG 7- strand or size #4 AWG solid, and at least [460] mm below ground. Bond ground conductor, or short tap from it, to outside metal sheathing of building close to power service conduit. Use lug or cast clamp, with bronze or plated bolt, nut and washers (not sheet metal screw or wood screw). Remove paint from sheathing for good contact. Conduit is required only on outside wall of building. Indoors, run bare and fasten as specified for equipotential bonding wire.
- .4 Install electrode interconnections where metal parts, circuits or grounding conductors and/or electrodes are in proximity to lightning rod conductors.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies U shape support channels either surface mounted. Suspended or set in poured concrete walls or ceilings.

Part 2 PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41mm, 2.5mm thick, surface mounted, suspended, or set in poured concrete walls and ceilings.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to surfaces with lead anchors or nylon shields as required.
- .2 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .5 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .6 For surface mounting of two or more conduits use channels at 1.5m on centre spacing.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for splitters, junction boxes, pull boxes and cabinets.

1.2 PRODUCT DATA

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: submit manufacturer's product data sheets indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: submit shop drawings for custom manufactured items showing materials, finish, dimensions, accessories, layout, and installation details.

Part 2 PRODUCTS

2.1 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

Part 3 EXECUTION

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal blocks as required.
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies rigid and flexible conduits, fasteners, fittings and installation.

1.2 REFERENCES

- .1 Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware: to CSA C22.2 No. 18.
- .2 Rigid metal conduit (RMC): to CSA C22.2 No. 45.
- .3 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .4 Electrical metallic tubing (EMT): to CSA C22.2 No. 83.
- .5 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .6 PVC (DB2) conduit: to CSA #C22.1 211-1.
- .7 Flexible metal conduit (FMC): to CSA C22.2 No. 56.
- .8 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

1.3 BASIC WIRING METHODS

- .1 Underground or in concrete exterior to building:
 - .1 All wiring shall be in Schedule 40 RPVC conduit.
- .2 Concrete walls and slabs interior to building:
 - .1 All wiring shall be in Schedule 40 RPVC conduit.
- .3 Partition walls and ceilings:
 - .1 All wiring to be run in EMT conduit for:
 - .1 Branch circuits.
 - .2 Fire alarm.
 - .3 Low voltage systems.
 - .4 Distribution feeders and sub-feeders.
 - .5 Surface wiring in electrical and mechanical rooms.
- .4 T-bar ceilings:
 - .1 EMT to junction box with flexible armoured cable drops for individual luminaires. No feed through wiring to luminaires allowed, except for where luminaires butted together. Allow adequate cable to relocate luminaire one T-bar space in any direction.
- .5 Motors, transformers and all vibrating equipment:
 - .1 Short (600mm to 1200mm) PVC jacketed flexible conduit with liquid tight connectors shall be used. Allow sufficient slack to avoid strain on connectors at extreme extension of equipment movement.
- .6 Surface raceways - interior:
 - .1 All surface raceways shall be EMT, except if located without protection in areas susceptible to damage, which shall be rigid steel conduit.
- .7 Surface raceways - exterior:
 - .1 All surface raceways shall be UV compensated Schedule 40 RPVC conduit, protected from damage and excessive heating to the Consultant's satisfaction.

1.4 LOCATION

- .1 Electrical drawings are diagrammatic and do not show all conduits, wire, cable, etc. Electrical contractor to provide conduit, wire cable, etc., for a complete operating job to meet in all respects the intent of the drawings and specifications.
- .2 Outlet positions shown on architectural drawings (plans and elevations) to take precedence over locations and mounting heights indicated on electrical plans or in specifications.
- .3 Locate electrical devices on walls with regard given for convenience of operation and conservation of wall space. Switches, receptacles, fire alarm pull stations, etc. generally to be vertically lined up where items are in the same general location. Adjacent common devices to be installed in common outlet box.
- .4 Review the exact location criteria of each electrical outlet and device with the Architect and Consultant prior to rough-in. Relocate any item installed without architectural confirmation as required by the architect or Consultant at no cost to the owner as long as the relocation is within 3m of the location originally shown on the electrical drawings.
- .5 Do not install outlets back-to-back in party walls; allow a minimum of one stud space horizontal clearance between boxes. Install behind all outlets in party walls a Lowry Acoustic backing pad.
- .6 Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms on latch side of door.
- .7 All outlets located on exterior walls to be complete with moulded plastic vapour barriers to maintain integrity of wall vapour barrier system.
- .8 All raceways and wiring shall be installed concealed in building fabric, except for mechanical and electrical rooms where they shall be installed on the surface.
- .9 All outlet boxes, junction boxes, and cabinets to hold electrical devices shall be mounted so the equipment can be flush mounted unless indicated otherwise.
- .10 All junction boxes and other raceway access devices shall be mounted to avoid being visible from public areas. Obtain approval from Architect or Consultant for any and all junction boxes that, due to the building design, cannot be concealed.
- .11 All junction boxes mounted, out of necessity, on surface of solid walls shall be painted to match adjacent surface, with junction boxes painted to match designated systems.

Part 2 PRODUCTS

2.1 RIGID PVC RACEWAY SYSTEM

- .1 Rigid PVC fittings shall be of the same manufacturer as the conduit.
- .2 PVC boxes and covers shall be Sceptre "F" Series or equivalent complete with all components and adaptors.
- .3 PVC junction boxes exceeding the size of "F" Series shall be Sceptre: "JB" Series boxes and be complete with junction box adaptors.
- .4 All fittings with removable covers shall be complete with VC gaskets and brass securing screws and inserts. All metal components shall be brass or stainless steel.

2.2 PVC DUCT RACEWAY

- .1 PVC duct fittings shall be of the same manufacturer as duct.
- .2 PVC duct shall be colour coded white for communications, grey for power.

2.3 EMT RACEWAY

- .1 Electrical Metallic Tubing (EMT) shall be galvanized steel of sufficient quality and thickness to allow smooth field formed bends.

- .2 EMT couplings, connectors and fittings shall be steel. Cast type units shall not be used on this installation.

2.4 PVC JACKETED FLEXIBLE CONDUIT

- .1 PVC jacketed flexible conduit (liquid tight) shall be interlocking spiral aluminum conduit with continuous extruded PVC jacket.
- .2 Conduit fittings shall be steel liquid tight type that fit over PVC jacket and seal uniformly all round.

2.5 FLEXIBLE ELECTRIC NON-METALLIC (ENT) TUBING

- .1 Flexible electrical non-metallic tubing (ENT) **shall not** be used on this project.

2.6 OUTLET BOXES AND JUNCTION BOXES

- .1 Except as noted for rigid PVC raceways, all outlet boxes and junction boxes shall be one piece formed or welded.
- .2 Outlet boxes to be galvanized steel.
- .3 Junction boxes to be galvanized steel or aluminum.

2.7 INNERDUCTS

- .1 Provide and install innerducts in underground conduits where called for on plans.
- .2 Innerducts to be outdoor corrugated high density polyethylene type complete with pullstring, cable plugs, blank plugs for unused innerducts, and quadraplex sealing plugs.

2.8 ACCESS HATCHES

- .1 Provide and install access hatches in drywall ceilings to access junction boxes. Coordinate with other trades and check locations with architect before installing.
- .2 Access hatches shall have the following specifications:
 - .1 Door: aluminum frame with gypsum board inlay.
 - .2 Frame: Recessed aluminum
 - .3 Finish: to receive the same finish and paint as the surrounding surface.
 - .4 Hinge: concealed, non-corroding.
 - .5 Latch: flush screwdriver cam latch.
- .3 Access hatches to be of a size to suit but not less than 305mm square.

2.9 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1500mm oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

2.10 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT in all exterior applications. Set-screws are not acceptable.

2.11 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.12 FISH CORD

- .1 Polypropylene.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use rigid galvanized steel threaded conduit except [where specified otherwise].
- .4 Use epoxy coated conduit underground corrosive areas.
- .5 Use electrical metallic tubing (EMT) except in cast concrete and above 2.4 m not subject to mechanical injury.
- .6 Use rigid PVC conduit underground, in corrosive areas, and surface mounted in wet areas not subject to damage.
- .7 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.
- .8 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .9 Use explosion proof flexible connection for connection to explosion proof motors.
- .10 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .11 Minimum conduit size for lighting and power circuits: 19mm.
- .12 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install fish cord in empty conduits.
- .15 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in [flush concrete] [surface] type box.
- .16 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .17 Dry conduits out before installing wire.
- .18 Conduits shall be installed mechanically continuous from outlet to outlet and without pockets. All the necessary standard bushings, elbows and bends shall be provided. All conduit bends shall have a radius of not less than six (6) times the internal diameter of the conduit and in no case shall the equivalent of more than four quarter bends from outlet to outlet be made. For all conduit sizes to be used for low voltage raceway, the conduits shall have a minimum bending radius of 230mm.
- .19 Conduit bends shall be made with no more than 10% flattening of the conduit. Bends shall be smooth throughout deformations.

- .20 On surface wall runs, all conduit shall be installed in true vertical or horizontal direction and on ceilings in true 90 degree angles or parallel to the walls. Crossings of conduits shall also be made at 90 degree angles. Parallel running conduit shall be kept on equal spacing on the entire length of run including bends.
- .21 All conduits shall be fastened to structure with steel straps (no cast type straps allowed).
- .22 Where more than three conduits are run parallel in ceiling cavity, they shall be installed on cantruss type channel, complete with all manufacturer's fittings to secure channel to structure and to conduit.
- .23 Raceways extending out concrete slabs shall be securely protected using rebar stubs or similar material. All duct stubs are to be kept sealed during construction

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

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

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.
- .8 Do not install conduits in slabs/concrete floors in lab areas.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.
- .2 Do not install conduits in slabs/concrete floors in lab areas.

3.6 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.7

FIRE STOPPING

- .1 Apply ULC approved fire stopping assembly to all conduit penetrations passing through fire rated walls and floors.
- .2 Provide shop drawings showing details for each type of application on the project. Shop drawings shall include catalogue data and installation details.
- .3 For all communication sleeves accessible via ceilings or in stacked closets/rooms passing through floors, provide 2 hour rated STI EZ-PATH assembly. Where quantity is not indicated on plans, provide minimum two sleeves between each floor and each communication closet/room.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE

- .1 Provide and install the following types of lighting controls:
 - .1 Occupancy/vacancy sensor line voltage lighting control
 - .2 Interior lighting low voltage switching
 - .3 Exterior photocell
 - .4 Interior lighting level sensors with dimming or switching control (day light harvesting)
 - .5 Central lighting control panel.
 - .6 Proprietary communications link between panels.
- .2 Controls shall include for daylighting harvesting in indicated areas, occupancy sensing and control of exterior lighting using photoelectric and timeclock functions.

1.2 IDENTIFICATION

- .1 Label each dimming switch indicating zone of control using lamicaid labels.
- .2 Label all junction boxes and power supplies associated with controls using lamicaid labels.

Part 2 PRODUCTS

2.1 DIMMING SWITCHES, LINE VOLTAGE WALL MOUNTED

- .1 LED push button switch separate from slide to turn dimmer on/off.
- .2 Rated: 1000 watts at 120V.
- .3 Radio/TV interference filter.
- .4 Brushed stainless steel cover plate.
- .5 Accepted manufacturers: Lightolier Sunrise ZP1000EB or Lutron or Leviton equivalent.
- .6 **Contractor is responsible to ensure compatibility of these dimmers with fluorescent lighting products supplied in this project.**

2.2 OCCUPANCY/VACANCY SENSOR LIGHTING CONTROL, LINE VOLTAGE

- .1 Wall mounted wall switch, Type 1
 - .1 PIR occupancy sensor.
 - .2 Adjustable delayed-off time setting 30 seconds to 30 minutes.
 - .3 Dual technology PIR sensing.
 - .4 180° field of view.
 - .5 120V supply.
 - .6 Device will provide the following functions:
 - .1 Automatic timed off when person leaves room.
 - .2 Manual turn on required when person enters room. (i.e. device does NOT turn on lights automatically when person enters room).
 - .7 These devices to be used in all rooms noted for line voltage occupancy control, **except** for all washrooms.

- .2 Wall mounted wall switch, Type 2
 - .1 PIR occupancy sensor.
 - .2 Adjustable delayed-off time setting 30 seconds to 30 minutes.
 - .3 Dual technology PIR sensing.
 - .4 180° field of view.
 - .5 120V supply.
 - .6 Device will provide the following functions:
 - .1 Automatic timed off when person leaves room.
 - .2 Automatic turn on when person enters room.
 - .3 Manual override. (on-off-auto).
 - .7 These devices to be used in all washrooms noted with line voltage occupancy control.

2.3 EXTERIOR MOUNTED ANALOG PHOTOCCELL

- .1 Wall Mounted Analog Exterior Photocell
 - .1 Sensor to be mounted on north face of building, as noted in drawings.
 - .2 Provide analog signal for realtime control of exterior lighting and feedback to building management system.

Part 3 EXECUTION

3.1 OCCUPANCY/VACANCY SENSOR LIGHTING CONTROL, LINE VOLTAGE

- .1 Install and wire as recommended by manufacturer.
- .2 Ensure that sensors will be clear of obstructions and will be able to sense the occupant from the mounting position.
- .3 Configure sensor dipswitch settings for timing and sensitivity as directed by Engineer.

3.2 LOW VOLTAGE DIMMING SWITCHES

- .1 Install and wire as recommended by the manufacturer.
- .2 Test dimmers to ensure that they do not cause interference or noise.
- .3 Each dimmer shall have a dedicated neutral wire.

3.3 LINE VOLTAGE DIMMING AND DAYLIGHT SENSING

- .1 Install and wire as recommended by the manufacturer.
- .2 Confirm correct operation of the dimming function and correct sensitivity.
- .3 Adjust device for correct light settings as directed by Engineer.

3.4 OCCUPANCY/VACANCY SENSOR LIGHTING CONTROL, LINE VOLTAGE

- .1 Install and wire as recommended by manufacturer.
- .2 Ensure that sensors will be clear of obstructions and will be able to sense the occupant from the mounting position.
- .3 Configure sensor dipswitch settings for timing and sensitivity as directed by Engineer.

3.5 EXTERIOR ANALOG PHOTOCCELL

- .1 Install photosensor recessed in a junction box. Flush mount and seal cover using silicon gel. Confirm exact location prior to rough in.
- .2 Connect to lighting control system.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE

- .1 This contract includes final connections to all equipment, requiring electrical power including:
 - .1 Mechanical equipment per mechanical schedule.
 - .2 Door Opener and other equipment specified by architect.
 - .3 Connection to holding tank control panel and AV alarm devices.
- .2 The contractor shall review all shop drawings, including those by other trades, to ensure correct location, size and characteristic of service before completing installation. Where size and characteristic of services require changes, these shall be brought to the engineer's attention immediately, for change to either equipment or service.

Part 2 PRODUCTS

2.1

- .1 Connections to equipment shall be in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Fittings.
 - .1 Any equipment that may be required to be moved for cleaning, etc. shall have adequate loop of cable to allow such movement without stress on connections.
 - .2 All equipment that vibrates or is occasionally moved, shall have stranded conductors and cable/raceway connectors to equipment and outlet box of a compression liquid tight type.

Part 3 EXECUTION

3.1

- .1 Refer to Section 26 05 34 for Conduit, Conduit Fastenings and Fittings

END OF SECTION

Part 1 GENERAL

1.1 SCOPE

- .1 Electrical Contractor to supply and install distribution centres as indicated on the plans.
- .2 The available space is restrictive, and the electrical equipment had been designed to accommodate this. All proposed manufactures shall take particular note of this when pricing equipment, and include for any variations to their standard equipment in the tender sum.
- .3 This section of specification includes main distribution centres and circuit breakers in main distribution circuits.

1.2 MOUNTING SECURING

- .1 The equipment securing to meet specification Section 26 05 00 - Common Work Results - Electrical.
- .2 The manufacturer to provide a declaration sealed by a professional engineer that, if secured as shown by the manufacturers shop drawing, the electrical equipment will not sustain damage under direct earthquake loads as specified in the N.C. Building Code.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Indicate on shop drawings:
 - .1 Floor anchoring method and foundation template, channel details of mounting frame.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
- .3 Include time-current characteristic curves for circuit breakers and fuses rated 250 A and higher.

1.4 MAINTENANCE DATA

- .1 Provide data for incorporation into maintenance manual specified in Section 26 05 00 - Common Work Results - Electrical.

1.5 SOURCE QUALITY CONTROL

- .1 Engineer to witness final factory tests.
- .2 Notify engineer in writing five days in advance that service entrance board is ready for testing.
- .3 Submit three (3) copies of certified test results.

1.6 SPARE PARTS

- .1 Provide 2 – 15 Amp single pole, 2 – 15 Amp three pole, 2 – 20 Amp 3 pole and 2 – 30 Amp three pole spare breakers. Install in panel as directed by engineer.
- .2 Review for additional spare breaker requirements.

Part 2 PRODUCTS

2.1 POWER SUPPLY

- .1 Power supply: 120/208V, 3 phase, 4 wire, grounded neutral, 60 Hz, short circuit current 100 kA (rms symmetrical).

2.2 SERVICE ENTRANCE BOARD

- .1 Rating: 70A.
- .2 Cubicles, free standing, dead front, size as indicated. Frame and structure of enclosure and all components to be secured to earthquake standards.
- .3 Barrier metering section from adjoining sections.
- .4 BC Hydro metering standards.
- .5 Distribution sections.
- .6 Hinged access panels with captive knurled thumb screws.
- .7 Bus bars and main connections: copper.
- .8 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
- .9 Identify phases with colour coding.

2.3 MOULDED CASE CIRCUIT BREAKERS

- .1 Series Rated.
- .2 Common-trip breakers with single handle and trip mechanism for multipole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers, 200 A and above, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.
- .4 Manufacturer: Square D, Cutler-Hammer.

2.4 FUSIBLE DISCONNECTS

- .1 Disconnect switches shall be heavy duty, lockable position, complete with HRC fuses.
- .2 Disconnects shall have quick make/quick break mechanism.
- .3 Disconnects shall be adapted for HRC fuses.
- .4 Manufacturer: Schneider, Cutler-Hammer.

2.5 FUSES

- .1 All fuses shall be designed for special fault limiting.
- .2 Fuse sizes 30 Amp – 350 Amp shall be bus low peak LPN-RK1 (or equivalent fuse providing equal or better fault limiting characteristics).

2.6 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Copper lugs at each end for size #3 grounding cable, connect to main ground bus.

2.7 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical:
 - .1 Service entrance board exterior grey.
 - .2 Supply 2 spray cans touch-up enamel.

2.8 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Nameplates:
- .3 White plate, black letters, size 30mm lettering.
- .4 Complete board labelled: "120/208 600 V".
- .5 Branch disconnects labelled: "Feeder panel _____".

2.9 MANUFACTURERS

- .1 Acceptable manufacturers: Cutler-Hammer, Square D, Siemens.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Locate service entrance board as indicated and fasten to base, in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Connect main secondary service to line terminals of main breaker.
- .3 Connect load terminals of distribution breakers to feeders as indicated.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Run one grounding conductor from ground bus to building ground.
- .6 Check trip unit settings against coordination study to ensure proper working and protection of components.
- .7 Have Manufacturer's technician check complete system, and provide report that:
 - .1 All connections are secured to the correct tension.
 - .2 All trip settings are correct, and function to settings indicated.
 - .3 Complete system is installed to manufacturers' recommendations.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This Section specifies standard and custom panelboards and their installation.

1.2 SCOPE OF WORK

- .1 Provide and install panelboards as indicated on the drawings, single line diagram, panel schedules and these specifications.
- .2 Types of panelboards in this section include the following:
 - .1 Lighting and power panelboards

1.3 PRODUCT INFORMATION

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- .3 Shop drawings to include matching tub and trim details for factory installed low voltage relay cabinets where specified.

1.4 PLANT ASSEMBLY

- .1 Install circuit breakers in panelboards before shipment from plant.
- .2 In addition to CSA requirements, manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .3 All panelboards to be of a common manufacturer.

1.5 FINISH

- .1 Apply finishes in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Panel finish in electrical and equipment rooms and closets to be standard ASA Grey baked enamel. Confirm with Consultant prior to shop finishing panels.

Part 2 PRODUCTS

2.1 PANELBOARDS, DOORS AND TRIMS

- .1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.
- .2 Panel Board shall have Main MCCB Breaker series rated.
- .3 Bus and breakers unless otherwise indicated on the drawings and in the specifications, shall be series rated for 100 kA at 208Y/120V.
- .4 Copper bus with full size neutral.
- .5 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.
- .6 Mains capacity, number of circuits and number and size of branch circuit breakers as indicated.
- .7 Provide all necessary connectors and mounting hardware in every space to facilitate installation of future breakers. Provide blank fillers for all spaces.
- .8 Concealed hinges and concealed trim mounting screws, hinged locking door with flush catch.
- .9 Panelboards to have flush doors. (Gasketed where required for damp locations).

- .10 Provide two keys for each panelboard and key similar voltage and system panelboards alike.
- .11 Panel tubs to be typically 600mm wide.
- .12 Provide door within door trims where indicated to facilitate ease of service maintenance Each tub trim cover to be hinged and self supporting and to swing out to expose breaker cable terminations and wireways. Hinged trim shall be secured with cover screws on opening side by concealed machine screws. Hinged breaker cover shall be recessed into the hinged overall tub cover. Breaker cover shall have latch type closures. Submit details on shop drawings prior to manufacturing.

2.2 BREAKERS

- .1 All breakers to be:
 - .1 For Lighting: Bolt on type molded case, non-adjustable and non-interchangeable trip, single, two and three pole, 120/208V and with trip free position separate from "On" or "Off" positions.
 - .2 For Power: Bolt on type molded case, adjustable and interchangeable trip, single, two and three pole, 120/208V and with trip free position separate from "On" or "Off" positions.
- .2 Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard.
- .3 Main breaker (where required) to be separately mounted at top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Provide circuit breakers with indicated trip ratings as shown in the panelboard schedules or the Single Line Diagram.
- .5 Provide spare circuit breakers as indicated on panel schedules or single line diagram as applicable.
- .6 Provide breaker type Ground Fault Interrupter(s) (GFI) as indicated.
- .7 Provide Lock-on devices as indicated and for Fire Alarm circuits, Security Equipment circuits, and Exit sign circuits.

2.3 PANELBOARD IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.
- .3 Complete updated circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a "letter sized" paper copy of each directory in the project maintenance manual.
- .4 Provide a plasticized typewritten information card fixed to the back of the each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a "letter sized" paper copy of each information card in the project maintenance manual.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.
- .2 Panelboards located in service rooms, mechanical rooms, and electrical rooms to be mounted on unistrut supports.
- .3 Mount panelboards to height given in Section 26 05 00 or as indicated.
- .4 Connect loads to circuits as indicated.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Provide spare breakers as indicated on panelboard schedules and on single line diagram.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This Section specifies switches, receptacles, wiring devices, cover plates and their installation.

1.2 PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA-C22.2 No.42.1, Cover Plates for Flush Mounted Wiring Devices.
 - .3 CSA-C22.2 No.55, Special Use Switches.
 - .4 CSA-C22.2 No.111, General Use Snap Switches.

Part 2 PRODUCTS

2.1 COLOUR

- .1 All devices to be decora style white.
- .2 Receptacles that are switched via occupancy control or similar automatic controls shall be gray unless noted otherwise in the drawings.

2.2 SWITCHES

- .1 Heavy duty specification grade shall be installed in office spaces only.
- .2 20 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.
- .3 Manually-operated general purpose ac switches as indicated and with following features:
 - .1 Terminal holes approved for No.10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine molding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle (red toggle for emergency power circuits).
- .4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rating capacity of motor loads.
- .5 Switches of one manufacturer throughout project.
- .6 Standard of acceptance:
 - .1 Hubbell HBL.1221 20A series
 - .2 Leviton 1221-20A 120V series
 - .3 Pass & Seymour PS20AC1 120V series

2.3 RECEPTACLES – GENERAL

- .1 Heavy duty specification grade.
- .2 Duplex receptacles, CSA type L5-15 R, 125 V, 15 A, U ground, with following features:
 - .1 White nylon molded housing (red for emergency power circuits)
 - .2 Suitable for No.10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.

- .5 Triple wipe contacts and non riveted grounding contacts.
- .3 Receptacles of one manufacturer throughout project.
- .4 Standard of acceptance:
 - .1 Hubbell 5252 heavy duty, construction series
 - .2 Leviton 5262 series
 - .3 Pass & Seymour 5262 series

2.4 RECEPTACLES – PARTICULAR APPLICATION

- .1 Surge Suppression TVSS 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, blue face, parallel blade, U ground, impact resistant nylon face audible and LED alarm. Equal to:
 - .1 Hubbell 8262SA heavy duty series with LED.
 - .2 Leviton 8280 series
 - .3 Pass & Seymour 8200SP series (Décor)
- .2 Isolated Ground type to be 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, orange face, parallel blade, U ground, impact resistant nylon face. Equal to:
 - .1 Hubbell IG8262A series
 - .2 Leviton 8200IG series
 - .3 Pass & Seymour IG26262 series (Décor)
- .3 Ground Fault Interrupter type to be 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, white face, parallel blade, U ground, impact resistant nylon face, complete with breaker and reset button. Equal to:
 - .1 Hubbell GF8200A series
 - .2 Leviton 7599HG series
 - .3 Pass & Seymour HG1595 series (Décor)
- .4 20 Amp Receptacles (Housekeeping) Duplex receptacles – T-slot type CSA type L5-20R 125V. 20 Amp u ground with features matching 15 Amp rated Receptacles.
- .5 Safety Tamper Resistant Receptacles. Receptacles indicated with an 'S' on the drawings shall be Tamper Resistant type. Hubbell RR15xx.TR series.
- .6 All other single outlet and special purpose receptacles to be similar to the grade and series indicated above. Confirm ampacity, voltage and pin configuration prior to installation.
- .7 Range receptacle to be 250V, 50A with a 40A, 2P breaker per outlet.
- .8 Dryer receptacle to be 250V, 40A with a 30A, 2P breaker per outlet.

2.5 COVER PLATES

- .1 Stainless steel: Type 302 or 304, No. 4 finish, 1mm thick, accurately die cut, protective cover for shipping. Outlets in labs or as indicated in the drawings or specifications.
- .2 Nylon plates: Heavy duty, unbreakable and flush. All nylon plates to match wiring device colour.
- .3 Steel: sheet steel hot dip galvanized with rolled edges for surface mounted utility boxes.
- .4 Wall plates to be flush mounting with "positive bow" feature to ensure that all edges of plate are flush with wall or surface box when installed.
- .5 All plates to be beveled type with smooth rolled outer edge and smooth face. Exposed sharp edges are not acceptable.
- .6 Cast metal: die cast profile, ribbed for strength, flash removed, primed with grey enamel finish and complete with four mounting screws to box for special purpose wiring devices.

- .7 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for wiring devices as indicated. Double doors for standard duplex receptacles. Cover plates to fasten to box by four screws.
- .8 Gaskets: resilient rubber or close cell foam urethane.
- .9 Cover plates for all wiring devices to be from one manufacturer throughout project.

Part 3 EXECUTION

3.1 INSTALLATION GENERAL

- .1 Mount wiring devices to height specified in Section 26 05 00 or as indicated.
- .2 Upper edge of plates located on separate outlets immediately alongside one another to be at exactly the same height above finished floor.
- .3 All plates to be installed parallel or perpendicular to building lines.

3.2 INSTALLATION PARTICULAR

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .2 Receptacles:
 - .1 Install all receptacles in the vertical plane unless otherwise noted.
 - .2 Generally install the L5-15/20R U ground pin down unless otherwise noted. Neutral up when receptacle in mounted horizontal.
 - .3 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.
 - .4 Where split receptacles has one portion switched, mount vertically and switch the upper portion.
 - .5 Surge suppression duplex receptacles to be provided for all communication and computer terminal equipment backboards and cabinets including fire alarm, telephone, public address, door security, nurse call, central dictation, RF television, security television, etc. Provide dedicated neutral conductors for each surge suppression receptacle.
 - .6 Ground fault interrupter duplex receptacles to be used, adjacent sinks or water sources.
- .3 Cover plates:
 - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies equipment and components for ground fault circuit interrupters (GFCIs).

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.144- latest edition, Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2-latest edition, Application Guide for Ground Fault Protection Devices for Equipment.

1.3 PRODUCT DATA

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data and shop drawings.
- .3 Submit test report for field testing of ground fault equipment to Consultant and a certificate that system as installed meets criteria specified herein.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Single or Two pole ground fault circuit interrupter for indicated voltage c/w test and reset facilities. Refer to panelboard schedules.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Do not ground neutral on load side of ground fault relay.
- .2 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical.
- .2 Arrange for field testing of ground fault equipment by ground fault equipment manufacturer before commissioning service.
- .3 Demonstrate simulated ground fault tests.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for fused and non-fused disconnect switches.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No. 4-latest edition, Enclosed Switches.
 - .2 CSA C22.2 No. 39-latest edition, Fuseholder Assemblies.

1.3 SUBMITTALS

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

Part 2 PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure type 2 or as indicated.
- .2 Provision for padlocking in off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated.
- .5 Fuseholders: suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

Part 3 EXECUTION

3.1 INSTALLATION

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

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies the materials and installation for luminaires for the entire project including exterior lighting fixtures.
- .2 Refer to the Luminaire Schedule on the electrical drawings.

1.2 REFERENCES

- .1 CAN/CSA C22.1-09, Canadian Electrical Code, Part I.
- .2 CAN/CSA C22.2 No.9.0, General Requirements for Luminaires.

1.3 ADDITION OF ACCEPTABLE MANUFACTURERS

- .1 Material/products considered to satisfy the specification, but of a manufacturer other than those named may be submitted to the Consultant for consideration not later than five (5) working days prior to closing of tender or of bid depository subtrade tender whichever is earlier.
- .2 Alternate approvals will be given by written addendum only. No other substitution will be permitted after closing of tenders.
- .3 Alternate approvals granted before the closing of tenders will be limited to a manufacturer's system and/or series only. This limited approval will not preclude substitute equipment/material from complying with specific features included with equipment/material specified. Determine that the alternate product meets the specification intent before basing a tender on the product.

1.4 PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit complete photometric and heat dissipation data prepared by independent testing laboratory for proposed luminaires.

1.5 INTENT

- .1 Provide lighting fixtures along with LED driver/modules and accessories for all outlets as listed in the Luminaire Schedule and as shown on drawings.
- .2 Lighting fixtures shall be structurally well designed and constructed, using new parts and materials of the highest commercial grade available.
- .3 Ground all lighting equipment to grounding system.
- .4 Verify all ceiling types and finishes before ordering fixtures and provide fixtures suitable for mounting in or on ceilings being installed in each area, as specified. Where fixture types specified are not suitable for ceiling being installed, obtain written instructions from the Consultant before ordering fixtures.
- .5 Fixtures of the same or similar type shall be supplied by the same manufacturer.

Part 2 PRODUCTS

2.1 SOLID STATE LIGHTING

- .1 Solid state lighting rated correlated colour temperature (CCT) shall be with four (4) MacAdam ellipses of the specified CCT in the luminaire schedule. Colour consistency between lamps in the same fixture type shall be within four (4) MacAdam ellipses of the rated CCT.

- .2 Solid state lighting shall have a CRI greater or equal to the value listed in the luminaire schedule. In addition the lamps shall have an R9 value greater than 50 measured under the same conditions as the CRI.
- .3 Solid state lighting systems (including required drivers) shall have a power factor greater than 90 at full rated output.
- .4 Solid state lighting lumen maintenance data shall be provided for L70 testing.

2.2 FIXTURES

- .1 Accessories and components shall comply with relevant CSA Standards.
- .2 Recessed downlight fixtures shall be of the approved prewired type with junction box forming an integral part of the fixture assembly and so located in relation to the fixture that the junction box is CSA approved for 75 degree C wire. The electrical trade shall supply and install all necessary plaster rings, supports, etc., required for complete and proper installation.
- .3 Except where otherwise noted in the Luminaire Schedule, depth of recessed fixtures shall not exceed 150 mm, including mounting yokes, or bridges. Design of reflector and lamp position shall be to provide high efficiency, even brightness and lack of lamp lines.
- .4 All metal parts shall be thoroughly cleaned and finished in high reflectance baked enamel over corrosion-resistant primer. Finish as indicated in luminaire schedule.
- .5 All internal fixture diffusers, lens panels, lens frames, etc., shall be securely and adequately supported and shall be removable without the use of tools for cleaning.
- .6 Fixtures shall incorporate adequate gasketing, stops and barriers to form light traps and prevent light leaks.
- .7 Fixtures shall be designed for adequate dissipation of driver and lamp heat to avoid short driver life, nuisance thermal tripping and decreased lamp output. Heat test reports by independent laboratories shall be provided where required by the Consultant.
- .8 Construction of all fixtures shall be such as to provide a rigid well aligned fixture. Formed or ribbed backplates, end plates, reinforcing channel, heavy gauge sockets, straps, etc., shall be used where required to accomplish this.
- .9 The construction and performance of all fixtures shall be subject to the acceptance of the Consultant.
- .10 All external lights shall be supplied with motion sensors to turn on the lights.**

Part 3 EXECUTION

3.1 INSTALLATION AND SUPPORTS

- .1 Provide complete and proper support for all fixtures, fixture hangers, etc., including headers in ceiling space, where required, for proper support of outlet boxes and fixture hanger assemblies.
- .2 Support fixtures as shown on the drawings, level, plumb and true with the structure and other equipment in a horizontal or vertical position as intended. Wall or side bracket mounted fixture housings shall be rigidly installed and adjusted to give a neat flush fit to the surface on which it is mounted.
- .3 All hangers, supports, fastenings or accessory fittings shall be protected against corrosion. Care shall be taken during the installation to assure that insulation and corrosion protection is not damaged.
- .4 Self aligning seismically rated ball joint hangers shall be used for rod suspended fixtures. Ceiling canopies or hood assemblies intended to cover the suspension attachments shall be installed to fit tightly to the ceiling without restricting the alignment of the hanger. Support fixtures by hangers and mounting arrangements which will not cause the fixture frame, housing, sides or lens frame to be distorted; or prevent complete alignment of several fixtures in a row.

- .5 The suspension length of all ceiling mounted suspended types of lighting fixtures as listed in the Fixture Schedule shall be the overall length from the ceiling to the lowest point of the fixture body, reflector or glassware in its hanging position.
- .6 Metal inserts, expansion bolts or toggle bolts in concrete slabs for stems which do not carry wiring must be accurately located in relation to the outlet boxes, to allow perfect alignment and spacing of suspension stems.
- .7 Where fixtures are surface mounted on the underside of an inverted tee bar ceiling, the fixture shall be supported either directly from the building structure by means of rod hangers and inserts or by means of metal angle headers, supported from the tee bar framing structure above the tile. Fixtures shall be supported from the quarter points.
- .8 Connection to incandescent fixtures shall be by means of approved fixture type wiring.
- .9 All recessed fixtures to be installed so that they are removable from below to gain access to outlet box or prewired fixture box. Connect all recessed fixtures to boxes with flexible conduit and approved fixture wire. Provide approved drywall enclosures in insulated ceilings. Volume of enclosure to comply with Electrical Code.
- .10 Install fixture lenses as late as possible to protect from dirt and dust. Remove and clean or replace lenses to the satisfaction of the Consultant.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for emergency lighting systems.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-M1985 (R1999), Unit Equipment for Emergency Lighting.

1.3 SCOPE

- .1 Provide and install complete emergency lighting back-up system utilizing self-powered lighting units as indicated

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

Part 2 PRODUCTS

2.1 SELF-POWERED LIGHTING UNITS

- .1 Self-powered battery unit with integral emergency heads to be 4W high intensity LED type complete with white injection moulded thermoplastic housing, prismatic lens, and specular reflector. complete with ten (10) year warranty on battery LITHONIA LIGHTING ELM6L SERIES or equivalent. Suitable for supply of 120V. System shall be capable of providing 30 minutes of operation.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install self-powered units as indicated on plans and connect unswitched to local lighting circuit.
- .2 Direct heads towards path of egress.
- .3 Conductors sized to manufacturer's recommendations.

END OF SECTION

Part 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- .1 Electrical general provisions: to Section 26 05 00 - Common Work Results - Electrical.

1.2 SYSTEM DESCRIPTION

- .1 Complete raceway system consist of outlet boxes, cover plates, terminal and distribution cabinet, conduits, pull boxes sleeves, caps and fish wires, as indicated in the riser diagram and on the plans. Install owner supplied flush mounted enterphone panel back box at main entry for communication to suites.
- .2 Underground service.

Part 2 PRODUCTS

2.1 MATERIAL

- .1 Conduits: EMT type, to Section 26 05 33 - Raceways and Wiring.
- .2 Outlet boxes to Section 26 05 33 - Raceways and Wiring.
- .3 Cover plates to Section 26 05 28 - Grounding Secondary.
- .4 Supply and installation of telephone wiring, telephone jacks, RJ45 and cover plates to each unit. Division 26 to wire each individual unit from telephone closet. Extension outlets within each suite to be wired in star configuration from master telephone outlet in suite. Wiring to be CSA approved, 4 pair, 24 AWG, FT6 rated, Level 5e voice and data transmission rating.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install empty conduit system where indicated on plans, including fish wire, terminal cabinets, outlet boxes, pull boxes, cover plates, conduit, sleeves and miscellaneous and positioning material to constitute complete system.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies the materials and installation for security door systems.
- .2 The section specifies system control panel, door switches, terminal blocks, end-of-line resistors and system operation.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 Canadian Electrical Code, C22.1 (latest edition).

1.3 SYSTEM DESCRIPTION

- .1 System to consist of control panel and electrical strike located at door to be.

1.4 SHOP DRAWINGS

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

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for Door control system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include description of system operation.
- .3 Include parts list, using component identification numbers standard to electronics industry.

1.6 INSTALLER QUALIFICATIONS

- .1 The installation and commissioning of door control systems shall be by qualified alarm service technicians. Only qualified companies with extensive experience, reliable references, and substantial service backup will be allowed to provide the work of this section.
- .2 Installation of door strikes and locks shall be by qualified, licensed locksmiths.

Part 2 PRODUCTS

2.1 CONTROL PANEL

- .1 Control panel: surface mounted with 4 supervised zone capacity, modular design. "Power on" light, "reset" key switch, "acknowledge button", common "trouble light, buzzer and silencing switch". Separate alarm lamp, trouble lamp and deactivating key switch for each zone and necessary modules, and relays as required for operation as indicated. Power supply from 120 V ac.

2.2 DOOR CONTROLLERS

- .1 Door controllers shall be located in Garage rooms. Controllers shall be capable of monitoring door lock power. Controller shall have battery backup to operate for a minimum of eight hours of full operation with no power. A lithium battery shall protect the card schedule database and time base in the absence of all power.
- .2 Controller shall monitor normally open or normally closed status points, with wiring supervised by end-of-line resistors. Status inputs shall be used for door contacts.
- .3 Controllers shall have controllable relays, which shall be used to annunciate door held or forced open violations and other alarm conditions capability to allow monitoring from local remote stations.

- .4 Provide 120 volt power source for controller.

2.3 POWER SUPPLIES AND BATTERIES

- .1 Provide power supplies/transformers as required to power each door controller system.
- .2 Provide batteries as required to power system for a minimum of eight hours of full operation with no power.

2.4 TERMINAL CABINETS AND BLOCKS

- .1 Terminal cabinets: Type T. In accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .2 Terminal Blocks: In accordance with Section 27 11 19 - Communications Termination Blocks and Patch Panels.
- .3 All circuits shall be supervised and provided with end-of-line resistors.
- .4 Mount end-of-line resistors to control supervisory current in each circuit, in control panel.

2.5 ELECTRIC DOOR STRIKES

- .1 Heavy duty, continuous rated, UL-listed, fail-secure electric door strikes provided and installed by others.
- .2 Coordinating door hardware and frames with the door supplier to accept door strikes is part of the work of this contract. Magnetic locks are not an acceptable alternative to electric strikes.
- .3 Provide minimum 19mm conduit from each door strike location for connection to door access controllers.

2.6 KEYPADS

- .1 Alphanumeric keypads shall be provided at the main control panel for time programming entry, as indicated on plans. Keypad panels shall have an LCD display.

2.7 LOCAL ALARM

- .1 Buzzer for local alarm at each door location and mount in single gang box as indicated.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install door access system to control doors as indicated on plans.
- .2 Install and coordinate door strikes installation in controlled doors in accordance with manufacturer's instructions and recommendations.
- .3 Wire controller and field wiring in accordance with manufacturer's instructions. All wiring shall be CSA listed, FT4 rated. All wiring shall be tagged and identified.
- .4 All system wiring shall be concealed. Wiring to controlled doors shall be run on secure side only.
- .5 Install complete door supervision system as indicated and in accordance with manufacturer's instructions.
- .6 System shall be fully programable to provide access to the washroom during certain hours/days,

3.2 COMMISSIONING, START-UP, AND TRAINING

- .1 Place system in full operation and provide certificate from manufacturer's authorized representative that the system is functioning in accordance with manufacturer's instructions and specifications.
- .2 Program controllers in accordance with Owner's Representative's instructions.

- .3 Provide training for Owners representative's operation and maintenance personnel to ensure that they are fully conversant in the use, care, programming, maintenance, and repair of the system. Allow for the following training sessions:
 - .1 Two one-hour sessions for system users

3.3 SEQUENCES OF OPERATION

- .1 System operation: the system shall have time based program which will allow access to the washroom in a specific times/days as required by the client.

3.4 SITE TESTS

- .1 Perform tests in accordance with Canadian Electrical Code 2018.
- .2 Test system components to ensure correct operation of system. On completion of tests, submit certificate listing components tested.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This Section specifies the intrusion detection system consisting of a control panel, detection accessories, communications and environmental monitoring.

1.2 REFERENCE DOCUMENTS

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 70, Article 517, National Electric Code.
 - .2 NFPA 101, Life Safety Code.
- .2 Electronic Industries Association (EIA)
 - .1 REC 12749, Power Supplies.
 - .2 RS 16051, Sound Systems.

1.3 REFERENCE STANDARDS

- .1 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S303-latest edition, Local Burglar Alarm Units and Systems.
 - .2 CAN/ULC-S304-latest edition, Intrusion Detection.
 - .3 CAN/ULC-S306-latest edition, Intrusion Detection Units.
 - .4 ULC-S318-latest edition, Power Supplies for Burglar Alarm Systems.
 - .5 ORD-C634-latest edition, Connectors and Switches for Use with Burglar Alarm Systems.

1.4 DEFINITIONS

- .1 EAC: Electronic Access Control System.
- .2 PIR: Passive Infrared Detectors.

1.5 DESIGN PERFORMANCE REQUIREMENTS

- .1 Design intrusion detection system using only ULC/UL Listed products.
- .2 Design intrusion detection system using ULC/UL Listed Alarm Service Company, company specializing in intrusion detection systems.
- .3 Design intrusion detection system as a ULC/UL Certified Alarm System.
- .4 Design system as a modular access control, alarm monitoring system expandable, and easily modified for inputs, outputs and remote control stations.
 - .1 Design components in accordance with CAN/ULC-S306 and be capable of:
 - .1 Annunciating undesirable, abnormal or dangerous condition.
 - .2 Prioritizing alarms by alarm type, and to include panic/duress alarm, intrusion alarm and tamper alarm.
 - .3 Determining zone where alarm occurred.
 - .4 Annunciating power failure and power restoration.
 - .5 Annunciating low battery condition.
 - .6 Operate continuously for minimum period of 4 hours in the event of a power failure.
- .5 Equip control panels with continuous tamper detection on door and wall.
 - .1 Tamper detection to trigger alarm.
- .6 Design system with:
 - .1 Alarm masking.
 - .2 Remote maintenance or diagnostics with password activation.

- .3 Unique identifier for each authorized person.
- .4 Arming and disarming capabilities: manual and automatic by time of day, day of week, or by operator command.
- .5 Support both manual and automatic responses to alarms entering system.
- .6 Each alarm capable of initiating different functions of camera, homing, and activation of remote devices, audio switching, door control and card or pin validation.
- .7 Zone or alarm location annunciated at monitoring station.
- .7 Communications link: security level as appropriate for type of facility as described in CAN/ULC-S304.
- .8 Signal link: Security level as appropriate for type of facility as described in CAN/ULC-S304.
- .9 Alarm condition: Design system to provide maximum time for an alarm to be communicated of 60 seconds from alarm initiation to annunciation at remote monitoring location.
- .10 Junction boxes: tamper proof .
- .11 Design system power supplies rated to provide cumulative load of all systems components plus safety factor of 50% or greater.

1.6

PRODUCT DATA

- .1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit manufacture's literature for each control panel, detection accessory device.
 - .3 Submit:
 - .1 Functional description of equipment.
 - .2 Technical data for all devices.
 - .3 Device location plans and cable lists.
 - .4 Devices mounting location detail drawings.
 - .5 Typical devices connection detail drawings
 - .2 Shop Drawings: Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit shop drawings to indicate project layout, mounting heights and locations, wiring diagrams, detection device coverage patterns, contact operating gaps.
 - .3 Quality Assurance Submittals: Submit the following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Submit UL Product Safety Certificates.
 - .2 Submit verification Certificate that service company is ULC/UL List alarm service company.
 - .3 Submit verification Certificate that intrusion alarm system is Certified Alarm System.
 - .3 Instructions: Submit manufacturer's installation instructions.
 - .4 Manufacturer's Field Services: Submit copies of manufacturer's field reports.

.4 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01780- Closeout Submittals.

.1 Include:

- .1 System configuration and equipment physical layout.
- .2 Functional description of equipment.
- .3 Instructions of operation of equipment.
- .4 Illustrations and diagrams to supplement procedures.
- .5 Operation instructions provided by manufacturer.
- .6 Cleaning instructions.

1.7 WARRANTY

- .1 For all materials the 12-month warranty period prescribed in other sections is extended to [60] months.
- .2 Extended warranty period must include warranty against meeting specified performance requirements, for specified time period.
- .3 Manufacturer's Warranty: Submit, for Consultant's acceptance, manufacturer's standard warranty document executed by authorized company official.

1.8 SUPPORT SERVICES

- .1 Provide manufacturer/dealer advice, information and support services for 1 years.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Control Panel: ULC approved, expandable.
 - .1 Zones (protection inputs): 16.
 - .2 Fixed Zones: 4.
 - .3 Expandable: 8 zones.
 - .4 Number of user codes required: 4.
 - .5 Keypads: LED (lights).
 - .6 Alarm: Monitored.
 - .7 System: Wired.
 - .8 Integrated with sub systems: access control, building entry.
 - .9 Number of programmable outputs required: 8.
 - .10 System supervision: telephone.
 - .11 Siren output.
 - .12 Number of devices per zone: To be determined.
- .2 Detection Accessories:
 - .1 Passive Infrared Detectors PIR's: ULC approved.
 - .1 Coverage pattern: To be determined.
 - .2 Tamper switch.
 - .3 Mounting: wall or ceiling as required.
 - .2 Contacts : ULC approved.
 - .1 Mounting: concealed.
 - .2 Mounting locations: doors and overhead doors.
 - .3 Security level: high security.
 - .4 Type: magnetic.

- .3 Notification Devices:
 - .1 Siren: 30 watt.
 - .2 Speaker complete with driver.
- .3 Communications: To be determined.
- .4 Power supplies: to ULC-S318 or UL 603.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install panels, intrusion detection system and components in accordance with manufacturer's written installation instructions to locations, heights and surfaces shown on reviewed shop drawings.
- .2 Install panels, intrusion detection system and components secure to walls, ceilings or other substrates.
- .3 Install required boxes in inconspicuous accessible locations.
- .4 Conceal conduit and wiring.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, and protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review, and submit, immediately, to Consultant.

3.4 VERIFICATION

- .1 Perform verification inspections and test in the presence of Consultant.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors and manufacturer's representatives are present for verification.
- .2 Visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance of device locations with reviewed shop drawings.

- .4 Compatibility of equipment installation with physical environment.
- .5 Inclusion of all accessories.
- .6 Device and cabling identification.
- .7 Application and location of ULC approval decals.
- .3 Technical verification: Purpose to ensure that all systems and devices are properly install and free of defects and damage. Technical verification includes:
 - .1 Measurements of coverage patterns
 - .2 Connecting joints and equipment fastening.
 - .3 Compliance with manufacturer's specification, product literature and installation instructions.
- .4 Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
 - .1 Operation of each device individually and within its environment.
 - .2 Operation of each device in relation with programmable schedule and or/specific functions.

3.5 CLEANING AND ADJUSTING

- .1 Remove protective coverings from control panels, detection accessories and components.
- .2 Adjust all components for correct function.
- .3 Clean housings and system components, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies video components configured as a system, which performs functions related to image acquisition, video display and recording images.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1- latest edition, Canadian Electrical Code, Part 1 Safety Standard for Electrical Installations.
 - .2 CAN/CSA-C22.3 No.1- latest edition, Overhead Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 ULC-S317- latest edition, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

1.3 SCOPE OF WORK

- .1 Supply and installation of a complete and operating system including but not necessarily limited to:
 - .1 Video cameras.
 - .2 Video handling.
 - .3 Recording devices (**up to 7 days storage**) .
 - .4 Transmission methods.
 - .5 PC workstation complete with monitor, mouse, keyboard and wifi connection.

1.4 DEFINITIONS

- .1 CCTV: Closed Circuit Television.
- .2 CCVC: Closed Circuit Video.
- .3 CCD: Charge Coupled Device.
- .4 FOV: Field of View.

1.5 DESIGN PERFORMANCE REQUIREMENTS

- .1 Support: Camera functions such as pan/tilt and zoom fully supported by CCTV system.
 - .1 Provide operator with ability to control all camera functions.
- .2 Alarm point monitoring: System capable, upon alarm recognition, of switching CCTV cameras associated with alarm point.
- .3 Switching:
 - .1 Provision to switch any camera in system to any monitor in system manually or automatically.
 - .2 Provision to switch system video recorders to selective monitor outputs in system.
- .4 Control: Provision for any camera equipped with pan, tilt, and/or motorized zoom lens:
 - .1 Manually control pan, tilt and lens functions.
 - .2 Set pan and tilt home position.
 - .3 Set and clear movement limits of pan and tilt mechanism.
 - .4 Adjust motorized zoom lens.
- .5 Enter and edit CCTV programs and save them for future use.
- .6 Set dwell time for viewing of any camera picture.
- .7 Define sequence for viewing cameras on each monitor.
- .8 Bypass cameras in system during sequencing to monitor.

- .9 Overall control of CCTV provided through software control, which provides complete integration of security components.
- .10 Environment: Design video components and systems to operate with all specified requirements under following ambient temperatures:
 - .1 Outdoor installations:
 - .1 Temperature: -40°C to 60°C.
 - .2 Humidity: 10 to 100%

1.6 SUBMITTALS

- .1 Product Data: Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings: Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labelling scheme including:
 - .1 Functional description of equipment.
 - .2 Technical data sheets of all devices.
 - .3 Device location plans and cable lists.
 - .4 Video camera surveillance chart.
 - .5 Video interconnection detail drawings.
- .3 Samples: Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit one sample of each camera selected complete with housing, brackets and mounting hardware.
 - .2 Camera will be returned for incorporation into work as appropriate.
- .4 Quality Assurance Submittals: Submit the following in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Submit UL Product safety Certificates.
 - .2 Submit verification Certificate that service company is “UL List alarm service company”.
 - .3 Submit verification Certificate that monitoring facility is “UL Listed central station”.
 - .4 Submit verification Certificate that video surveillance system is “Certified alarm system”.
 - .3 Instructions: Submit manufacturer's installation instructions.
 - .4 Manufacturer's Field Services: Submit copies of manufacturer's field reports.
- .5 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. Include following:
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions on operation, adjustment and cleaning.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Manufacturer's operation instructions

1.7 WARRANTY

- .1 For all materials the 12 month warranty period specified in other sections is extended to [60] months.
- .2 Extended warranty period must include warranty against meeting specified performance requirements, for specified time period.
- .3 Manufacturer's Warranty: Submit, for [Department Representative's] [Consultant's] acceptance, manufacturer's standard warranty document executed by authorized company official.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Video Camera Characteristics:
 - .1 Colour.
 - .2 Sensitivity: Super Low illumination.
 - .3 Resolution: Lines of horizontal resolution: 1080p
 - .4 Environment: Outdoor.
 - .5 Lens functions: Fixed
 - .6 Operational voltage: Standard 24 AC, 12 DC or POE.
 - .7 30mins UPS.
- .2 Lenses
 - .1 Fixed Focal Length: 4 mm
 - .2 Variable Focus Lens: 3.5 mm to 8 mm on same lens
 - .3 Fixed
- .3 Video Handling
 - .1 Mixer/switcher: Supporting 8 cameras.
 - .2 Technical Characteristics
 - .1 Impedance: 75 Ohms UNBAL
 - .2 Input: 1 V pp +/- 0.1 V pp (one for each signal, plus spares).
 - .3 Output: Two, 1.0 V pp.
 - .4 Frequency response: Zero to 6.0 mHz + 0.5 dB.
 - .5 Sequencing speed: Variable, 1.0 to 45 SEC.
 - .6 Features:
 - .1 Permit multi-screen display of live camera images as they are being recorded.
 - .2 Video loss detection.
 - .3 Video motion detection.
 - .4 Security lock.
 - .5 Call monitor output.
 - .6 Multi display formats e.g.: 4x4, 3x3, 2x2 etc.
 - .7 Multi-screen display: Permit screen to split to show 1, 4, 7, 10, 13 or 16 images at same time.
 - .8 Live-on-playback and play-back-live: Permit live camera images while monitoring so that DVR image can be shown on screen at same time.
 - .1 Permit live camera image to be shown during DVR playback.

- .9 Auto sequential switching: Permit switching between cameras one field at a time to allow smooth flowing of multi-screen displays.
 - .10 Camera title indicator: Permit an 8 character title to be accorded to each channel.
 - .11 Alarm function: Provide 16 alarm inputs and 2 alarm outputs for each camera.
 - .12 I.D./time-date generator: Provide as built-in calendar function with capability to display time and date on monitor or not, and in recording or playback mode.
 - .13 On-screen setup menus: Provide on-screen menus and front panel push buttons permitting quick and easy setup and operation.
 - .14 Alarm log function: 100 events.
 - .15 Provide HDMI input/output terminal.
- .4 Recording: 7 days Digital Recording.
- .1 Alarm recording:
 - .1 Alarm recording: Provide system with capability to switch to alarm recording when an externally connected alarm sensor is triggered and begin to record situation that triggered alarm.
 - .2 Alarm display: Equip unit to flash [AL] on screen during alarm recording and display number of alarms.
 - .3 Alarm scan: Provide scan feature to search whole track for alarm recordings and play the first 15seconds of each alarm.
 - .2 I.D./time and date generator: Provide built-in microprocessor equipped with calendar capable of setting internal timer, display current time and manage other clock-related functions on monitor and on digital display.
 - .3 Time recording: Provide unit with capability to preset time recording on daily or weekly basis and special holidays. Settings to be performed and confirmed on monitor.
- .5 Camera Housings
- .1 Outdoor: Equipped with heater/blower.
- .6 Transmission Methods: Twisted Pair.

2.2 CAMERA POWER SUPPLY

- .1 Power supply: Custom designed for all cameras requiring 12, 24 VAC power or POE, locate inside equipment cabinet capable of providing correct voltage to overcome real and circulated system power loss for 8 cameras and to provide future expansion of [25]%. Permanently mount power supply.

2.3 JUNCTION BOX

- .1 Metal, sized to handle all system conduit interconnections with appropriate expansion.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install video surveillance equipment and components in accordance with ULC-S317.
- .2 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.
- .3 Install components secure, properly aligned and in locations shown on reviewed shop drawings.
- .4 Connect cameras to cabling in accordance with installation instructions.
- .5 Install ULC labels where required.
- .6 Install all required outdoor and indoor conduit, ducts, pull boxes and junction boxes, and any other accessories require to provide a complete functional system.
- .7 Contractor shall include in his scope all required software, license, programing...etc. to provide complete functional system.
- .8 The system shall be capable of processing four individual video inputs into one composite video signal consisting of original four signals displayed in four quadrants of output composite signal. Unit to contain front panel controls which, when selected, will produce full screen display of selected input signal or freeze selected quadrant

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, and protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review, and submit, immediately, to Consultant.

3.4 VERIFICATION

- .1 Perform verification inspections and test in the presence of Consultant.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors and manufacturer's representatives are present for verification.
- .2 Visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance of device locations with reviewed shop drawings.
 - .4 Compatibility of equipment installation with physical environment.
 - .5 Inclusion of all accessories.
 - .6 Device and cabling identification.
 - .7 Application and location of ULC approval decals.

- .3 Technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
 - .1 Measurements of tension and power.
 - .2 Connecting joints and equipment fastening.
 - .3 Measurements of signals (dB, lux, baud rate, etc).
 - .4 Compliance with manufacturer's specification, product literature and installation instructions.
- .4 Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
 - .1 Operation of each device individually and within its environment.
 - .2 Operation of each device in relation with programmable schedule and or/specific functions.
 - .3 Operation control of camera lens, pan, tilt and zoom.
 - .4 Switching of camera to any monitor.
 - .5 Switching of system video recorder to selective monitor.
 - .6 Set dwell times.
 - .7 Demonstrate:
 - .1 Sequence viewing of cameras.
 - .2 Bypass capability.
 - .3 Display of stored image to cardholder.

3.5 CLEANING AND ADJUSTING

- .1 Remove protective coverings from cameras and components.
- .2 Adjust cameras for correct function.
- .3 Clean camera housings, system components and lens, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 31 23 10 - Excavating, Trenching and Backfilling
- .3 Section 32 11 19 - Granular Subbase
- .4 Section 32 11 23 - Aggregate Base Courses
- .5 Section 33 41 00 - Storm Utility Drainage Piping

1.2 REFERENCES

- .1 ASTM; AWWA; CAN – As specified in the contract document

1.3 SOURCE QUALITY CONTROL

- .1 Submit samples in accordance with Section 01 33 01 - Submittal Procedures.
- .2 Inform Departmental Representative of proposed source and provide samples or access for sampling at least 2 weeks prior to commencing production.
- .3 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.
- .4 Should a change of material source be proposed during work, advise Departmental Representative 2 weeks in advance of proposed change to allow sampling and testing.
- .5 Acceptance of material does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified.
- .6 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.

PART 2 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 MATERIAL

- .1 To be any workable soil free of organic or foreign matter; any material obtained within limits of Contract may be approved by the Departmental 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 dia) | (100) |
| (200mm dia) | (100) |
| (100mm dia) | (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 PIT RUN SAND

- .1 To be well graded pit run sand, free from organic materials and conform to following gradations:

| Sieve Designation | Percent Passing |
|-------------------|-----------------|
| 12.5mm | 100 |
| 4.75mm | 35-100 |
| 2.36mm | 20-70 |
| 1.18mm | 13-50 |
| 0.600mm | 8-35 |
| 0.300mm | 5-25 |
| 0.150mm | 2-15 |
| 0.075mm | 0-6 |

2.5 RIVER SAND

- .1 River sand to be free of organic material and conform to following gradations:

| Sieve Designation | Percent Passing |
|-------------------|-----------------|
| 19mm | 100 |
| 4.75mm | 80-100 |
| 0.600mm | 20-100 |
| 0.420mm | 10-100 |
| 0.250mm | 0-80 |
| 0.150mm | 0-50 |
| 0.075mm | 0-4 |

2.6 DRAIN ROCK

- .1 To consist of clean round stone or crushed rock conforming to the following gradations:

| Sieve Designation | Percent Passing | |
|-------------------|-----------------|--------|
| | Course | Fine |
| 25.0mm | 100 | |
| 19.0mm | 0-100 | |
| 9.5mm | 0-5 | 100 |
| 4.75mm | 0 | 50-100 |
| 2.36mm | | 10-35 |
| 1.18mm | | 5-15 |
| 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 Departmental Representative after examination of soils against which drain rock will be placed.

2.7 GRANULAR PIPE BEDDING AND SURROUND MATERIAL

- .1 Crushed or graded gravels to conform to following gradations:

| Sieve Designation | Percent Passing | |
|-------------------|-----------------|---------|
| | 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 |
| 0.300mm | | 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

Recycled concrete free from contaminated and other extraneous material, conforming to the Type 1 gradations, may be used as pipe bedding and surround material.

- .2 Other permissible materials: only where shown on Contract Drawings or directed by Departmental Representative shall drain rock, pit run sand or approved native material be used for bedding and pipe surround.

2.8 SELECT GRANULAR SUBBASE

- .1 To be well graded granular material, substantially free from lumps and organic matter, screened if required to conform to following gradations:

| Sieve Designation | Percent Passing |
|-------------------|-----------------|
| 75mm | 100 |
| 25mm | 50-85 |
| 0.150mm | 0-15 |
| 0.075mm | 0-8 |

2.9 CRUSHED GRANULAR SUBBASE

- .1 To be 75mm crushed gravel conforming to following gradations:

| Sieve Designation | Percent Passing |
|-------------------|-----------------|
| 80mm | |
| 75mm | 100 |
| 38mm | 60-100 |
| 25.0mm | - |
| 19.0mm | 35-80 |
| 12.5mm | - |
| 9.5mm | 26-60 |
| 4.75mm | 20-40 |
| 2.36mm | 15-30 |
| 1.18mm | 10-20 |
| 0.60um | 5-15 |
| 0.30um | 3-10 |
| 0.18um | - |
| 0.15um | - |
| 0.075um | 0-5 |

2.10 GRANULAR BASE

- .1 To be 19mm crushed gravel conforming to following gradations:

| Sieve Designation | Percent Passing |
|-------------------|-----------------|
| 19.0mm | 100 |
| 12.5mm | 75-100 |
| 9.5mm | 60-90 |
| 4.75mm | 40-70 |
| 2.36mm | 27-55 |
| 1.18mm | 16-42 |
| 0.600mm | 8-30 |
| 0.300mm | 5-20 |
| 0.075mm | 2-8 |

2.11 RECYCLED AGGREGATE MATERIAL

- .1 Aggregates containing recycled material may be utilized if approved by the Departmental Representative. In addition to meeting all other conditions of this specification, recycled material should not reduce the quality of construction achievable with quarried materials. Recycled material should consist only of crushed Portland cement concrete; other construction and demolition materials such as asphaltic pavements, bricks, plaster, etc. are not acceptable.

PART 3 EXECUTION

3.1 HANDLING

- .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .2 Do not use intermixed or contaminated materials. Remove and dispose rejected materials within 48 h of rejection.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 35 43 - Environmental Procedures
- .2 Section 31 05 16 - Aggregate Materials
- .3 Section 33 05 13 - Manholes and Catchbasin Structures
- .4 Section 33 41 00 - Storm Utility Drainage Piping

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 117, Standard Test Method for Material Finer than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
 - .4 ASTM D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700 kN-m/m³).
 - .5 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).
 - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 DEFINITIONS

- .1 Rock Excavation: As defined in Section 31 23 17 – Rock Removal.
- .2 Common Excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, partially cemented materials, clay or frozen materials which can be ripped and excavated with heavy construction equipment.
- .3 Over-excavation: excavation below design elevation of bottom of specified bedding, and including backfilling of resultant excavation with specified material, as authorized by Departmental Representative.

- .4 Removals: removal and disposal at an approved location off-site of surface concrete structures and walks, curbs, gutters, manholes, catchbasins, pipes, culvers, enwalls, and any other structure on surface or underground specifically designated on Contract Drawings for removal. Removals to include backfilling of resultant excavation with specified material.
- .5 Native Topsoil: to Section 32 91 19 - Topsoil Placement and Grading.

1.4 SAFETY REQUIREMENTS

- .1 Comply with Section 01 35 33 - Health and Safety Requirements.
- .2 Design and install trench shoring in accordance with the regulations of the Workers Compensation Act of British Columbia.

1.5 BLASTING

- .1 Ensure all blasting operations comply with Section 31 23 17 - Rock Removal.

1.6 DISPOSAL

- .1 Dispose of all surplus spoil from excavations on-site and/or off-site as shown on Contract Drawings or as specified in Contract Documents. Suitability of excavated material for use as native bedding or trench backfill will be governed by Part 2 of this Section. Dumping of spoil on private property will be permitted only upon written approval from property owner and provided all necessary permits and approvals have been obtained.

1.7 LIMITATIONS OF OPEN TRENCH

- .1 Excavate trenches only as far in advance of pipe laying operation as safety, traffic, and weather conditions permit and, in no case, to exceed 30m. Before stopping work on last day of work before each weekend or holiday, completely backfill every trench. If circumstances do not permit complete backfilling of all trenches, adequately protect all open trenches or excavations with approved fencing or barricades and, where required, with flashing lights.

1.8 ARCHEOLOGICAL MONITORING

- .1 The Contractor shall make provisions for the continuous monitoring of excavation work and excavated materials by a designated Archeological Consultant engaged by PSPC.
- .2 Follow instructions from the Departmental Representative for the handling of any uncovered identified items of interest. Refer to General Conditions GC6 for Changes to the Contract in the case of any discovered items of interest.
- .3 All contractor personnel involved in excavations must attend an archeological briefing.
- .4 Archeological consultants must be present during excavation activities to view excavation of material for archeological purposes.

PART 2 PRODUCTS

2.1 USE OF SPECIFIED MATERIALS

- .1 Back filling for over-excavated trench or structure excavations to be one of the following:
 - .1 Granular pipe bedding and surround material.
 - .2 Pit run sand.
 - .3 Drain rock (only where approved by Departmental Representative)
 - .4 Concrete.
 - .5 Controlled density fill.
- .2 Pipe bedding and surround: see applicable Sections:
 - .1 Section 33 11 16 - Site Water Utility Distribution Piping
 - .2 Section 33 31 13 - Public Sanitary Utility Sewerage Piping
 - .3 Section 33 34 00 - Sanitary Utility Sewerage Force Mains
 - .4 Section 33 41 00 - Storm Utility Drainage Piping
 - .5 Section 33 42 13 - Pipe Culverts
- .3 Trench and excavation backfill to be one of the following:
 - .1 Approved native material.
 - .2 Pit run gravel.
 - .3 Pit run sand.
 - .4 Controlled density fill.
- .4 Surface treatment to be:
 - .1 Restoration to match existing conditions
 - .2 Subgrade, subbase and base for works described in other Sections
 - .3 Topsoil, grass, sod or requirements for landscaping works described in other Sections.

2.2 MATERIALS

- .1 Refer to Section 31 05 16 – Aggregates and Granular Materials for specifications for approved granular materials and approved native materials.
- .2 Other granular materials: granular materials approved for roadwork (subbase, base,) also acceptable for trench backfill subject to approval of Departmental Representative.
- .3 Concrete: to Section 03 30 02, to be minimum 20 MPa.

PART 3 EXECUTION

3.1 SITE PREPARATION

- .1 Remove all brush, weeds, grasses and accumulated debris to an approved offsite location.
- .2 Cut pavements or sidewalk neatly along limits of proposed excavation as shown on Contract Drawings in order that surface may break evenly and cleanly. Cut beyond limits shown only if authorized by Departmental Representative.

- .3 Where trench passes through lawn, neatly cut and remove sod before trench excavation. Save sod for replacement upon backfilling trench.
- .4 Strip topsoil after area has been cleared and stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2m. Avoid mixing topsoil with subsoil. Dispose of unused topsoil as specified. Do not handle topsoil while wet or frozen condition or in any manner in which soil structure is adversely affected.

3.2 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative. Stockpile granular materials in manner to prevent segregation.

3.3 EXCAVATION

- .1 Connecting to existing mains:
 - .1 Prior to or at commencement for construction, check existing main for line and elevation at point of connection. If found different from Contract Drawings report such difference to Departmental Representative immediately.
 - .2 Connections to existing waterworks, sanitary and storm sewer systems to be made by the Contractor unless shown otherwise on Contract Drawings. Notify Departmental Representative minimum 48 hours in advance of schedule connection. Make connection in presence of Departmental Representative.
 - .3 To prevent damage to existing utilities, excavation last 300 mm over utility by hand.
- .2 Surface Drainage:
 - .1 Provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction area and adjacent lands. Provide siltation controls to protect natural watercourses or existing drainage facilities.
 - .2 Comply with Section 01 35 44 - Environmental Procedures.
- .3 Excavation to grade: excavation trenches to allow pipe to be laid to alignment and grades required with allowance for specified pipe bedding.
- .4 Excavation below grade: when bottom of excavated trench at subgrade is unstable and in opinion of Departmental Representative, cannot adequately support pipe, install pipe using concrete bedding as shown on Contract Drawings or over-excavate trench to suitable subgrade or as directed by Departmental Representative. Backfill over excavated with specified materials and compact to minimum 95% Modified Proctor density in compliance with ASTM D1557. Use drain rock backfill only if authorized by Departmental Representative.
- .5 Trench width: excavation trench to section and dimension shown on Contract Drawings. If width exceeds maximum allowable, Contractor may be required to demonstrate that specified pipe is still adequate or provide pipe with approved higher class bedding. All additional requirements as a result of excessive trench width to be to Contractor's cost.
- .6 Hand excavation: excavate by hand if necessary to preserve or minimize damage to existing trees, shrubs, building and all similar existing features or facilities.

- .7 Trench bottom conditions: remove disturbed or softened material from trench bottom before placing bedding material. Maintain trench free from water and soft materials during placement of pipe bedding, pipe installation and trench backfill to ensure proper compaction of granular materials.
- .8 Trench drainage:
 - .1 See Drainage/Dewatering in Section 01 35 44 – Environmental Procedures.
 - .2 During pipe laying, jointing, bedding and backfilling, keep trench free of water by pumping or other appropriate means. Provide pumps and dewatering equipment and take precautions to prevent any damage to adjoining buildings, structures, roads or land from prolonged or excessive pumping by installing shoring, sheeting or other supportive measures. Discharge water from excavations in such manner as not to cause nuisance, injury, loss or damage. Contactor to be responsible for any claims or actions arising from such discharge of water.
 - .3 Keep bell holes free from water during jointing. Diverting trench water through newly laid system not allowed, unless authorized by Departmental Representative.
- .9 Disposal of surplus soil: Dispose of surplus excavation soil off-site. Side-casting not allowed in restricted areas where, in opinion of Departmental Representative, side-casting would create interference with flow of traffic. In such case, temporarily store materials or dispose to an approved site. Provisions of Provincial Contaminated Sites Legislation must be met prior to disposal of soil offsite.
- .10 Where native backfill is approved for re-use, and side-casting not allowed, transport approved material to other locations where material is required or temporarily store at approved site. Protect stored material from contamination, segregation and weather.
- .11 Rock excavation: Section 31 23 17 - Rock Removal.
- .12 Maintain roads used for transporting materials and equipment in clean condition. Clean, flush and/or sweep on daily basis and more frequently if directed by Departmental Representative.

3.4 PIPE INSTALLATION

- .1 Related work: Pipe installation, including bedding, pipe laying, and granular surround to be in accordance with following sections:
 - .1 Section 33 05 13 - Manholes and Catch Basin Structures
 - .2 Section 33 11 16 - Site Water Utility Distribution Piping
 - .3 Section 33 31 13 - Public Sanitary Utility Sewerage Piping
 - .4 Section 33 34 00 - Sanitary Utility Sewerage Force Mains
 - .5 Section 33 41 00 - Storm Utility Drainage Piping
 - .6 Section 33 42 13 - Pipe Culverts
- .2 Concrete encasements or protection: where specified or required by Departmental Representative provide concrete encasements of pipe or slab protection as shown on Contract Drawings. Do not place backfill material until concrete has taken its initial set and in no case less than 1 hour.

- .3 Anchor blocks: where specified or required by Departmental Representative provide anchor blocks as shown on Contract Drawings. Ensure all concrete anchor blocks at least 150 mm into undisturbed ground on bottom side of each trench.

3.5 BACKFILL AND COMPACTION

- .1 General: Place backfill carefully in trench to prevent damage to installed pipe.
- .2 Shoring: during backfill and compaction of trench, remove shoring in such a manner as to allow proper compaction and to prevent trench walls from collapsing. Remove all bracing and/or shoring from trench.
- .3 Backfill Materials:
 - .1 Boulevards and easements: for trenches in boulevards, easements or other areas not subjected to vehicle loading, and outside of ditch lines, backfill with approved native materials except as shown otherwise on Contract Drawings.
 - .2 Roads, driveways and shoulders: for trenches in paved or graveled roads, driveways, shoulders or other areas subjected to vehicle loading, backfill with imported granular material or approved native material as specified on Contract Drawings. Road shoulder is that portion of right-of-way between travelled, and road ditch. Where no ditch exists, ensure shoulder width minimum of 1.5 m.
 - .3 Ditches: backfill with imported granular material or approved native material as specified on Contract Drawings.
 - .4 Departmental Representative may permit native materials for all above uses subject to suitability of native material for said use. Native material approved for re-use to be handled, stockpiled and compacted using construction method appropriate for given moisture content and weather conditions.
- .4 Compaction: place backfill and compact to following Modified Proctor densities in compliance with ASTM D1557. (All following references to density imply compliance with ASTM D1557).
 - .1 Boulevards and easements to minimum 90%.
 - .2 Roads, driveways, shoulders, re-shaped ditches and sidewalks to minimum 95%.
 - .3 Use caution in pipe zone to ensure no damage to pipe.

3.6 SURFACE RESTORATION

- .1 General:
 - .1 Restore all disturbed surfaces to condition at least equal to which existed prior to construction.
 - .2 Make good any damage to adjacent lands or improvements.
 - .3 Resolve all reasonable claims arising from Contractor's actions and obtain written releases from Departmental Representative following final restoration.
- .2 Boulevards and easements:
 - .1 Restore surface to minimum 100 mm depth.
 - .2 Restore unimproved surfaces with material equal to that removed at surface.
 - .3 Restore gardens with approved topsoil or bark mulch to match existing conditions.

- .4 Restore lawns with approved topsoil and seed or sod to match existing lawn.
- .5 Restore gravel surfaces with matching granular materials.
- .6 Complete final restorations immediately upon completion of trench backfilling.
- .3 Graveled roads and driveways:
 - .1 Restore surface with minimum 75 mm to 100 mm thick lift of 19 mm granular road base material.
 - .2 Compact to minimum 95% Modified Proctor density.
 - .3 Complete final restoration immediately upon completion of trench backfilling.
- .4 Ditches:
 - .1 Re-shape ditches to specified lines, grades and sections as specified to ensure stability of ditch slopes and bottom.
 - .2 Compact to minimum 95% Modified Proctor Density.
 - .3 Complete final restoration immediately upon completion of trench backfilling.
- .5 Base preparation for paved surfaces:
 - .1 Paved surfaces to include all paved roads, driveways, sidewalks and parking areas.
 - .2 If native material used for backfill provide specified depth of subbase as shown on Contract Drawings.
- .6 Temporary pavement patching:
 - .1 Patch arterial and collector roads same day excavation made.
 - .2 Patch all other roads within 24 hours of closing trench.
 - .3 Patching material to be hot-mix asphalt on all roads unless specified otherwise, cold-mix may be used only where directed by Departmental Representative.
 - .4 Place temporary pavements to 50 mm minimum thickness.
 - .5 Maintain temporary patch to ensure safe and smooth conditions.
- .7 Permanent pavement restoration:
 - .1 Install permanent pavement within 30 days of placement of temporary patch or sooner where directed by Departmental Representative.
 - .2 Remove broken or cracked pavement as well as any paved areas showing settlement and dispose off-site.
 - .3 Remove underlying granular road base material as required to permit placement of specified thickness of permanent pavement. Ensure remaining base meets specified thickness. Material and placement of road base to Section 32 11 23- Aggregate Base Courses
 - .4 Compact base to minimum 95% Modified Proctor density.
 - .5 Restore pavement as detailed on Contract Drawings. If thickness of existing pavement permits, grind 40 mm depth along edge of pavement. Dry if necessary and paint clean, dry edge with asphalt emulsion (tack coat).
 - .6 Place and compact hot-mix pavement material to minimum thickness as shown on Contract Drawings.

- .7 Material and placement of hot-mix pavement to Section 32 12 16-Asphalt Paving.
 - .8 Restore surface to smooth condition and match with grade of adjacent pavement.
 - .9 Where shown on Contract Drawings place hot-mix overlay over restored trench section and adjacent pavement to Section 32 12 16-Asphalt Paving.
 - .10 Maintain restored pavements in complete repair during Maintenance Period. Effect repairs within 14 days from receipt of written notice from Departmental Representative or immediately if so directed by Departmental Representative if dangerous situation exists.
- .8 Landscape Restoration:
- .1 Landscape restoration to following sections:
 - .1 Section 32 91 19 - Topsoil Placement and Grading
 - .2 Section 32 92 19 - Hydraulic Seeding
 - .4 Section 32 92 23 - Sodding
 - .5 Section 32 93 10 - Trees, Shrubs and Ground Cover Planting
 - .2 Restoration of planted areas to consist of restoration to original condition by replacement to original depth of approved topsoil (minimum 100mm), seeding or sodding of grassed areas and replacement of any killed or removed plants or shrubs by ones equal quality, type and maturity to originals.
 - .3 Plant replacement trees and shrubs at a suitable time of year in accordance with good horticulture practice, to provide maximum assurance of plant survival. If tree or shrub has died, or shows signs of dying, as a result of environmental disturbance, cutting of roots, or other causes directly attributed to Contractors work, close to but not actually within excavation areas, replace with new tree or shrub of a similar variety, age and size, up to limits of maximum available size.
- .9 Restoration acceptance: no restoration work to be considered satisfactory until acceptance by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 35 43 - Environmental Procedures
- .2 Section 31 05 16 - Aggregate Materials

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D 698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m³)

1.3 DEFINITIONS

- .1 Excavation classes: only two classes of excavation will be recognized:
 - .1 Rock excavation: to Section 31 23 17 - Rock Removal.
 - .2 Common Excavation: to Section 31 23 10 - Excavating, Trenching and Backfilling.
- .2 Native Topsoil: to Section 32 91 19 - Topsoil Placement and Grading.
- .3 Embankment (subgrade fill): material derived from usable excavation and placed above original ground or stripped surface up to top of subgrade.
- .4 Imported embankment fill: approved granular material, supplied by Contractor and obtained from off-site sources, to be used for embankment fill up to subgrade elevation.
- .5 Pavement structure: combination layers of unbound or stabilized granular subbase, base and asphalt or concrete surfacing.
- .6 Subgrade elevation: elevation immediately below pavement structure.
- .7 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.
- .8 Borrow Material: material obtained from areas outside limit of work and required for construction of embankments or for other portions of work.

1.4 BLASTING

- .1 All blasting operations to comply with Section 31 23 17 - Rock Removal.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert excess materials from landfill to site approved by Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Unless shown otherwise on the Contract Drawings, the following specified materials are approved for their respective uses. Backfill for embankment fill (subgrade fill) to be:
 - .1 Approved native or imported granular material

- .2 Pit run gravel
- .3 Pit run sand
- .2 Refer to Section 31 05 16 - Aggregate Materials for specifications for approved granular materials.
- .3 Refer to Section 31 32 19 - Geotextiles.

PART 3 EXECUTION

3.1 GENERAL

- .1 Strip all organic material to specified limits and specified depth or as directed by Departmental Representative. Do not handle topsoil while wet or frozen condition or in any manner in which soil structure is adversely affected. Remove all debris. Stockpile and place topsoil as specified.
- .2 Surface drainage:
 - .1 Provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction are and adjacent and other affected properties. Provide siltation controls to protect natural watercourses or existing municipal drainage facilities.
 - .2 Comply with Section 01 35 44 - Environmental Procedures.

3.2 EXCAVATION

- .1 Notify Departmental Representative sufficiently in advance of excavation operations for initial cross-sections to be taken.
- .2 Notify Departmental Representative whenever unsuitable materials are encountered in cut sections and remove unsuitable materials to depth and extent as directed by Departmental Representative.
- .3 If, during excavation, material appearing to conform to classification for rock is encountered, notify Departmental Representative in sufficient time to enable measurements to be made to determine volume of rock.
- .4 Rock excavation: Rock excavation to Section 31 23 17 - Rock Removal

3.3 INSPECTION OF NATIVE SURFACE

- .1 Prior to placing embankment fill, proof roll graded native surface using fully loaded single or dual axle dump truck. Departmental Representative may authorize use of other acceptable proof rolling equipment. Remove soft or other unstable material. Replace with approved embankment fill to Section 31 24 13 - Roadway Embankments proctor density in compliance with ASTM D1557. (All following references to density imply compliance with ASTM D1557).

3.4 PLACING

- .1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
- .2 Begin spreading material on crown line or high side of one-way slope.

- .3 Place materials using methods which do not lead to segregation or degradation.
- .4 Place material to full width in uniform layers and compact to specified densities.
- .5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .6 Remove and replace that portion of any layer in which material becomes segregated during spreading.
- .7 Where shown on Contract Drawings or as directed by Departmental Representative, scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces.
- .8 Where fill material consists principally of rock:
 - .1 Place to full width in layers of sufficient depth to contain maximum sized rocks, but in no case layer thickness to exceed 1 m.
 - .2 Individual rock fragments not exceeding 1.5 m in horizontal dimension permitted provided their vertical dimension does not exceed one third of fill section depth.
 - .3 Carefully distribute rock material to fill voids with smaller fragments to form compact mass.
 - .4 Fill surface voids at subgrade level with rock spalls or selected material to form an earth-tight surface.
 - .5 Do not place boulders and rock fragments with dimensions exceeding 150 mm within 300 mm of subgrade elevation.

3.5 COMPACTION

- .1 Compaction equipment to be capable of obtaining required densities in materials on project.
- .2 Compact to density of not less than 95% Modified Proctor density.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted layers.
- .4 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers.
- .6 Finish slopes to neat condition, true to line and grade.
 - .1 Remove boulders encountered in cut slopes and fill resulting cavities.
 - .2 Hand finish slopes that cannot be finished satisfactorily by machine.

3.6 FINISHED TOLERANCES

- .1 Ensure finished subgrade within plus or minus 15 mm of specified grade and cross-section but not uniformly high or low.
- .2 Ensure finished subgrade surface has no irregularities exceeding 15 mm when checked with a 3 m straight edge places in any direction.

- .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.7 PROOF ROLLING

- .1 For proof rolling use fully loaded single or dual axle dump truck.
- .2 Departmental Representative may authorize use of other acceptable proof rolling equipment.
- .3 Proof roll top of embankment fill upon completion of fine grading and compaction.
- .4 Make sufficient passes with proof roller to subject every point on surface to three space passes of loaded tire.
- .5 Where proof rolling reveals areas of unsuitable subgrade:
 - .1 Remove unsuitable embankment material to depth and extent directed by Departmental Representative.
 - .2 Replace with approved embankment material and compact in accordance with this section.

3.8 PLACE TOPSOIL

- .1 Place, spread and grade topsoil as shown on Contract Drawings.
- .2 Restore planted areas with topsoil, ground cover, and plants or shrubs to match existing planted areas as shown on Contract Drawings.

3.9 MAINTENANCE

- .1 Maintain finished embankment fill in condition conforming to this section until succeeding material is applied or until granular base is accepted by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- .1 The work of this Section consists of all paving work and related items as indicated on the drawings and or as specified herein and includes, but is not limited to, the following items:
 - .1 Stabilized Aggregate pathways.
- .2 Related Sections:
 - .1 Section 31 05 16 – Aggregate Materials
 - .2 Section 32 11 23 – Aggregate Base Course
- .3 General Provisions
 - .1 All of the contract documents, including General and Supplementary Conditions and Division I General Requirements, apply to the work of this Section.
 - .2 Examine all drawings and all other Sections of the Specifications for requirements therein affecting the work of this trade.
 - .3 Coordinate work with that of all those affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SAMPLES AND SUBMITTALS

- .1 Sieve analysis of aggregate for pathways.
- .2 Samples and or shop drawings for the following: Aggregate for strength and color–pathways.
- .3 Construction Samples:
 - .1 Stabilized Aggregate pathway: Construct a 3m x 8m sample of finished Stabilized Aggregate surface as directed by the Departmental Representative on site.
 - .2 General:
 - .1 Schedule mock-up construction so that mock-up can be accepted a minimum of 30 days prior to the application of paving surfaces represented by the mock-up.
 - .2 Locate mock-up panel(s) in areas as directed by the Departmental Representative.
 - .3 Continue to construct mock-ups until acceptable mock-up is produced (at no cost to the Owner). Acceptable mock-up shall be standard for texture, color and workmanship.
 - .4 Use same setting bed and joint mixes used in accepted mock-up in final work unless otherwise directed by Departmental Representative.
 - .5 Protect accepted mock-ups from damage until completion and acceptance of the work represented by the mock-up.
 - .6 Remove mock-up panel(s) from the site at completion of the project, unless otherwise instructed by Departmental Representative.

- .4 Maintenance Instructions:
 - .1 Submit copy(ies) of manufacturer's written maintenance instructions in accordance with 01 33 00 – Submittal Procedures.

1.3 PROJECT/SITE CONDITIONS

- .1 Field Measurements:
 - .1 Where surfacing is indicated to fit with other construction, verify dimensions of other construction by field measurements before proceeding with the work.
- .2 Environmental Limitations:
 - .1 Do not install Stabilized Aggregate during rainy conditions or below 5 degrees Celsius and falling.

1.4 QUALITY ASSURANCE

- .1 Installer Qualifications:
 - .1 Installer to provide evidence to indicate successful experience in providing Stabilized Aggregate surface or ability to follow installation instructions.
- .2 Compaction testing to be provided by contractor, one test per 200 square metre of base course.
- .3 Manufacturer's technical representative shall visit the site at the start of an installation to ensure the installer understands the correct installation methods to use.

1.5 WARRANTY

- .1 General Warranty:
 - .1 The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- .2 Special Warranty:
 - .1 Submit a written warranty executed by the installer agreeing to repair or replace components of Stabilized Aggregate that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
 - .1 Premature wear and tear, provided the material is maintained in accordance with manufacturer's written maintenance instructions.
 - .2 Failure of system to meet performance requirements.
- .3 Warranty Period:
 - .1 Contractor shall provide warranty for performance of product. Contractor shall warranty installation of product for the time of one year from completion.

- .4 Contractor shall provide, for a period of sixty days, unconditional maintenance and repairs as required.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Sand and crushed stone shall consist of inert materials that are hard and durable, with stone free from surface coatings and deleterious materials.

- .1 The sand equivalent shall be in the range of 35-55. The R-value shall be a minimum of 71. ASTM testing shall be used for the sand equivalent and R-value determination.

- .2 Dense graded crushed stone base shall be furnished and installed as required and specified to a 150mm compacted depth.

- .3 Gradation requirements shall be as follows:

| U.S. Sieve No. | Percent Passing by Weight |
|----------------|---------------------------|
| 12.5mm | 95 – 100 |
| 9.5mm | 90 – 100 |
| 4.75mm | 65 – 80 |
| 2.36mm | 48 – 63 |
| 1.18mm | 40 – 49 |
| 0.600mm | 30 – 40 |
| 0.300mm | 20 – 27 |
| 0.150mm | 10 – 18 |
| 0.075mm | 10 - 12 |

- .2 Stabilizer Binder

- .1 Non-toxic, organic binder that is a colorless and odorless concentrated powder that binds crushed 9.5mm or 6.35" minus aggregate.

- .2 Product to have 64% pre-consumer recycled content.

- .3 Product shall have 25 years experience at same formulation.

- .3 Aluminum Edging

- .1 Rigid, L-shaped with sliding connection system, 150mm depth, mill finish

- .2 Aluminum stakes 300mm long placed every 0.6m-0.8m.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Base shall be compacted layer of granular road base as shown on drawings. Make any corrections necessary to base furnished and installed to bring gravel to the elevations shown on the drawing.

- .2 Edging:

- .1 Ensure that all underground utility lines are located and will not interfere with the proposed edging installation before beginning work.

- .2 Locate border line of edging with string or other means to assure border straightness and curves as designed.
- .3 Dig trench 25mm deeper than set of edging bottom.
- .4 Set edging into trench with top at 12mm above compacted finished grade on turf side with side having loops for stakes placed on opposite side of turf. Drive stakes through edging loops until locked in place.
- .3 Pre-soak base material with water and compact to 95% determined by Test Method ASTM D 1557 prior to installing Stabilized Aggregate.
- .4 Although porous, it is recommended to have proper drainage available to ensure no standing water on surface or adjacent to Stabilized Aggregate, including downspouts when placed under roof overhang and surface drains.
- .5 Before proceeding with installation, notify Departmental Representative in writing of unsuitable site/base conditions.

3.2 BLENDING

- .1 Stabilizer shall be thoroughly pre-mixed with aggregate at the rate of 15-lbs of Stabilizer per 1-tonne of aggregate. Verify with manufacturer for correct Stabilizer rate for project and climate conditions. Drop spreading of Stabilizer over pre-placed aggregate or mixing by rototilling is not acceptable for vehicular access. Stabilizer shall be mechanically pre-mixed per manufacturer's recommendations using an approved mechanical blending unit that will adequately mix and blend Stabilizer with aggregate (Bucket blending is not an approved blending apparatus). Always blend Stabilizer and aggregate DRY.

3.3 PLACEMENT

- .1 Place the Stabilized Aggregate directly on a prepared base, and rake smooth to desired grade and cross section. Place material to sufficient depth to allow 150mm after compaction. Installation of Stabilized Aggregate to be installed in lifts of no more than 75mm thick. DO NOT place on filter fabric.

3.4 WATERING

- .1 Water heavily for full-depth moisture penetration of profile. Water activates Stabilizer, saturate to total depth. Apply 100 to 170-litres of water per 1-tonne. Application test moisture using a probing device reaching full depth.
- .2 Contractor shall wait a minimum of 6 – 72 hours or until such time that the Stabilized Aggregate is able to accept compaction from a 2 to 5 tonne roller without separation, plowing or any other physical compromise of the aggregate.
- .3 If surface aggregate dries significantly quicker than subsurface material, lightly mist surface before compaction.

3.5 COMPACTION

- .1 Compact Stabilized Aggregate to 85% relative compaction by equipment such as; a 2 to 5-tonne double drum roller making 3 to 4 passes. Do not begin compaction for 6 hours after placement and up to 72 hours. DO NOT use a vibratory plate compactor or vibration feature on roller, as vibration separates large aggregate particles. If pumping or pancaking of surface occurs, surface is still too wet to roll.

- .2 Take care in compacting Stabilized Aggregate when adjacent to planting and irrigation systems. Hand tamping with 200mm or 250mm hand tamp recommended.
- .3 Lightly spray surface area following compaction. Do not disturb aggregate surface with spray action.

3.6 INSPECTION

- .1 Finished surface shall be smooth, uniform and solid. There shall be no evidence of chipping or cracking. Cured and compacted surface shall be firm throughout profile with no spongy areas. Loose material shall not be present on the surface after installation, but may appear after use and according to environmental conditions. Surface shall remain stable underneath the loose granite on top with a 'natural' look. Any significant irregularities in Stabilized Aggregate surface shall be repaired to the uniformity of entire installation.

3.7 PROTECTION

- .1 Contractor shall furnish and install construction fence around new surface to prevent public access. Maintain in place for a minimum of 12 - 72 hours after installation, or as directed by the Departmental Representative.
- .2 Contractor shall notify Departmental Representative to restrict landscape irrigation near surface until drying period is complete. Standing water on surface and adjacent to path shall be restricted at all times.

3.8 MAINTENANCE

- .1 Remove debris, such as paper, grass clippings, leaves or other organic material by mechanically blowing or hand raking the surface as needed. Any plowing program required shall involve the use of a rubber baffle on the plow blade or wheels to lift blade 6mm off of paving surface.
- .2 During the first year, a minor amount of loose aggregate may appear on the surface (1.5 to 6mm). If material exceeds a 6mm, redistribute material over entire surface. Water thoroughly to 25mm depth and compact with power roller of no less than 1000 lb. This process shall be repeated as needed.
- .3 If cracking occurs, simply sweep fines into cracks, water thoroughly and hand tamp with an 200mm to 250mm hand tamp.

3.9 REPAIRS

- .1 Excavate damaged area to the depth of the Stabilized Aggregate and square off sidewalls.
- .2 If area is dry, moisten damaged portion lightly.
- .3 Pre-blend the dry required amount of Stabilizer powder with the proper amount of aggregate in a concrete mixer.
- .4 Add water to the pre-blended Stabilized Aggregate. Thoroughly moisten mix with 100 to 170 litre per ton of pre-blended material or to approximately 10% moisture content.
- .5 Apply moistened pre-blended Stabilized Aggregate to excavated area to finish grade.
- .6 Compact with an 200mm to 250mm hand tamp or use a larger 1000 lb. roller. Keep traffic off areas for 12 to 48 hours after repair has been completed.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 31 24 13 - Roadway Embankments
- .2 Section 31 05 16 - Aggregate Materials

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 117, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 422, Standard Test Method for Particle-Size Analysis of Soils.
 - .5 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m³).
 - .6 ASTM D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700kN-m/m³).
 - .7 ASTM D 1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .8 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.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused granular materials from landfill to local facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Material for road subbase to be:
 - .1 Select granular subbase.
 - .2 75 mm pit run gravel.
 - .3 75 mm minus crushed gravel.
 - .4 Pit run sand.
 - .5 Approved native material.
 - .6 Other approved materials.

- .2 Refer to Section 31 05 16 - Aggregate Materials for material specifications.
- .3 Other granular materials: granular materials approved for road base or pipe bedding also acceptable for road subbase subject to approval of Departmental Representative.

PART 3 EXECUTION

3.1 INSPECTION OF UNDERLYING SUBGRADE SURFACE

- .1 Ensure underlying subgrade surface true to cross-section and grade and compacted to specified density. Departmental Representative may accept satisfactory proof rolling as evidence of acceptable compaction of undisturbed native subgrade. Do not place granular subbase until subgrade is inspected and approved by Departmental Representative.

3.2 PLACING

- .1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
- .2 Begin spreading subbase material on crown line or high side of one-way slope.
- .3 Place granular subbase materials using methods which do not lead to segregation or degradation.
- .4 Place material to full width in uniform layers not exceeding 300mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .6 Remove and replace portion of layer in which material has become segregated during spreading.

3.3 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 95% Modified Proctor Density.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted subbase.
- .4 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.

3.4 SITE TOLERANCES

- .1 Ensure finished subbase within plus or minus 15 mm of specified grade and cross-section but not uniformly high or low.
- .2 Ensure finished subbase surface has no irregularities exceeding 15 mm when checked with a 3 m straight edge placed in any direction.

- .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.5 PROOF ROLLING

- .1 For proof rolling use fully loaded single or dual axle dump truck.
- .2 Departmental Representative may authorize use of other acceptable proof rolling equipment.
- .3 Proof roll at level in subbase as required. Maintain finished subbase in condition conforming to this section until succeeding base is constructed, or until granular subbase is accepted by Departmental Representative. If alternative proof rolling equipment is authorized, Departmental Representative will determine level of proof rolling.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .5 Where proof rolling reveals area of unsuitable subgrade:
 - .1 Remove subbase and subgrade material to depth and extent as directed by Departmental Representative.
 - .2 Backfill excavated subgrade with approved embankment material and compact in accordance with Section 31 24 13 - Roadway Embankments.
 - .3 Replace subbase material and compact in accordance with this section.
- .6 Where proof rolling reveals areas of unsuitable subbase, remove unsuitable materials to depth and extent directed by Departmental Representative and replace with new materials in accordance with this section at no extra cost.

3.6 MAINTENANCE

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 31 05 16 - Aggregate Materials
- .2 Section 32 11 19 - Granular Subbase

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 117, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m³).
 - .5 ASTM D 1557-[00], Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700kN-m/m³).
 - .6 ASTM D 1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .7 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.

1.3 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Material for road base to be:
 - .1 19 mm crushed gravel.
 - .2 Refer to Section 31 05 16 - Aggregate Materials for material specifications.

PART 3 EXECUTION

3.1 INSPECTION OF UNDERLYING SUBGRADE SURFACE

- .1 Ensure underlying subbase surface true to cross-section and grade and compacted to 95% Modified Proctor density in compliance with ASTM D1557. Do not place granular subbase until subgrade is inspected and approved by Departmental Representative.

3.2 PLACING

- .1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
- .2 Begin spreading subbase material on crown line or high side of one-way slope.
- .3 Place granular subbase materials using methods which do not lead to segregation or degradation.
- .4 Place material to full width in uniform layers not exceeding 150mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .6 Remove and replace portion of layer in which material has become segregated during spreading.

3.3 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 95% Modified Proctor Density.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted subbase.
- .4 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.

3.4 SITE TOLERANCES

- .1 Ensure finished base within plus or minus 10 mm of specified grade and cross-section but not uniformly high or low.
- .2 Ensure finished surface has no irregularities exceeding 10 mm when checked with a 3 m straight edge placed in any direction.
- .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.5 PROOF ROLLING

- .1 For proof rolling use fully loaded single or dual axle dump truck.

- .2 Departmental Representative may authorize use of other acceptable proof rolling equipment.
- .3 Proof roll top of base upon completion of fine grading and compaction.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .5 Where proof rolling reveals area of unsuitable subgrade:
 - .1 Remove base, subbase and subgrade material to depth and extent as directed by Departmental Representative.
 - .2 Backfill excavated subgrade with approved embankment material and compact in accordance with Section 31 24 13 - Roadway Embankments.
 - .3 Replace subbase material and compact in accordance with this Section 32 11 19 - Granular Subbase.
 - .4 Replace base material and compact in accordance with this Section.
- .6 Where proof rolling reveals areas of unsuitable base or subbase, remove unsuitable materials to depth and extent directed by Departmental Representative and replace with new materials in accordance with Section 32 11 19 - Granular Subbase at no extra cost.

3.6 MAINTENANCE

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

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and application of asphalt tack coat to an existing asphalt or concrete surface prior to asphalt paving.

1.2 RELATED SECTIONS

- .1 Section 01 33 01 - Submittal Procedures
- .2 Section 01 35 14 - Special Procedures for Traffic Control
- .3 Section 32 12 16 - Asphalt Paving

1.3 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM D 140, Standard Practice for Sampling Bituminous Materials.
 - .2 ASTM D 633, Standard Volume Correction Table for Road Tar.
 - .3 ASTM D 1250, Standard Guide for Use of the Petroleum Measurement Tables.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-16.2, Emulsified Asphalts, Anionic Type, for Road Purposes.

1.4 QUALITY ASSURANCE

- .1 Upon request by Departmental Representative, submit manufacturer's test data and certification that asphalt tack coat material meets requirements of this section.
- .2 Provide access on tanker for Departmental Representative to sample asphalt material to be incorporated into work, in accordance with ASTM D140.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with ASTM D 140.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused asphalt from landfill to facility capable of recycling materials.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Emulsified asphalt: to CAN/CGSB-16.2, grade: SS-1.

PART 3 EXECUTION

3.1 EQUIPMENT

- .1 Pressure distributor to be :
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.

- .2 Applied uniformly on variable widths of surface up to 5 m.
- .3 Applied at controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and allowable variation from any specified rate not exceeding 0.1 L/m².
- .4 Distributed in uniform spray without atomization at temperature required.
- .2 Equipped with meter registering metres of travel per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
- .3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
- .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
- .5 Equipped with accurate volume measuring device or calibrated tank.
- .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
- .7 Equipped with nozzle spray bar, with operational height adjustment.
- .8 Cleaned if previously used with incompatible asphalt material.
- .2 Hand Sprayer: For small and/or inaccessible areas, a pressurized hand-held spray wand may be used.

3.2 APPLICATION

- .1 Obtain Departmental Representative's approval of surface before applying asphalt tack coat.
- .2 Apply asphalt tack coat only on clean and dry surface.
- .3 Dilute asphalt emulsion with water at 1:1 ratio for application.
 - .1 Mix thoroughly by pumping or other method approved by Departmental Representative
- .4 Apply asphalt tack coat evenly to pavement surface at rate as directed by Departmental Representative, but not to exceed 0.7 L/m² when diluted with water at 1:1 ratio.
- .5 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt tack coat material.
- .6 Do not apply asphalt tack coat when air temperature is less than 5 degrees C or when rain is forecast within 2 hours of application.
- .7 Apply asphalt tack coat only on unfrozen surface.
- .8 Asphalt tack oil, is toxic to aquatic life. Provide extra caution near catchbasins and storm drain inlets as all storm sewers in the worksite drain to an environmentally sensitive watercourse.
- .9 Evenly distribute localized excessive deposits of tack coat by brooming as directed by Departmental Representative.

- .10 Where traffic is to be maintained, treat no more than one half of width of surface in one application.
- .11 Keep traffic off tacked areas until asphalt tack coat has set.
- .12 Re-tack contaminated or disturbed areas as directed by Departmental Representative.
- .13 Permit asphalt tack coat to set before placing asphalt pavement.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for asphalt concrete paving for roads and airport runways.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 31 05 16 - Aggregate Materials
- .3 Section 32 12 15 - Asphalt Tack Coats

1.3 REFERENCES

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO M320, Standard Specification for Performance Graded Asphalt Binder.
 - .2 AASHTO R29, Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
 - .3 AASHTO T245, Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
- .2 Asphalt Institute (AI)
 - .1 AI MS2 Sixth Edition, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
- .3 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C 88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .2 ASTM C 117, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C 123, Standard Test Method for Lightweight Particles in Aggregate.
 - .4 ASTM C 127, Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - .5 ASTM C 128, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
 - .6 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .7 ASTM C 136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .8 ASTM C 207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - .9 ASTM D 995, Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
 - .10 ASTM D 2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - .11 ASTM D 3203, Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

- .12 ASTM D 4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .4 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 CAN/CGSB-16.3, Asphalt Cements for Road Purposes.

1.4 PRODUCT DATA

- .1 Submittals in accordance with Section 01 33 01 - Submittal Procedures.
- .2 Submit manufacturer's test data and certification that asphalt cement meets requirements of this Section.
- .3 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for review at least 4 weeks prior to beginning Work.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.
- .4 Divert unused asphalt from landfill to facility capable of recycling materials.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Asphalt cement: to CAN/CGSB-16.3-M90, grade: 80-100.
- .2 Reclaimed asphalt pavement:
 - .1 Crushed and screened so that 100% of RAP material passes 37.5 mm screen before mixing.
- .3 Aggregates: in accordance with Section 31 05 16 - Aggregate Materials: General following requirements:
 - .1 Crushed stone or gravel consisting of hard, durable angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
 - .2 Gradations: within limits specified when tested to ASTM C 136 and ASTM C 117.

.3 Table

| Sieve Designation | Percent Passing | |
|-------------------|--------------------|--------------------|
| | Lower Course #2 | Upper Course #2 |
| 25.0mm | - | - |
| 19.0mm | 100 | - |
| 12.5mm | 84-99 | 100 |
| 9.5mm | 73-88 | - |
| 4.75mm | 50-68 | 55-75 |
| 2.36mm | 35-55 | 38-58 |
| 1.18mm | 27-46 | 28-47 |
| 0.600mm | 18-36 | 20-36 |
| 0.300mm | 10-26 | 10-26 |
| 0.150mm | 4-17 | 4-17 |
| 0.075mm | 3-8 | 3-8 |

- .4 Coarse aggregate: aggregate retained on 4.75mm sieve and fine aggregate is aggregate passing 4.75mm sieve when tested to ASTM C 136.
- .5 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75mm sieve and stockpile separately from coarse aggregate.
- .6 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .7 Sand equivalent: ASTM D 2419 Min: 40.
- .8 Magnesium Sulphate soundness: to ASTM C 88 Max% loss by mass after five cycles:
- .1 Coarse aggregate: 15%.
 - .2 Fine aggregate: 18%.
- .9 Los Angeles abrasion: Grading B, to ASTM C 131 Max % loss by mass:
- .1 Coarse aggregate, upper course: 25%
 - .2 Coarse aggregate, lower course: 35%.
- .10 Absorption: to ASTM C 127 Max % by mass:
- .1 Coarse aggregate, upper course: 1.75%.
 - .2 Coarse aggregate, lower course: 2.00%.
- .11 Loss by washing: to ASTM C 117 Max % passing 0.075 mm sieve:
- .1 Coarse aggregate, upper course: 1.5
 - .2 Coarse aggregate, lower course: 2.0
- .12 Flat and elongated particles: to ASTM D 4791, (with length to thickness ratio greater than 3): Max% by mass:
- .1 Coarse aggregate, upper course: 10%.
 - .2 Coarse aggregate, lower course: 10%.
- .13 Crushed fragments: at least 60% of particles by mass within each of following sieve designation ranges, to have at least 2 freshly fractured face. Material to be tested according to ASTM C 136 and ASTM C117.

Determination of amount of fractured material will be in accordance with Ministry of Transportation and Highways' Specification I-11, Fracture Count for Coarse Aggregate, Method "B", which determines fractured faces by mass.

| Passing | | Retained on | |
|---------|----|-------------|--|
| 25 mm | to | 12.5 mm | |
| 12.5 mm | to | 4.75 mm | |

.14 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.

.4 Mineral filler:

.1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.

.2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.

.3 Mineral filler to be dry and free flowing when added to aggregate.

2.2 MIX DESIGN

.1 Mix design provided by the Contractor (to be developed by testing laboratory) for approval by Departmental Representative.

.2 Mix to contain maximum 20% by mass of RAP. Departmental Representative may approve higher proportion of RAP if Contractor demonstrates ability to produce mix meeting requirements of specification.

.3 Design of mix: by Marshall method to requirements below.

.1 Compaction blows on each face of test specimens: 75.

.2 Mix physical requirements:

| Property | Roads | |
|-----------------------------|-----------|-------------------|
| Marshall Stability at 60° C | kN min | 5.5 upper course |
| | | 6.4 lower course |
| Flow Value | mm | 2-4 |
| Air Voids in Mixture | % | 3-5 upper course |
| | | 3-6 lower course |
| Voids in Mineral Aggregate | % min | 15 upper course 2 |
| | | 14 upper course 1 |
| | | 14 upper course 2 |
| | | 13 upper course 1 |
| Index of Retained Stability | % minimum | 75 |

- .3 Measure physical requirements as follows:
 - .1 Marshall load and flow value: to ASTM D1559.
 - .2 Air voids: to ASTM D3203.
 - .3 Index of Retained Stability: measure in accordance with Marshall Immersion Test (ASTM D1559).
 - .4 Do not change job-mix without prior approval of Departmental Representative. When change in material source proposed, new job-mix formula to be reviewed by Departmental Representative.

PART 3 EXECUTION

3.1 PLANT AND MIXING REQUIREMENTS

- .1 Batch and continuous mixing plants:
 - .1 To ASTM D 995.
 - .2 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders. Do not load frozen materials into bins.
 - .3 Feed cold aggregates to plant in proportions to ensure continuous operations.
 - .4 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
 - .5 Before mixing, dry aggregates to moisture content not greater than 0.5% by mass or to lesser moisture content if required to meet mix design requirements.
 - .6 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.
 - .7 Store hot screened aggregates in manner to minimize segregation and temperature loss.
 - .8 Heat asphalt cement and aggregate to mixing temperature directed by Departmental Representative. Do not heat asphalt cement above 160 degrees C.
 - .9 Maintain temperature of materials within 5 degrees C of specified mix temperature during mixing.
 - .10 Mixing time:
 - .1 In batch plants, both dry and wet mixing times as directed by Departmental Representative. Continue wet mixing as long as necessary to obtain thoroughly blended mix but not less than 30s or more than 75s.
 - .2 In continuous mixing plants, mixing time as directed by Departmental Representative but not less than 45s.
 - .3 Do not alter mixing time unless directed by Departmental Representative.
 - .11 Where RAP is to be incorporated into mix:
 - .1 Feed from separate cold feed bin specially designed to minimize consolidation of material. Provide 37.5mm scalping screen on cold feed to remove oversized pieces of RAP.

- .2 Ensure positive and accurate control of RAP cold feed by use of hydraulic motor or electric clutch and equip with anti rollback device to prevent material from sliding backward on feed belt.
 - .3 Combine RAP and new aggregates in proportions as directed by Departmental Representative. Dry mix thoroughly, until uniform temperature within plus or minus 5 degrees C of mix temperature, as directed by Departmental Representative Consultant is achieved prior to adding new asphalt cement. Do not add new asphalt cement where temperature of dried mix material is above 160 degrees C.
- .2 Dryer drum mixing plant:
- .1 To ASTM D 995.
 - .2 Load aggregates from individual stockpiles to separate cold feed bins. Do not load frozen materials into bins.
 - .3 Feed aggregates to burner end of dryer drum by means of multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
 - .4 Where RAP is to be incorporated into mix, dryer drum mixer is to be designed to prevent direct contact of RAP with burner flame or with exhaust gases hotter than 180 degrees C.
 - .5 Feed RAP from separate cold feed bin designed to minimize reconsolidation of material.
 - .6 Meter total flow of aggregate and RAP by an electronic weigh belt system with indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate RAP and asphalt entering mixer remain constant.
 - .7 Provide for easy calibration of weighing systems for aggregates and RAP without having material enter mixer.
 - .8 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved. Calibrate weigh bridge on charging conveyor by weighing amount of aggregate passing over weigh bridge in set amount of time. Difference between this value and amount shown by plant computer system to differ by not more than plus or minus 2%.
 - .9 Make provision for conveniently sampling full flow of materials from cold feed.
 - .10 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate and RAP from cold feed prior to entering drum.
 - .11 Provide system interlock stop on feed components if either asphalt or aggregate from bin stops flowing.
 - .12 Accomplish heating and mixing of asphalt mix in approved parallel flow dryer-mixer in which aggregate enters drum at burner end and travels parallel to flame and exhaust gas stream. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each week, if required.

- .13 Mixing period and temperature to produce uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer to be less than 0.5%.
- .3 Temporary storage of hot mix:
 - .1 Provide mix storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
 - .2 Do not store asphalt mix in storage bins in excess of 12 hour.
- .4 Mixing tolerances:
 - .1 Permissible variation in aggregate gradation from job mix (percent of total mass).

| | |
|-----------------------------|-----|
| 4.75 mm sieve and larger | 5.5 |
| 2.36 mm sieve | 4.5 |
| 0.600 mm sieve | 3.5 |
| 0.150 mm sieve | 2.5 |
| 0.075 mm sieve | 1.5 |
 - .2 Permissible variation of asphalt cement from job mix: 0.3%.
 - .3 Permissible variation of mix temperature at discharge from plant: 5 degrees C.

3.2 EQUIPMENT

- .1 Pavers: mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
 - .1 Minimum drum diameter: 1200mm.
 - .2 Maximum amplitude of vibration (machine setting): 0.5mm for lifts less than 40 mm thick.
- .4 Haul trucks: sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
 - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
 - .4 Use only trucks which can be weighed in single operation on scales supplied.
 - .5 Hand tools:
 - .1 Lutes or rakes with covered teeth for spreading and finishing operations.

- .2 Tamping irons having mass not less than 12 kg and bearing area not exceeding 310 cm² for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by Departmental Representative may be used instead of tamping irons.
- .3 Straight edges, 3.0m in length, to test finished surface.

3.3 PREPARATION

- .1 Reshape granular road bed, if required.
- .2 When paving over existing asphalt surface, clean pavement surface. When leveling course is not require, patch and correct depressions and other irregularities to approval of Departmental Representative before beginning paving operations.
- .3 Adjust existing castings to new elevations and protect from asphaltic mix.
- .4 When matching new pavement with existing pavement make vertical cut between existing pavement and new pavement as shown on Contract Drawings.
- .5 Apply prime coat and/or tack coat in accordance with Section 32 12 14 - Asphalt Prime Coats and/or Section 32 12 15 - Asphalt Tack Coats prior to paving.
- .6 Prior to laying mix, clean surfaces of loose and foreign material.

3.4 TRANSPORTATION OF MIX

- .1 Transport mix to job site in vehicles cleaned of foreign material.
- .2 Paint or spray truck beds with limewater, soap or detergent solution, or non petroleum based commercial product, at least daily or as required. Elevate truck bed and thoroughly drain. No excess solution to remain in truck bed.
- .3 Schedule delivery of material for placing in daylight, unless Departmental Representative approves artificial light.
- .4 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.
- .5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within range as directed by Departmental Representative, but not less than 125 degrees C.

3.5 PLACING

- .1 Obtain Departmental Representative's approval of base and existing surface and tack coat and prime coat prior to placing asphalt.
- .2 Place asphalt concrete to thicknesses, grades and lines as shown on Contract Drawings.
- .3 Placing conditions:
 - .1 Place asphalt mixtures only when air temperature is above 5 degrees C. Place overlay pavement only when air temperature is above 10 degrees C.

- .2 When temperature of surface on which material is to be placed falls below 10 degrees C, provide extra rollers as necessary to obtain required compaction before cooling.
- .3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .4 Place asphalt concrete in compacted lifts of thickness as shown on Contract Drawings:
 - .1 Levelling courses to thicknesses required but not exceeding 100mm.
 - .2 Lower course in layers of 100mm each.
 - .3 Surface course in layers of maximum 60mm each.
- .5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300 mm.
- .6 Spread and strike off mixture with self propelled mechanical finisher.
 - .1 Construct longitudinal joints and edges true to line markings. Position and operate paver to follow established line closely.
 - .2 When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver. Work pavers as close together as possible and in no case permit them to be more than 30 m apart.
 - .3 Maintain constant head of mix in auger chamber of paver during placing.
 - .4 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
 - .5 Correct irregularities in alignment left by paver by trimming directly behind machine.
 - .6 Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.
 - .7 Do not throw surplus material on freshly screeded surfaces.
- .7 When hand spreading is used:
 - .1 Use approved wood or steel forms, rigidly supported to assure correct grade and cross section. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
 - .2 Distribute material uniformly. Do not broadcast material.
 - .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes. Reject material that has formed into lumps and does not break down readily.
 - .4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.
 - .5 Provide heating equipment to keep hand tools free from asphalt. Control temperature to avoid burning material. Do not use tools at higher temperature than temperature of mix being placed.

3.6 COMPACTING

- .1 Roll asphalt continuously to density not less than 97% of 75 blow Marshall density to ASTM D1559 with no individual test less than 95%.
- .2 General:
 - .1 Provide at least two rollers and as many additional rollers as necessary to achieve specified pavement density. When more than two rollers are required, one roller must be pneumatic tired type.
 - .2 Start rolling operations as soon as placed mix can bear weight of roller without excess displacement of material or cracking of surface.
 - .3 Operate roller slowly initially to avoid displacement of material. For subsequent rolling do not exceed 5 km/h for static steel-wheeled and 8 km/h for pneumatic tired rollers.
 - .4 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 20 impacts per metre of travel. For lifts less than 50 mm thick, impact spacing not to exceed compacted lift thickness.
 - .5 Overlap successive passes of roller by minimum of 200mm and vary pass lengths.
 - .6 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.
 - .7 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
 - .8 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
 - .9 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side. Ensure that all points across width of pavement receive essentially equal numbers of passes of compactors.
 - .10 When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.
 - .11 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.
- .3 Breakdown rolling:
 - .1 Commence breakdown rolling immediately following rolling of transverse and longitudinal joint and edges.
 - .2 Operate rollers as close to paver as necessary to obtain adequate density without causing undue displacement.
 - .3 Operate breakdown roller with drive roll or wheel nearest finishing machine. Exceptions may be made when working on steep slopes or super-elevated sections.
 - .4 Use only experienced roller operators for this work.

- .4 Second rolling:
 - .1 Use pneumatic-tired, steel wheel or vibratory rollers and follow breakdown rolling as closely as possible and while paving mix temperature allows maximum density from this operation.
 - .2 Rolling to be continuous after initial rolling until mix placed has be thoroughly compacted.
- .5 Finished rolling:
 - .1 Accomplish finish rolling with steel wheel rollers while material is still warm enough for removal of roller marks.
 - .2 Conduct rolling operations in close sequence.

3.7 JOINTS

- .1 General:
 - .1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.
 - .2 Construct joints between asphalt concrete pavement and Portland cement concrete pavement as indicated.
 - .3 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.
- .2 Transverse joints:
 - .1 Offset transverse joint in succeeding lifts by at least 600mm.
 - .2 Cut back to full depth vertical face and tack face with thin coat of hot asphalt prior to continuing paving.
 - .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
- .3 Longitudinal joints:
 - .1 Offset longitudinal joints in succeeding lifts by at least 150mm.
 - .2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100 degrees C prior to paving of adjacent lane.
 - .1 For airfield runway paving, avoid cold joint construction in mid 30 m of runway.
 - .2 If cold joint can not be avoided, tack face with thin coat of hot asphalt prior to continuing paving.
 - .3 Overlap previously laid strip with spreader by 100mm.
 - .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
 - .5 Roll longitudinal joints directly behind paving operation.
 - .6 When rolling with static roller over onto previously placed lane in order that 100 to 150 mm of drum width rides on newly laid lane, then operate roller to pinch and press fines gradually across joint. Continue rolling until thoroughly compacted neat joint is obtained.

- .7 When rolling with vibratory roller, have most of drum width ride on newly placed lane with remaining 100 to 150 mm extending onto previously placed and compacted lane.
- .4 Construct feather joints so that thinner portion of joint contains fine graded material obtained by changed mix design or by raking out coarse aggregate in mix. Place and compact joint so that joint is smooth and without visible breaks in grade. Location of feather joints as indicated.
- .5 Construct butt joints as indicated.
- .6 Wherever practical, locate joints under future traffic markings (paint lines.)

3.8 PAVEMENT PATCHING

- .1 Ensure temporary and permanent pavement patching done by handwork conforms to all standards specified for machine place asphaltic concrete.
- .2 Subbase and base preparation as specified in Section 32 11 19 and 32 11 23, respectively, unless shown otherwise on Contract Drawings.

3.9 SIDEWALKS, DRIVEWAYS AND CURBS

- .1 Hot-mix asphalt concrete sidewalks, driveways and curbs as shown on Contract Drawings.
- .2 Machine place where practical.
- .3 Ensure placement by handwork conforms to all standards specified for machine placed asphaltic concrete.
- .4 Other than requirements relating specifically to Portland cement concrete, ensure hot-mix asphalt concrete sidewalks and curbs comply with all requirements of Section 32 16 15 - Concrete Walks, Curbs and Gutters.
- .5 Ensure hot-mix asphalt concrete driveways comply with all requirements of Section 32 12 16 - Asphalt Paving.

3.10 FINISH TOLERANCES

- .1 Finished asphalt surface to be within 6mm of design elevation but not uniformly high or low.
- .2 Finished asphalt surface not to have irregularities exceeding 6mm when checked with 3 m straight edge placed in any direction.
- .3 Water ponding not permitted.
- .4 Against concrete gutter, finished asphalt surface to be higher than the gutter by not more than 6mm.

3.11 DEFECTIVE WORK

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking, rippling, or segregation.

- .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

3.12 CLEAN-UP

- .1 Remove lids or covers from all castings and clean any prime, tack coat or hot-mix asphaltic concrete from frames, lids and covers of all castings.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 03 30 02 - Cast-In-Place Concrete
- .3 Section 31 24 13 - Roadway Embankments
- .4 Section 32 11 23 - Aggregate Base Courses

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 117, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 260, Standard Specification for Boiled Linseed Oil.
 - .4 ASTM D 698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-3.3, Kerosene, Amend. No. 1, National Standard of Canada.
 - .2 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 SUBMITTALS

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

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with Section 03 30 02 - Cast-in-Place Concrete with the following criteria specific to this Section:
 - .1 Hand-formed and hand-placed concrete:
 - Slump: 80 mm.
 - Air entrainment: 5 to 8%.
 - Maximum aggregate size: 20 mm.
 - Minimum cement content: 335 kg/m³.
 - Minimum 28 day compressive strength 32 MPa.

- .2 Extruded concrete:
 - Slump: 0-25 mm.
 - Air entrainment: 6 to 9%.
 - Maximum aggregate size: 10 mm.
 - Fineness modulus: 2.1 to 2.4.
 - Minimum cement content: 335 kg/m³.
 - Minimum 28 day compressive strength 32 MPa.
- .2 Joint filler and Curing Compound: in accordance with Section 03 30 02 - Cast-in-Place Concrete.
- .3 Granular subbase: to Section 31 05 16 - Aggregate Materials.
- .4 Granular base: to Section 31 05 16 - Aggregate Materials.
- .5 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water-soluble soap.
- .6 Borrow material: to Section 31 24 13 - Roadway Embankments.
- .7 Monuments: Geodetic survey control station to be 76mm diameter solid unleaded silicon bronze with dome top and center punch for concrete inset into proposed barrier curb. Locations to be determined during construction by the Departmental Representative. Submit shop drawings in accordance with Section 01 33 01. Monument identification markings to be coordinated during shop drawing process. Following installation, complete a legal survey of monuments based on DND coordinate system.

PART 3 EXECUTION

3.1 GRADE PREPARATION

- .1 Do grade preparation work in accordance with Section 31 24 13 - Roadway Embankments.

3.2 GRANULAR SUBBASE AND BASE

- .1 Place subbase and minimum of 100mm granular base material to design grade as shown on Contract Drawings.
- .2 Compact subbase and base to minimum 95% Modified Proctor density.
- .3 Obtain Departmental Representative's approval of compacted base prior to placing forms or control devices for extruding equipment.

3.3 FORMWORK

- .1 Ensure steel forms of approved design and free from twists and warp.
- .2 Ensure wood forms of select dressed lumber, straight and free from defects and thoroughly cleaned.
- .3 Use flexible forms for all curves less than 60 m radius.
- .4 After obtaining Departmental Representative's approval of compacted base, set forms to line and grade as shown on Contract Drawings, free from waves or irregularities in line or grade.

- .5 Set special isolation forms as required around catchbasins, manholes, poles or other objects as shown on Contract Drawings or as directed by Departmental Representative.
- .6 Forms to be to shape, lines and full dimensions of work being formed.
- .7 Adequately brace forms to maintain specified tolerances after concrete is placed.
- .8 Treat forms lightly with approved form release agent and remove surplus agent.

3.4 INSPECTION

- .1 Immediately prior to placement of concrete, carefully inspect all formwork to ensure forms are properly set at required horizontal and vertical alignment, sufficiently rigid, clean, surface treated and ready for placement of concrete. Obtain Departmental Representative's approval of formwork and compacted base.

3.5 CONCRETE PLACEMENT

- .1 Place concrete to Section 03 30 02 - Cast-In-Place Concrete and the following criteria specific to this Section.
- .2 Do not place concrete during rain or on ponded water or frozen base.
- .3 Do not place concrete when air temperature appears likely to fall below 5°C within 24 h, unless specified precautions are taken and approved by Departmental Representative.
- .4 Schedule concrete placement to ensure sufficient daylight hours available to permit edging and finishing or provide adequate illumination.
- .5 Moisten granular base immediately prior to placing Concrete.
- .6 Place concrete within 1.5 h of batching time.
- .7 Place concrete in forms, ensuring no segregation of aggregate and consolidate with approved mechanical vibrator or power screed.
- .8 Place concrete in continuous operation until entire panel or section completed. Do not place fresh concrete on concrete which has achieved partial set.
- .9 Incorporate all castings into concrete at time of placement.
- .10 Incorporate survey monuments into concrete at locations identified by Departmental Representative.

3.6 EXTRUDED SECTIONS

- .1 Extruding machine to be fitted with approved template consistent with sections shown on Contract Drawings.
- .2 Extruded sections to be true to line, grade and cross-section.
- .3 Finished appearance, quality and workmanship to comply with Contract Drawings and this Specification.
- .4 Where finished product does not conform to specifications, remove defective product and replace.
- .5 Defective extruded work replaced with hand placed concrete to be paid at tendered price for extruded product.

3.7 DRIVEWAY CROSSINGS AND WHEELCHAIR RAMPS

- .1 Construct driveway crossings and wheel chair ramps where shown on Contract Drawings.

3.8 TOLERANCES

- .1 Maximum horizontal deviation = 6 mm.
Maximum vertical deviation = 6 mm.
Maximum deflection from horizontal or vertical alignment to be 6 mm in 3 m.

3.9 EXPANSION JOINTS

- .1 Form transverse expansion joints at both ends of curb returns and at a maximum spacing of 9 m for sidewalks, 9 m for curb and gutter, at each end of driveway crossings and at tangent points on circular work.
- .2 Extend through full depth of concrete.
- .3 Fill with 13 mm approved expansion joint material.
- .4 Bond break compound may be used in lieu of expansion joint between sidewalk and back of abutting curb and gutter or where applicable between sidewalk and back of abutting utility strip or sidewalk infill.

3.10 CONTROL JOINTS

- .1 In sidewalks, construct control joints at maximum 3m intervals.
- .2 In curb or curb and gutter construct control joints at maximum 3 m intervals and match with control joints in butting sidewalk.
- .3 Cut to minimum depth of concrete section as shown on Contract Drawings.
- .4 Use proper tool to make cut while concrete is still green or sawcut after concrete has hardened.

3.11 ISOLATION JOINTS

- .1 Form isolation joints around all poles, hydrants, manholes and all structures or fixed objects located within the concrete section by using specified joint filling material.
- .2 Form longitudinal isolation joints between sidewalk and abutting curb and gutter, abutting utility strips, abutting structures using 13 mm approved joint filling material.
- .3 Use 13 mm remolded hardboard joint material to form isolation joints between sidewalks and abutting walls and structures.

3.12 FINISHING

- .1 Finish surface of concrete sidewalks and utility strips to smooth surface with magnesium or wood float and brush or broom to provide uniform non-skid surface.
- .2 Broom or brush crossways or as otherwise required to match adjacent finish or as directed by Departmental Representative.

- .3 Grooves or scoring (dummy joints) used for aesthetic purposes as shown on the Contract Drawings or as directed by Departmental Representative, to be marked with proper tools and set 15 mm deep.
- .4 Finish driveway Crossings and wheel Chair ramps as shown on Contract Drawings.
- .5 Round edges with steel edging tool to a width of 50mm around perimeter of each panel or as shown on Contract Drawings.
- .6 Ensure surface of hand-formed curb and gutter is smooth magnesium or wood float finish. Ensure extruded Curb and gutter is smooth finished and hand floated as required to correct irregularities.
- .7 Under no circumstances is concrete to be overworked by trowelling, dusted with dry cement or finished with a mortar coat.
- .8 Ensure finished surface as specified.

3.13 SPECIAL EFFECTS

- .1 Exposed aggregate and colored or stamped concrete as specified on Contract Drawings.

3.14 PROTECTION

- .1 Protect freshly finished concrete from dust, rain or frost by using tarpaulins or other suitable protective coverings. Keep clear of finished surface.
- .2 Place and maintain suitable barriers to protect finished concrete from equipment, vehicles or pedestrian traffic.
- .3 Provide personnel as required to prevent vandalism until concrete has set.
- .4 Do not run vehicles or construction equipment on concrete for at least 3 days.

3.15 CURING

- .1 Apply approved curing compound to all exposed concrete surfaces at rate recommended by manufacturer or alternatively, use moist curing procedures for minimum of 7 days.
- .2 When temperature is below 5°C, maintain all concrete at temperature not less than 10°C for at least 72 h and protect from freezing for at least another 72 h or such time as required to ensure proper curing of concrete. Admixtures are not to be used for prevention of freezing.

3.16 PERFORATED DRAIN PIPE

- .1 Where shown on Contract Drawings or where directed by Departmental Representative install perforated drain pipe adjacent to sidewalk or curb and gutter: to Section 33 41 00 - Storm Utility Drainage Piping.

3.17 ACCEPTANCE

- .1 Before acceptance of finished concrete remove all irregular, cracked, vandalized or otherwise defective sections and replace in accordance with specifications.
- .2 Minimum area of replacement of defective sidewalk is one panel section.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 32 92 19 - Mechanical Seeding

1.2 REFERENCES

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

1.3 DEFINITIONS

- .1 Compost:
 - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
 - .2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
 - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below (25) (50)), and contain no toxic or growth inhibiting contaminants.
 - .4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A) (B).

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- .1 Pre-installation meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused soil amendments from landfill to official hazardous material collections site approved by Departmental Representative.

- .2 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

PART 2 PRODUCTS

2.1 TOPSOIL

- .1 Topsoil for Tree planting, planting beds (shrub planting) and sodded areas shall meet the requirements as specified in Section 6.2 of the BC Landscape Standards and shall include a mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.

2.2 NATIVE TOPSOIL

- .1 On-site native topsoil may be used provided it meets standard set for imported topsoil and can be modified to meet requirements set out for specified growing medium.
- .2 If testing show on-site soil to be suitable for landscaping, a sufficient quantity of stripped topsoil to be stockpiled as directed by the Departmental Representative.
- .3 Do not handle topsoil while in a wet or frozen condition or in any manner in which structure is adversely affected.

2.3 SOIL AMENDMENTS

- .1 Fertilizer:
 - .1 Fertility: major soil nutrients present in following amounts:
 - .1 Nitrogen (N): shall be 0.2% to 0.6% by weight.
 - .2 Phosphorus (P): 20 to 250 ppm
 - .3 Potassium (K): 50 to 1000 ppm
 - .4 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
 - .5 Ph value: 4.5-7.0
- .2 Peatmoss:
 - .1 Derived from partially decomposed species of Sphagnum Mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5mm.
- .3 Sand: washed coarse silica sand (or locally available equivalent), medium to course textured.
- .4 Organic matter: compost Category A in accordance with CCME PN1340, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
- .5 Limestone:
 - .1 Ground agricultural limestone.

- .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .6 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

2.4 SOURCE QUALITY CONTROL

- .1 Advise Departmental Representative of sources of topsoil to be utilized with sufficient lead time for testing.
- .2 Contractor is responsible for amendments to supply topsoil as specified.
- .3 Soil testing by recognized testing facility for PH, P and K, and organic matter.
- .4 Testing of topsoil will be carried out by testing laboratory designated by Departmental Representative.
 - .1 Soil sampling, testing and analysis to be in accordance with Provincial standards.

PART 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

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

3.2 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as directed by Departmental Representative after area has been cleared of brush, weeds and grasses and removed from site.
- .2 Strip topsoil to depths as indicated.
 - .1 Avoid mixing topsoil with subsoil where textural quality will be moved outside acceptable range of intended application.
- .3 Stockpile in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2 m.
 - .2 Disposal of unused topsoil is to be in an environmentally responsible manner but not used as landfill as directed by Departmental Representative.
 - .3 Protect stockpiles from contamination and compaction.
 - .4 Any non-hazardous, granular or organic fill, unusable at site, may be dumped outside the perimeter fence, on CSC property, near the South West Guard Tower as directed by the Departmental Representative. Dump and spread fill, level with adjoining grades.

3.3 PREPARATION OF EXISTING GRADE

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

3.4 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after Departmental Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 15mm below finished grade.
- .4 Spread topsoil as indicated.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.5 FINISH GRADING

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

3.6 ACCEPTANCE

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

3.7 SURPLUS MATERIAL

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

3.8 CLEANING

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

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- .1 This section refers to those portions of the work that are unique to the supply and application of grass seed by mechanical methods. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 This section is based on the "British Columbia Landscape Standard" published by the B.C. Society of Landscape Architects and the B.C. Nursery Trades Association. This standard is intended to set a level of quality which is to be equaled or bettered in the construction documents for each project. Guidance of a registered British Columbia Landscape Architect is recommended.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 32 91 19 - Topsoil Placement and Grading

1.3 REFERENCES

- .1 British Columbia Landscape Standard
- .2 Canadian System of Soil Classification

1.4 SCHEDULING

- .1 Schedule all operations to ensure optimum environmental protection, grading, growing medium placement, planting, seeding or sodding operations as outlined in these Specifications. Organize scheduling to ensure a minimum duration of on-site storage of plant material, minimum movement and compaction of growing medium, and prompt mulching and watering operations. Coordinate work schedule with scheduling of other trades on-site.
- .2 Coordinate and schedule such that no damage occurs to materials before or after placement. In particular, meet requirements of living plant material.
- .3 Plan, schedule and execute work to ensure a supply of water for landscape purposes in adequate amounts and at adequate pressures for satisfactory irrigation of all plants.

1.5 HANDLING AND STORAGE

- .1 Store all grass seed and nurse crop see, mulch, fertilizers and related materials, where required, in dry, weatherproof storage place and protect from damage by heat, moisture, rodents or other causes until time of seeding. Do not remove or deface labels or other identification.

1.6 SITE EXAMINATION

- .1 Do not carry out landscaping work in areas or over surfaces that are not properly prepared, examine site before starting work to verify all surfaces are properly prepared.

1.7 SAMPLES

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

- .2 Provide samples of all material required, handle and ship in such a manner that they are representative of material or product sampled.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Grass Seed:
 - .1 to meet requirements of Canada Seed Act for Canada No. 1 seed. Where specified, all nurse crop seed to meet requirements of Canada Seed Act for Canada No. 1 seed.
 - .2 Seed mixtures to be approved by Departmental Representative and to be suited to climate, terrain, establishment and maintenance conditions under which they are to be grown.
 - .3 Seed to have minimum germination rate of 75% and minimum purity of 97%, except where otherwise required by professional selecting seed mixture.
 - .4 Seed to be packed and delivered in original containers clear showing:
 - .1 Name of supplier.
 - .2 Analysis of seed mixture.
 - .3 Percentage of pure seed.
 - .4 Year of production.
 - .5 Net weight (mass).
 - .6 Date and location of bagging.
 - .5 Mixture to be mixed and supplied by recognized seed house.
 - .6 Water:
 - .1 Free of impurities that would inhibit germination and growth or may be harmful to environment.
 - .2 Contractor to supply.
 - .7 Fertilizer:
 - .1 To Section 32 91 19 - Topsoil Placement and Grading.

PART 3 EXECUTION

3.1 FINISH GRADE PREPARATION

- .1 Do not perform work under adverse field conditions such as frozen soil, excessively wet or dry soil or soil covered with snow, ice or standing water or when wind exceeds 10 km/h.
- .2 Verify that grades are correct. If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.
- .3 Remove and dispose of seeds; debris; soil contaminated by oil, gasoline and other deleterious materials; to approved off-site disposal area.
- .4 Loosen surface areas that are excessively compacted by means of thorough scarification, discing or harrowing, to minimum 150 mm depth.

- .5 Finish grade smooth to extend required for class or seeding to be carried out, firm against footprints, loose textured, and free of all stones, roots, branches, etc. larger than diameter required for removal for class of seeding to be carried out.

3.2 SEED PLACEMENT

- .1 For mechanical seeding:
 - .1 Mechanical landscape drill seeder ("Brillion" type or equivalent) which accurately places seed at specified depth and rate and rolls in single operation.
 - .2 Use equipment and method acceptable to Departmental Representative.
- .2 For manual seeding:
 - .1 Use manually operated drop seeder ("Cyclone" type or equivalent).
 - .2 Use manually operated, water ballast, landscaping type, smooth steel drum roller. Ballast as directed by Departmental Representative.
 - .3 Use equipment and method acceptable to Departmental Representative.

3.3 CLEAN UP

- .1 Remove all materials and other debris resulting from seeding operations from job site.

3.4 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Ensure maintenance is carried out under supervision of certified Landscape Maintenance Supervisor.
- .2 Perform following operations from time of seed application until acceptance by Departmental Representative:
 - .1 Water seeded area to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.
 - .2 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
 - .3 Cut grass to 50 mm whenever it reaches height of 70 mm. Remove clippings which will smother grass as directed by Departmental Representative.
 - .4 Fertilize seeded areas after [first] cutting in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.
 - .5 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.
 - .6 Adjust protection barrier as necessary to protect against deterioration due to pedestrian or other traffic as needed

3.5 FINAL ACCEPTANCE

- .1 Seeded areas will be accepted by Departmental Representative provided that:
 - .1 Areas are uniformly established free of rutted, eroded, bare or dead spots and extent of weeds apparent in grass is acceptable.
 - .2 Areas have been cut at least twice.
 - .3 Areas have been fertilized.

- .2 Areas seeded in fall will be accepted in following spring, one month after start of growing season provided acceptance conditions are fulfilled.

3.6 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period.
 - .1 Water seeded area to maintain optimum soil moisture level for continued growth of grass. Control watering to prevent washouts.
 - .2 Repair and reseed dead or bare spots to satisfaction of Departmental Representative.
 - .3 Cut grass to 50 mm whenever it reaches height of 70 mm. Remove clippings which will smother grass as directed by Departmental Representative.
 - .4 Fertilize seeded areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.
 - .5 Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- .1 Section 33 01 30.1 refers to those portion of the work that are unique to the requirements for inspecting new and existing sanitary, storm and combined sewer pipe and pipe culverts by closed circuit television. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 RELATED SECTIONS

- .1 Section 01 55 00 - Traffic Control, Vehicle Access and Parking
- .2 Section 33 40 01 – Storm Sewers
- .3 Section 33 44 01 – Manholes and Catchbasins
- .4 Section 33 01 30.2 – Cleaning of Sewers

1.3 SUBMISSION OF CERTIFICATION

- .1 Submit copy of the CCTV operator's current NASSCO certification certificate to the Departmental Representative at least one week prior to the start of the CCTV inspection operations.
- .2 Submit copy of certificate for each CCTV operator working on the contract.

1.4 WORK REGULATIONS

- .1 Work to conform to all applicable regulations of WorkSafe BC (WSBC). Confirm training compliance in the following:
 - .1 Confined space rescue
 - .2 Confined space entry
 - .3 Ventilation
 - .4 Atmospheric monitoring
 - .5 Self-contained breathing apparatus
 - .6 Personal protective equipment
- .2 Provide written confirmation to the Departmental Representative that workers have knowledge of confined space entry practices and of equipment required for confined space entry.

1.5 SCHEDULING OF WORK

- .1 Schedule work to minimize interruptions to existing services.
- .2 Maintain existing flow during inspection survey unless flow reduction measures required per 3.11 of this Section.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Survey Vehicle to contain a separate area for viewing, recording and controlling the CCTV operation.
 - .1 Viewing and control area to be insulated against noise and extremes in temperature. External and internal sources of light to be controlled to ensure the light does not impede the view of the monitor screen. Proper seating accommodation to be provided to enable one person in addition to the operator to clearly view the monitor screen.
 - .2 All equipment utilized within the pipeline to be stored outside the viewing, recording and control area.
 - .3 Vehicle to be equipped with a telephone for communication with the Departmental Representative for the duration of the work.
 - .4 Electrical power for the system to be self-contained. External power sources from public or private sources not permitted.
- .2 Survey Equipment to have sufficient cables to view the lengths of pipe as specified.
 - .1 Survey unit to be a self-propelled crawler type with a means of transporting the CCTV camera in a stable condition through the pipeline.
 - .2 Each unit to carry sufficient numbers of guides and rollers such that, when surveying, all cables are supported away from pipe and manhole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.
 - .3 Each unit to interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipeline condition and header reference location information.
- .3 Camera to be capable of producing high quality colour imagery and provide complete inspections and view of all laterals and deficiencies.
 - .1 Camera to be "Pan & Tilt" and have the capability of panning the pipe at 360 degrees with tilt capability of 275 degrees.
 - .2 Live picture to be visible with no interference and capable of registering a minimum number of 400 lines of resolution at the peripher.
 - .3 Focus and iris adjustment to allow optimum picture quality to be achieved and to be remotely adjusted. The adjustment of focus and iris shall provide a focal range from 150mm in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer.
 - .4 Camera to be waterproof with a self-contained lighting system capable of being remotely adjusted. Lights to provide an even distribution of light around the pipeline perimeter without the loss of contrast or flare out or picture shadowing.
- .4 Digital video playback to be of MPEG-2 standard.

2.2 MATERIALS

- .1 Digital video data storage to be compatible with the Owner's Record System devices.
- .2 Photographs to be colour, minimum image size 90mm x 70mm and stored as per clause 2.2.3.
- .3 Digital report data storage to be CD-R.

PART 3 EXECUTION

3.1 CCTV INSPECTION

- .1 CCTV operator to be certified by NASSCO.
- .2 Submit sample of inspection report, digital video on DVD-R and corresponding digital report on CD-R with the tender document for review. The review of these items will be part of the evaluation of the tender. Submission to satisfy all of the specifications contained herein and the accepted report submission will be used as a benchmark for subsequent inspection report submissions.
- .3 No inspection surveys to be carried out under this contract until an acceptable sample inspection report has been approved by the Departmental Representative.
- .4 Flow in the pipeline not to exceed approximately 1/3 of the pipe diameter. Notify Departmental Representative of excessive flows, video using flow reduction method per 3.11 of this Section.
- .5 Hemispherical head or fisheye lens type camera are not permitted.
- .6 Eliminate steaming and fogging encountered during the inspection survey by introducing forced air flow by means of fan.
- .7 Camera lens to remain free of grease or other deleterious matter to ensure optimal clarity.
- .8 Record all digital videos at MPEG-2 standard on DVD-R compatible with the Owner's Record System devices.
- .9 Set zero chainage at face of every manhole or on entrance into pipe or start of pipe culvert.
- .10 Report and record on full length of pipeline from inside face to inside face between manhole or outlet end of pipes and from one end of pipe culvert to the other.
- .11 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- .12 Data generator to electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following minimum information prior to the start of each run:
 - .1 Manhole (from-to) / pipe length reference numbers.
 - .2 Pipeline dimensions
 - .3 Pipe material (ie. vitrified clay, concrete, PVC etc.)
 - .4 Type or use of pipe (ie. sanitary, storm or combined sewer)
 - .5 Date of survey (yyyy.mm.dd)
 - .6 Road name/location

- .7 Direction of travel of survey equipment (U or D, Upstream or Downstream)
- .8 Inspection (report) number
- .9 Verbal description of all the above on screen information.
- .13 Data generator to continuously electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following minimum information during each run:
 - .1 Automatic update of the camera's metre reading position from adjusted zero.
 - .2 Manhole/pipe length reference numbers.
 - .3 Type or use of pipe (ie. sanitary, storm or combined sewer)
 - .4 The unique inspection/report number of the run.
 - .5 Display digital information such that it will not interfere with the video image on the screen.
- .14 Stop camera at each defect, change of condition of pipe and service connection to record defect in accordance with WRc codes.
- .15 Add WRc code overlay to digital video at defects or connections in addition to continuously displayed data.
- .16 Pan each service connection (junction) such that the camera looks down the centerline of the service, pause for a minimum of five (5) seconds and note condition of the joint and /or pipe/service interface.
- .17 Immediately notify Departmental Representative of any blockage or obstruction that will not allow passage of survey equipment.
- .18 Prior to restarting survey await instructions from Departmental Representative on removal of obstruction. Restart inspection survey from the opposite end of pipeline or culvert when blockage or obstruction is encountered unless directed by Departmental Representative.

3.2 RECORDING RESOLUTION

- .1 At the beginning of each OVO-R or when a substitute camera is introduced perform a recording resolution test with use of a Marconi or RETMA resolution chart.

3.3 SITE CODING SHEETS

- .1 Each pipeline length to be recorded according to the MSCC. Any variation from the manual to be noted in the survey report.
- .2 Standard coding form shown on page 14 of MSCC to be modified as follows:
 - .1 Line 2, field 8 (date) to be eight (8) characters in the format of yyyy.mm.dd (year, month, day).
 - .2 Condition detail number (video count) to be six (6) characters in the format of hh.mm.ss (hours, minutes, seconds).
 - .3 Note observations as to condition of service connections beyond mainline in remarks column using standard codes as per MSCC.

3.4 CAMERA POSITION

- .1 Position camera lens centrally in the pipeline with a positioning tolerance of '17'10% off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned 2/3 the height of the pipe measured from the invert.
- .2 Position camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.

3.5 CAMERA TRAVEL SPEED

- .1 Travelling speed of the camera in the pipeline to be as follows:
 - .1 0.1 m/s for pipeline of diameter less than 200 mm.
 - .2 0.15 m/s for diameters 200 mm and larger but not exceeding 310 mm: and
 - .3 0.20 m/s for diameters exceeding 310 mm.

3.6 CAMERA POSITION CHAINAGE DEVICE

- .1 Use a chainage device which enables the cable length to be accurately measured to indicate the location of the camera.
 - .1 Chainage information to be transmitted electronically to control area and displayed on the monitor.
 - .2 Chainage device to be accurate to within 0.3 m up to the first 50 m and within '17'1 % for lengths exceeding 50 m.
 - .3 Chainage tolerance to be checked at the start of contract and a minimum of once every two weeks there after or every 5000 m of pipeline inspected, whichever is greater.
 - .4 Provide audit form showing dates and distances checked to meet both tolerance requirements. Chainage linear measurement to be checked by use of a cable calibration device or tape or electronic measurement between fixed points.

3.7 PHOTOGRAPHS AND/OR DIGITAL IMAGES

- .1 Photograph all major defects as defined by condition codes: B, CC, CI, CM, CX, CX1, 0, FC, FI, FM, H, IR, IG, JDI, JDM, JX, OB, OJI, RM, RT, and X
- .2 Overlay on photographs the following data in alpha-numeric form such that it will not interfere with the defect condition reported:
 - .1 Report/job number
 - .2 Metre reading position (chainage)
 - .3 Manhole/pipe length reference numbers (from – to)
 - .4 Photograph number
 - .5 CSA condition defect code
 - .6 Date of survey (yyyy.mm.dd)
- .3 Capture photograph and alpha-numeric data as a digital image in a JPEG. File format with report reference number.
- .4 Co-ordinate photographs with the written report by reference number. Do not insert the photographs into the report.

3.8 INSPECTION REPORTING HARD COPIES & DIGITAL FORMAT

- .1 Submit reports to Departmental Representative within 10 working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.
- .2 Present machine printed (hard copy) and computer generated data base reports according to the MSCC format.
 - .1 Each binder to commence with an index of all survey inspection reports contained within.
 - .2 Hard copy reports to be presented in tabular form in accordance with WRC MSCC.
 - .3 Reports to be presented in sections or drainage areas and/or by pipeline type or as specified in the contract documents.
 - .4 Computer database file to contain identical survey report information as the printed report exclusive of photographs.
 - .5 Digital information to be presented in format approved by Departmental Representative.
 - .6 Provide CD-R of digital photographs. Disk to be labelled with photo and contract numbers.
 - .7 Include Owner supplied, scale drawings showing highlight inspected pipeline. Drawing to be attached to inspection condition report for each section of sewer pipeline surveyed.
- .3 Present report in 215 mm x 280 mm three ring (0 type) binder. DVD-R and case will not be incorporated into the binder.
- .4 Attach computer disks in three hole plastic diskette sheet holder in back of binder.
- .5 Attach identical identification labels on the three ring binder, DVD-R and CD-R.
- .6 Provide additional copies of printed report, if required as specified in contract documents.
- .7 All dimensions and chainages in the reports to be metric.
- .8 Each DVD-R to include a digital index of all inspection reports and observations with a digital link to the video survey.
- .9 Provide a copy or original of the digital video player software depending on what the software licensing requirements are. Attach the applicable licensing requirements if so required.

3.9 FLUSHING AND CLEANING

- .1 Flush and Clean pipelines to Section 33 01 30.2 – Cleaning of Sewers immediately prior to CCTV inspection survey, unless otherwise specified in the contract documents.

3.10 ROOF CUTTING & REMOVAL

- .1 Remove roots for condition codes RT and RM.

3.11 FLOW REDUCTION

- .1 Reduce flow in pipeline to approximately 1/3 pipe diameter to allow CCTV inspection by combination of the following:

- .2 Schedule work for off peak flow times.
- .3 Plug or block flow at upstream manhole.
 - .1 Plug designed to either plug all flow or impede flow to the approximate 1/3 pipe diameter.
 - .2 Obtain Departmental Representative's approval prior to plugging or impeding any flow.
 - .3 Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipeline.
- .4 Temporary bypass pump flow around inspection section when required, as specified in contract documents. Plug to be flow through with hoses and pump of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free. Flow to be pumped to downstream manhole on same system or run as inspection is to take place. Obtain Departmental Representative's approval prior to setting up temporary bypass pump system.

3.12 CODING ACCURACY

- .1 Coding accuracy to be a function of the number of defects or construction features not recorded (omissions) and the correctness of the coding and classification recorded. Coding accuracy to satisfy the following requirements:
 - .1 Header accuracy 95%
 - .2 Detail accuracy 85%
- .2 Contractor to implement a formal coding accuracy verification system at the onset of the work. Coding accuracy to be verified by the Contractor on a random basis on a minimum of 10% of the inspection reports. Departmental Representative to be entitled to review the accuracy verification system and results and be present when the assessments are being conducted.
- .3 A minimum of two accuracy verifications to be performed for each operator for each working week. Coding not satisfying the accuracy requirements to be recoded and the accuracy of the inspection report immediately proceeding and following the non compliant inspection to be verified. Process to be repeated until the proceeding and subsequent inspections meet accuracy requirements.
- .4 An operator failing to meet the accuracy requirements on two occasions will not be permitted to code on the remainder of the project until they have successfully passed the NASSCO Level of Qualification for CSA Operators.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- .1 Section 33 01 30.2 refers to those portions of the work that are unique to sanitary sewer and storm sewer cleaning. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 All details of sewer cleaning operations not specifically covered in this Section to comply with WorkSafe BC regulations and discharge regulations and/or manuals of practice specified by the municipality.

1.2 RELATED SECTIONS

- .1 Section 01 55 00 - Traffic Control, Vehicle Access and Parking
- .2 Section 33 40 01 - Storm Sewers
- .3 Section 33 44 01 - Manholes and Catchbasins
- .4 Section 33 01 30.1 - CCTV Inspection of Pipelines

1.3 WORK REGULATIONS

- .1 Work to conform to all applicable regulations of WorkSafe BC. Confirm training compliance in the following:
 - .1 Confined space rescue
 - .2 Confined space entry
 - .3 Ventilation
 - .4 Atmospheric monitoring
 - .5 Self-contained breathing apparatus
 - .6 Personal protective equipment

1.4 SCHEDULING OF WORK

- .1 Schedule work to minimize interruptions to existing services.
- .2 Maintain existing flow during sewer cleaning and debris removal unless directed otherwise in contract document.
- .3 Notify Departmental Representative of the location of cleaning one day before start of work.
- .4 Deliver notices specified by Departmental Representative to buildings affected by the work prior to start of work.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 High velocity cleaning equipment to be capable of providing a minimum flow of 4.0 litres per second at 13,800 kPa. A 30 degree bullet cleaning nozzle at 4.5 l/s is to be hydraulically or hydro-dynamically propelled. The equipment to include a water tank, pumps and hydraulically driven hose reel. Equipment to include a wash down gun for cleaning manholes and an approved back flow preventing device for water tank filling.
- .2 Debris removal equipment to consist of a vacuum pump complete with positive displacement pumps or fans producing a minimum of 700 l/s air movement. Equipment to be capable of removing debris at a minimum of 4.5 metres vertical head. Suction hose to be a minimum of 150 mm diameter. Debris tank to be water tight and capable of returning the liquid portion of the debris to the sewer.
- .3 Debris cutting equipment to be an accessory or attachment to hydraulic cleaning equipment. Equipment to be capable of removing heavy roots and solid debris such as encrustation and grease.
- .4 Intruding Sewer service pipe removal equipment to include remote controlled hydraulically driven cutters and reamers and remotely controlled routers or grinders capable of cutting back intruding sewer service pipes.
- .5 Sewer plugs to be designed to stop and/or reduce flow from upstream sewer. Sewer plugs to be equipped with a tethering mechanism to allow for securing during the flow reduction operation and their subsequent removal.

PART 3 EXECUTION

3.1 SEWER CLEANING

- .1 Clean all pipelines as specified in contract documents.
 - .1 Remove grease deposits to 25mm of pipe wall.
 - .2 Scour manhole walls and benching before cleaning downstream sewers.
 - .3 Begin cleaning from the upstream sewer in the system and proceed downstream. Under no circumstances should cleaning proceed downstream until all contributing upstream sewers have been cleaned.
 - .4 Sewers to be cleaned in the direction of flow.
- .2 Remove debris by vacuum pumping at manhole. Do not pass debris from manhole to manhole.
- .3 Dispose of debris at approved dump site, or location as specified in contract documents. Return decanted or dewatered liquid to the sewer of origin.
- .4 Advise Departmental Representative immediately if pipe material or backfill is observed during cleaning operations.

3.2 WATER SUPPLY

- .1 Water may be supplied from Municipal service at the site..

3.3 ROOT REMOVAL

- .1 Obtain Departmental Representative's approval prior to undertaking any root cutting.
- .2 Run root cutter through entire section of pipeline from manhole to manhole or end of pipe to end of pipe.
- .3 Use root cutter head appropriately sized for the diameter of the pipeline.

3.4 SEWER FLUSHING

- .1 Remove foreign material from pipeline and related appurtenances by flushing with water. Flush main at water velocities as high as can be obtained from available water sources. Minimum velocity to be 0.8 m/s and/or in accordance with AWWA C651. Continue flushing at least until flow from most distant point has reached discharge point and until water discharged is clean and clear.
- .2 Obtain municipal approval prior to discharging flushing water to municipal sewers or drainage ditches.
- .3 Provide Departmental Representative with all required approvals prior to discharging flushing water.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 31 23 10 - Excavating, Trenching and Backfilling
- .3 Section 33 41 00 - Storm Utility Drainage Piping

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 48/A 48M, Standard Specification for Gray Iron Castings.
 - .2 ASTM A 123/A 123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM C 117, Standard Test Method for Materials Finer than 75- μ m Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM C 139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .6 ASTM C 478M, Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - .7 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1, 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, 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).
 - .3 CAN/CSA-A165, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .4 CAN/CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement.

1.3 SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Concrete:
 - .1 to Section 03 30 02 - Cast-In-Place Concrete.
 - .2 concrete to be minimum 20 MPa or as specified otherwise on Contract Drawings.
- .2 Concrete reinforcement: to Section 03 20 02 - Concrete Reinforcing.
- .3 Precast manhole sections: to ASTM C 478M, complete with ladder rungs.
- .4 Precast "Tee" Sections: precast "Tee" sections constructed as an integral component of mainline pipe will be acceptable where shown on Contract Drawings as an approved alternative.
- .5 Manhole lids: to be precast reinforced concrete designed to withstand H20 loading.
- .6 Cast iron frame and cover: as shown on Contract Drawings.
 - .1 Frame and cover must conform to ASTM A48 and be designed to withstand H20 loading.
 - .2 Frame and cover must bear manufacturer identification on castings.
- .7 Ladder runs to be:
 - .1 As shown on Contract Drawings.
 - .2 To conform to ASTM C-497, C-478 load test
 - .3 20 mm cold rolled steel, hot dipped after bending to CSA G164, welded to reinforcing bars and cast with manhole sections or epoxy grouted into manhole walls.
 - .4 20 mm aluminum alloy #6351-T6 (CSA-S157 and NBC 1977), complete with polyethylene anchor insulating sleeves and installed in 25 mm or 26 mm precast or drilled holes in manhole sections.
 - .5 Polypropylene encased steel ladder rungs: polypropylene ASTM-D-4101 steel core to be ½ inch dia grade 60 per ASTM A615M.
 - .6 Distance from top of manhole cover to top rung to be maximum 500 mm where no handhold provided. Maximum distance may be extended to 660 mm where handhold provided.
 - .7 In compliance with all requirements of Workers' Compensation Board.
- .8 Safety platform: to be installed as shown on Contract Drawings in all manholes in excess of 6 m deep.
- .9 Precast catch basin sections: to ASTM C478M.
- .10 Catchbasin leads to be minimum 200 mm diameter and of PVC DR35.
- .11 Catchbasin lids: to be precast reinforced concrete designed to withstand H20 loading.
- .12 Cast iron catchbasin frame and grate: as shown on Contract Drawings.
 - .1 Frame and grate must conform to ASTM A48 and be designed to withstand H20 loading.

- .2 Frame and grate must bear manufacturers identification on casting.
- .13 Joints: made watertight using rubber rings to ASTM C443 or cement mortar.
- .14 Mortar:
 - .1 Aggregate: to CSA A82.56.
 - .2 Masonry Cement: to CAN/CSA-A8.
- .15 Adjusting rings: to ASTM C 478.
- .16 Concrete Brick: to CAN3-A165 Series.
- .17 Drop manhole pipe: to be as shown on Contract Drawings.
- .18 Lawn drains to be: as shown on Contract Drawings.
- .19 Concrete bags to be: Jute, burlap or synthetic bag of suitable size and texture filled to 2/3 capacity with mixture of 1 part Portland cement to 2 parts sand, thoroughly mixed, and weighing approximately 27 kg.
- .20 Concrete blocks: to be H type concrete construction blocks conforming to latest ASTM Specifications.
- .21 Prebenched manhole bases:
 - .1 Where precast manhole sections are incorporated into precast base by bonding to concrete benching, use precast reinforced concrete manhole sections to ASTM C478 complete with ladder rungs above benching.
 - .2 Where base benching is cast monolithically with manhole walls, reinforce wall and joint sections as specified in ASTM C478.
 - .3 Precast concrete base section minimum thickness to be 120 mm, measured from underside of base to lowest point in concrete channeling.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

- .1 Excavating and backfilling in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

3.2 CONCRETE WORK

- .1 Place concrete reinforcement in accordance with Section 03 20 02 - Concrete Reinforcing.
- .2 Do concrete work in accordance with Section 03 30 02 - Cast-In-Place Concrete.

3.3 MANHOLE INSTALLATION

- .1 Install manholes as shown on Contract Drawings, concurrently with pipe laying.
- .2 Ensure excavation free of water prior to placing concrete.
- .3 Place minimum 100mm of 25mm bedding gravel compacted to minimum 95% Modified Proctor density in compliance with ASTM D1557.
- .4 Construct base to ensure first precast riser section is set plumb.

- .5 Set all inlet and outlet pipes to specified alignments and elevations.
- .6 Connect concrete pipe into manhole using spigot or bell precast into manhole wall or, alternatively, grout pipe into pre-formed rough core in manhole wall using fast-setting grout.
- .7 Connect PVC pipe into manhole using "manhole adapter ring" or approved equal.
- .8 Ensure placement of concrete does not disturb connecting pipes.
- .9 Set remaining precast riser sections plumb with joints consisting of cement mortar or gaskets to ASTM C443.
- .10 Where possible, for channeling using half-sections of pipe or suitable fittings. Bench to direct flow parallel to main flow of sewer. From top of benching as high as crown of sewer pipe. Finish concrete to smooth surface using steel trowel.
- .11 Brace capped inlets or stubs to withstand testing head.
- .12 Set frames by firmly embedding in mortar on minimum of 1, maximum of 3 courses of bricks or precast concrete riser rings, or cast-in-place form system with due regard to maximum distance to first step.
- .13 "Butter" inside and outside faces of bricks with mortar to ensure neat even finish. Grout inside, outside and between courses of bricks or grade rings with mortar to ensure neat even finish. Pre-wet all joints before placing mortar.
- .14 Plug lifting holes in pipe.
- .15 Install drop structures where required to Contract Drawings.
- .16 Paint manhole covers if specified on Contract Drawings.
- .17 Ensure frames conform to design contour of pavement or existing surface.
- .18 Pre-fabricated Corrugated Steel Pipe Manholes to be installed as shown on the Contract Drawings and to manufacturer's specifications.

3.4 CLEANOUT INSTALLATION

- .1 Install cleanouts as shown on Contract Drawings, to standards and installation procedures described in 3.3.

3.5 CATCHBASIN INSTALLATION

- .1 Install catchbasins as Shown on Contract Drawings, to general standards and installation procedures described in 3.3.
- .2 Place minimum of 100 mm bedding gravel under base, compact to 95% Modified Proctor density.
- .3 Install catchbasin leads in accordance with Section 33 41 00 - Storm Utility Drainage Piping.

3.6 LAWN DRAIN INSTALLATION

- .1 Install lawn drains as shown on Contract Drawings.

3.7 ENDWALL INSTALLATION

- .1 Install reinforced concrete endwalls as shown on Contract Drawings or as shown otherwise on Contract Drawings and in accordance with Section 03 20 02 - Concrete Reinforcing and Section 03 30 02 - Cast-In-Place Concrete.
- .2 Precast concrete endwalls may be installed where shown on Contract Drawings as an approved alternative.

3.8 GRILLAGE TRASH SCREENS

- .1 Where specified, install grillage trash screens as shown on Contract Drawings.

3.9 ADJUSTING TOPS OF EXISTING UNITS

- .1 Remove existing gratings, frames and store for re-use at locations specified.
- .2 Precut units:
 - .1 Raise or lower precast units by adding or removing precast sections as required.
 - .2 When amount of raise is less than 300 mm use standard manhole bricks, precast riser rings or Cast-in place form system.
- .3 Cast-in-Place units:
 - .1 Raise cast-in-place units by roughening existing top to ensure proper bond and extend to required elevation with cast-in-place concrete.
 - .2 Lower cast-in-place units with straight wall by removing concrete to elevation indicated for rebuilding.
 - .3 Install additional manhole ladder rungs in adjusted portion of units as required.
 - .4 Re-use existing gratings, frames.
- .4 Re-set gratings and frames to required elevation on not more than 3 courses of brick. Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.
- .5 Ensure adjustments conform to requirements regarding distance to first step.

3.10 REMOVE EXISTING UNITS

- .1 Remove existing structures where shown on Contract Drawings. Backfill in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling

3.11 LEAKAGE TEST

- .1 Perform leakage testing of sanitary manholes in accordance with Section 33 31 13 - Public Sanitary Utility Sewerage Piping.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for storm sewer.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 03 30 02 - Cast-in-Place Concrete
- .3 Section 31 05 16 - Aggregate Materials
- .4 Section 31 23 10 - Excavating, Trenching and Backfilling
- .5 Section 33 05 13 - Manholes and Catchbasin Structures

1.3 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 14M, Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
 - .2 ASTM C 76M, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
 - .3 ASTM C 117, Standard Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C 136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM C 443M, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .6 ASTM C 506M, Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.
 - .7 ASTM C 507M, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe (Metric).
 - .8 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
 - .9 ASTM D 1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - .10 ASTM D 2680, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - .11 ASTM D 3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .12 ASTM F 405, Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.
 - .13 ASTM F 667, Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings.

- .14 ASTM F 794, 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 CAN/CGSB-34.9, Asbestos-Cement Sewer Pipe.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000, Cementitious Materials Compendium
 - .2 CAN/CSA-A257 Series, Standards for Concrete Pipe.
 - .3 CSA B1800, Thermoplastic Non-pressure Pipe Compendium – B1800 Series.
 - .4 CSA-G401, Corrugated Steel Pipe Products.

1.4 MATERIAL CERTIFICATION

- .1 Submit shop drawings in accordance with Section 01 33 01 - Submittal Procedures.
- .2 Products having CSA certification to be used where readily available. Certification by Standards Council of Canada approved independent third body that products conform to CSA standards in acceptable in lieu of CSA certification.
- .3 At least 2 weeks prior to commencing work, submit manufacturer's recent test data and certification that materials to be incorporated into works are representative and meet requirements of this Section. Include manufacturer's drawings where pertinent.

1.5 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services. Maintain existing flow during construction.
- .2 Submit schedule of expected interruptions to Departmental Representative for approval and adhere to interruption schedule as approved by Departmental Representative.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.
- .3 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.
- .4 Handle and dispose of hazardous materials in accordance with the Regional and Municipal regulations.
- .5 Dispose of unused asbestos cement pipe in accordance with regulations governing the disposal of hazardous materials.
- .6 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 CONCRETE PIPE

- .1 Non-reinforced circular concrete pipe and fittings: to ASTM C 14M maximum diameter 900 mm, strength class as shown on Contract Drawings, designed for flexible rubber gasket joints to ASTM C443M.
- .2 Reinforced circular concrete pipe and fittings: to ASTM C76M for all pipe greater than 900 mm diameter, strength class as shown on Contract Drawings, 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: engineered lift insert systems designed for the weight of the pipe cast into the pipe walls during manufacture. Not to exceed two in each piece of pipe.
 - .3 Manufacturer to provide properly rated lifting clutches to be used with lift insert cast into pipe.
 - .4 Lift insert opening not required to be grouted provided it does not extend beyond the depth of the engineered design.
 - .5 At request of Departmental Representative, manufacturer shall supply design information confirming suitability of lift insert system used.

2.2 CORRUGATED STEEL PIPE

- .1 Corrugated steel pipe and couplers: to CSA-G401.
 - .1 Gaskets: to ASTM D 1056.

2.3 PLASTIC PIPE, MAINLINE SMOOTH PROFILE AND PERFORATED DRAIN TILE

- .1 Polyvinyl chloride pipe up to 1200mm in diameter, DR35. Pipe to have minimum pipe stiffness (F/Y) of 320 kPa at 5.0% deflection, ASTM D2412. Pipe to be manufactured to specification for pipe size ranges as follows:
 - .1 100mm dia. – 375mm dia. to ASTM D3034
 - .2 450mm dia. – 1200mm dia. to ASTM F679.
- .2 Pipes to be certified by Canadian Standards Association to standards for pipe size ranges below.
 - .1 100mm dia. – 1200mm dia. to CSA B182.2
- .3 Joint: Pipe to include integral bell and spigot ends with stiffened wall section and formed groove for a rubber gasket; joints to conform to ASTM D3212, elastomeric gaskets to ASTM F477.
 - .1 Pipe joints to withstand minimum hydrostatic pressure of 345kPa without leakage.
 - .2 Pipe joints in pipes with pipe stiffness less than 320kPa to withstand 550kPa.

- .4 Normal pipe length joint to joint to be 4.0 m.
- .5 Maximum installed short term deflection not to exceed 5.0% of the base inside diameter

2.4 SERVICE CONNECTIONS

- .1 Storm sewer service connections to be 100mm minimum diameter; maximum diameter as specified on Contract Drawings.
- .2 Storm sewer service connections 100mm and 150mm diameter to be PVC type DR28 sewer pipe.
- .3 100mm and 150mm DR28 PVC storm service connection pipe to have a minimum pipe stiffness of 625kPa. Pipe to be manufactured to ASTM D3034 and certified by Canadian Standards Association to CSA B182.2
- .4 Storm sewer service connections greater than 150mm diameter to be of size and material specified on Contract Drawings and to conform to applicable specifications for mainline pipe.
- .5 Manufactured connections to non-reinforced or reinforced concrete mainline pipe to be made using sanded PVC pipe male end stub with integral bell by either:
 - .1 Stub grouted into neatly chipped hole in pipe wall by concrete pipe manufacturer. Grout to be Portland cement based grout.
 - .2 Stub epoxy resin cemented into neatly cored hole in pipe wall by concrete pipe manufacturer.
- .6 Stub and bell orientation to be 45° to centerline of mainline pipe (wyes) for concrete pipe less than 1050mm diameter. Orientation may be 90° to centerline of mainline pipe (tees) for concrete pipe 1050mm diameter or larger. No section of service stubs to protrude past inside of concrete pipe wall.
- .7 Manufactured wye connections to PVC mainline pipe to be made with extrusion moulded PVC or fabricated PVC fittings manufactured to ASTM D3034 and CSA B182.2
- .8 Field installed tees and wyes:
 - .1 In-situ installation of tees and wyes into concrete or PVC mainline pipe shall be made with approved PVC swaddle installed to the manufacturer's specifications into a neatly cored hole in the pipe wall.
 - .2 Connections to ribbed PVC pipe to be made with a preformed tee and wye fitting when connection is up to two sizes smaller than mainline pipe. For these pipes, in-situ installation of tees or wyes involving cutting across pipe ribs not permitted. For connections more than two sizes smaller than mainline pipe, an insertable tee for ribbed PVC pipe is permitted. When an insertable is used, hole cut into mainline pipe to cut as few ribs as possible.
- .9 PVC service connection pipe and fitting joints: push-on type comprised of integral bell with single elastomeric gasket to ASTM D3212 and ASTM F477. Normal pipe laying length joint to joint to be 4.0m.
- .10 Pipe and fitting joints for service connection pipe materials other than PVC type PSM sewer pipe to be as specified for applicable mainline pipe

2.5 CONCRETE

- .1 Concrete mixes and materials required for bedding cradles, encasement, and incidental uses: to Section 03 30 02 - Cast-in-Place Concrete.
- .2 Concrete to be minimum 20 MPa.

2.6 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 Section 03 30 02 - Cast-in-Place Concrete

2.7 BACKFILL MATERIAL

- .1 As shown on Contract Drawings.
- .2 In accordance with Section 31 05 16 - Aggregate Materials.

PART 3 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 as shown on Contract Drawings.

3.3 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete Work in accordance with Section 03 30 02 - Cast-in-Place Concrete. Place concrete to details as indicated.
- .2 Position pipe on concrete blocks to facilitate placing of concrete.
- .3 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .4 Do not backfill over concrete within 24 h after placing.

3.4 GRANULAR BEDDING

- .1 Fill over-excavation below design elevation of bottom of specified bedding with granular bedding placed and compacted. Drain rock may be used for backfill of over-excavation only with Departmental Representative's approval.
- .2 Place granular bedding material across full width of trench bottom in uniform layers not exceeding 150mm compacted thickness to depth as shown on Contract Drawings.
- .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. (All following references to density imply in compliance with ASTM D1557).

3.5 INSTALLATION

- .1 Handle pipe in accordance with manufacturer's recommendations.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .2 Lay and join pipes to manufacturer's instructions and specifications except as noted otherwise herein. Concrete pipe as specified herein, PVC pipe to CSA B182.11, Steel Spiral Rip Pipe to CAN3-G401.
- .3 Horizontal tolerances: ± 50 mm from specified alignment
Vertical tolerances: ± 10 mm from specified grade. Reverse grade is not acceptable:
- .4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Pipes on curved alignments:
 - .1 For Concrete, PVC, profile PVC and open profile HDPE pipe do not exceed permissible joint deflection recommend by pipe manufacturer.
 - .2 Smooth profile PVC pipe: for 100 mm to 300 mm sizes conform to required curvature by bending pipe barrel. In no case shall radius of curvature to be less than 300 times outside diameter of pipe barrel.
- .7 Keep jointing materials and installed pipe free of dirt, water and other foreign materials. Do not allow water to flow through pipes during construction except as may be permitted by Departmental Representative.
- .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Cut pipes as required, as recommended by pipe manufacturer, without damaging pipe and leave smooth end at right angles to axis of pipe.
- .10 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.
- .11 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as specified otherwise.
- .12 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.
- .13 Plug lifting holes with approved prefabricated plugs, to pipe supplier's recommendations for sealing methods.
- .14 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
 - .2 Core neat circular holes in walls of existing manholes. Do not hammer or chip except as approved by Departmental Representative.

3.6 PIPE SURROUND

- .1 Upon completion of pipe laying, and after Departmental Representative has inspected work in place, surround and cover pipes as shown on Contract Drawings.
- .2 Hand place surround material in uniform layers not exceeding 150mm compacted thickness simultaneously on each side of pipe. Do not dump material within 1 m of pipe.
- .3 Compact each layer from pipe invert to underside of backfill to minimum 95% Modified Proctor Density.

3.7 CONNECTIONS TO EXISTING MAINLINE PIPES

- .1 Use prefabricated saddles or approved field connection materials and techniques to connect service pipes to existing mainline sewer pipe.
- .2 Where feasible, make connections to existing non-reinforced or reinforced concrete mainline pipe by coring or sawing circular holes in existing pipe walls. Where not feasible, make as follows:
 - .1 Break in to pipe by drilling small diameter holes, spaced at approximately 50 mm along pipe axis, using a drill or chipping gun. Use hammer to strike concrete adjacent to centre holes to create small core, and similarly expand core to suit outside dimensions of stub.
 - .2 Core dimensions to allow maximum 20 mm clearance around stub at any point.
 - .3 Trim stub to conform closely to shape of pipe interior when installed.
 - .4 Insert stub into core, ensuring that no portion of stub protrudes beyond interior of pipe.
 - .5 Prepare non-shrink, fast-setting cementitious grout to "dry pack" consistency. Pack grout tightly into void between stub and pipe.
 - .6 Hand finish interior and exterior grout surfaces to smooth surface.
 - .7 Allow sufficient time for strength development of grout prior to installation of connecting pipe or trench backfill.

- .3 For new connections to existing PVC mainline sewers, drill hole in mainline to exact dimension of new connection. Use saddle or insertable tee for connections more than two sizes smaller than mainline. Insertable tees may be used for all types of gravity mains provided insertable tee designed for applicable pipe thickness is used.
- .4 For new connections to existing ribbed PVC pipe mainline sewers use performed tee or wye fitting when connection is up to two sizes smaller than mainline pipe. For these pipes, in-situ installation of tees or wyes involving cutting across pipe ribs not permitted. For connections more than two sizes smaller than mainline pipe, an insertable tee for ribbed PVC pipe is permitted. When an insertable tee is used, hole cut into mainline pipe to cut as few ribs as possible.

3.8 BACKFILL

- .1 Place backfill in accordance with Section 31 23 10 – Excavating, Trenching and Backfilling.
- .2 Backfill requirements, including type of material and compaction requirements, as shown on Contract Drawings.
- .3 Under paving and walks, compact backfill to at least 95% Modified Proctor Density.

3.9 SERVICE CONNECTIONS

- .1 Install service connections to 3.5 and as shown on Contract Drawings.
- .2 Install inspection chamber at specified location set plumb and to specified elevation. If inspection chamber located in driveway, lane or paved surface install cover or lid as shown on Contract Drawings.
- .3 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 40 x 90 mm stake extending from pipe end at pipe level to 0.6 m above grade.
 - .2 Paint exposed portion of stake green with designation STM SWR LINE in black.
- .4 Sawcut adjacent curb on alignment of service connection and paint green.

3.10 CLEANING AND FLUSHING

- .1 Before flushing and testing, ensure sewer system is completely finished and make arrangements with Departmental Representative for scheduling of testing.
- .2 Water may be supplied from Departmental fire hydrants upon application for a Hydrant Use Permit.
- .3 Obtain Departmental approval prior to discharging flushing water to sewers or drainage ditches.
- .4 Comply Section 01 35 44 - Environmental Procedures in regard to discharge of flushing water.
- .5 Provide Departmental Representative with all required approvals prior to discharging flushing water.

- .6 Remove foreign material from pipe and related appurtenances by flushing with water. Main to be flushed at water velocities as high as can be obtained from available water sources. Continue flushing at least until flow from most distant point has reached discharge point and until water discharged is clean and clear.

3.11 VIDEO INSPECTION

- .1 The Contractor shall video inspect completed storm sewers under 900 mm in diameter following completion of installation. The video inspection report shall be in the form specified by the Departmental Representative. Copies of the video tapes and written report shall be forwarded to the Departmental Representative when available.
- .2 Should video inspection indicate apparent deficiencies, Departmental Representative may direct Contractor to perform additional testing as follows.
- .3 Additional testing may include passing rubber ball, mandrel or test plug having a minimum dimension of 95% of diameter of sewer pipe completely through pipes and appurtenances. A light test may be performed in lieu of ball test at discretion of Departmental Representative.

3.12 INSTALLATION STANDARD

- .1 Repair all deficiencies and visible leaks.
- .2 Repair procedures and materials subject to approval of Departmental Representative.
- .3 Departmental Representative reserves right to require Contractor to replace defective installations at Contractor's sole cost.
- .4 Test Procedures, including video inspection, to be repeated and repairs made until satisfactory results are obtained.
- .5 Acceptable Ponding:
 - .1 Connections: 10mm maximum ponding over 4m length of pipeline.
 - .2 Mainline Plastic sewers:
 - .1 300mm diameter or less: 20mm maximum ponding over 4m length of pipe
 - .2 Greater than 300mm diameter: 30mm ponding over 4m length of pipeline.
 - .3 Mainline Concrete sewers:
 - .1 300mm diameter: 20mm maximum ponding over a 5m length of pipeline
 - .2 Greater than 300mm diameter: 30mm maximum ponding over a 5m length of pipeline.

3.13 CONNECTIONS TO EXISTING MAINS

- .1 Make connections to existing storm sewer systems unless shown otherwise on Contract Drawings. Notify Departmental Representative minimum 48 h in advance of scheduled connection.
- .2 Make connection in presence of Departmental Representative. To prevent damage to existing utilities, excavate last 300 mm over utility by hand.

3.14 PERFORATED DRAIN PIPE

- .1 Where shown on Contract Drawings or where directed by Departmental Representative install perforated drain pipe adjacent to sidewalk or curb and gutter.
- .2 Drain pipe to be 100 mm minimum.
- .3 Connect to catchbasins.
- .4 Install other perforated drain pipes as shown on Contract Drawings.
- .5 Install sweep bend and cap at ground grade at upstream end of run.
- .6 Install with perforations downward.

END OF SECTION

APPENDIX A

Sue Hum-Hortley

Director General
Patrimoine canadien et
Canadian Heritage and Parks Canada
Operations Branch

Directrice générale
Services de TPSCC pour
Patrimoine canadien et Parks Canada
Direction des opérations

Heritage Conservation Services

Client Services Team for
Canadian Heritage and Parks Canada
(CST for CH/PC)
Operations Branch

**Services de la
conservation du patrimoine**

Équipe de service à la clientèle pour
Patrimoine canadien et Parks Canada (ESC
pour CH/PC)
Direction générale des opérations

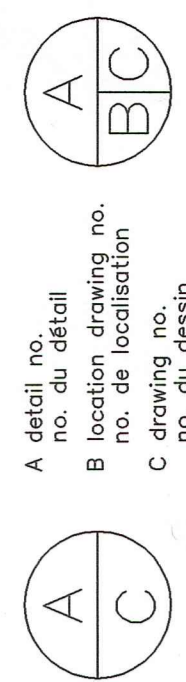
NOTES:

-SITE PLAN PRODUCED AND
PROVIDED BY BRAD CUNNING LAND
SURVEYING.

-AS BUILT IRRIGATION AND
DRAINAGE INFORMATION OBTAINED FROM
PLANS PROVIDED BY
MICHAEL BOCKING LANDSCAPE
ARCHITECT LIMITED (DEC.27,2002)

**KEY PLAN
PLAN-REFÈRE**

| | | |
|----------|---------------------|--------------|
| 05 | RECORD DRAWING | 31 MAR. 2004 |
| 04 | FOR IMPLEMENTATION | JAN. 2004 |
| 03 | FINAL | MAR. 2003 |
| 02 | FOR VAC REVIEW | FEB. 2003 |
| 01 | FOR SITE/ACP REVIEW | JAN. 2003 |
| revision | | date |



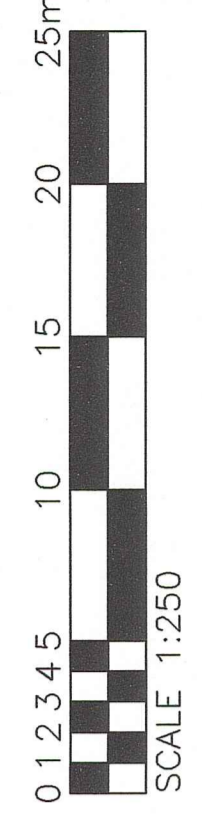
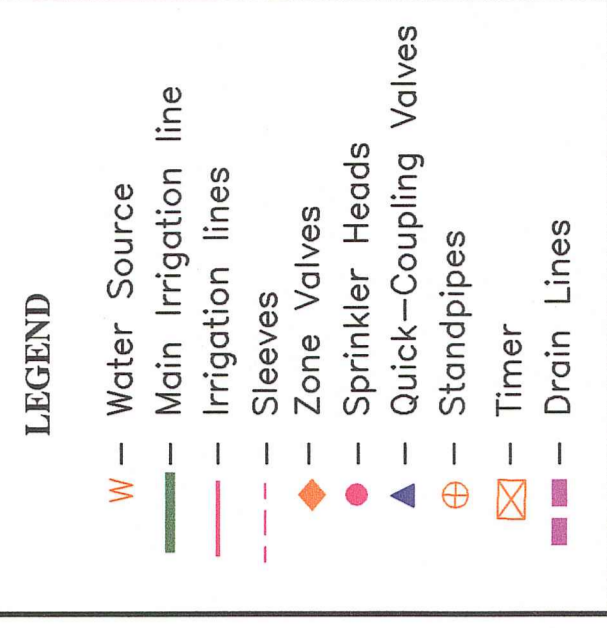
project
**VETERANS' CEMETERY
NATIONAL HISTORIC
SITE OF CANADA**

ESQUIMALT, BRITISH COLUMBIA

**SUCCESSION
PLANTING PLAN
RECORD DRAWING**

| | | |
|----------|-----------------|----------|
| designed | J. ZVONAR | confir |
| date | JANUARY 2003 | |
| drawn | C. CHANDLER | dessiné |
| date | JANUARY 2003 | |
| revised | J. LATREVOUILLE | révisé |
| date | JANUARY 2003 | |
| approved | | approuvé |
| date | | |
| checked | | vérifié |
| date | | |

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|-----------------|------------------------------|
| Project Manager | Administrateur de projet JPC |
| Project no. | 457731 |
| no. du projet | |
| no. de dessin | L-1 of/de 1 |



| Symbol | Botanical Name | Common Name | Quantity | Size |
|--------|--|-------------------------|----------|----------------|
| CD | Coniferous Trees (42) <i>Cedrus deodara</i> | Deodar (Himalaya) Cedar | 1 | 150-175 cm lit |
| CL | <i>C. libani 'pendula'</i> | Weeping Falsecypress | 1 | 150-175 cm lit |
| CN | <i>Chamaecyparis nootkatensis</i> | Yellow Cypress (Cedar) | 1 | 150-175 cm lit |
| PA | <i>Picea abies (excelsa)</i> | Norway Spruce | 4 | 150-175 cm lit |
| PM | <i>Pseudotsuga menziesii</i> | Douglas-fir | 9 | 150-175 cm lit |
| TB | <i>Taxus hicksii</i> | Hick's Yew | 7 | 150-175 cm lit |
| TH | <i>Thuja heterophylla</i> | Western Hemlock | 8 | 150-175 cm lit |
| TP | <i>Thuja plicata</i> | Western Redcedar | 11 | 150-175 cm lit |
| AR | Deciduous Trees (62) <i>Alnus nra</i> | Red Alder | 1 | 175-200 cm lit |
| BP | <i>Betula papyrifera</i> | Paper Birch | 3 | Existing |
| CW | <i>Cornus mitis</i> 'White Wonder' | White Wonder Dogwood | 15 | 175-200 cm lit |
| P | <i>Prunus vedensis 'Alicorno'</i> | Alicorno Cherry | 11 | 175-200 cm lit |
| QG | <i>Quercus garryana</i> | Garry Oak | 2 | 30 cm lit |

SUCCESSION PLANTING PLAN
SCALE 1:1250

APPENDIX B

LANDSCAPE & SITE IMPROVEMENTS

VETERANS CEMETERY ESQUIMALT, B.C.



Michael Bocking Landscape Architect Ltd.

March 29, 1999

Landscape & Site Improvements

Veterans Cemetery Esquimalt, B.C.

OUTLINE

1. Background
2. Site Analysis
3. Issues and Options
4. Proposed Plan

APPENDICES

- A. Cost Estimate
- B. Photographs
- C. Arborists Report

1. BACKGROUND

The Veterans Cemetery is situated on a 2.5 acre site. The cemetery was consecrated on July 14, 1868, with the first burial being made the following year. In 1927, the Gorge Vale Golf Course purchased the surrounding 150 acres. The golf course members are very respectful. In 1947, the Department of Veterans Affairs took over the responsibility for the cemetery.

The cemetery is frequently visited by families and friends who seek an opportunity to connect with their loved ones. The tranquil environment reinforces the contemplative and holistic nature of a cemetery as a place to grieve, to remember, and to heal. The renovation of the cemetery must be sensitive to the needs to these people and to the protocol of the armed forces.

Annual services are held in the cemetery to honour fallen soldiers. The cemetery is in active use with new burials occurring on a regular basis. There is a current and growing program bringing school children to learn more about the role of the armed forces and the sacrifices that have been made in the past.

2. SITE ANALYSIS

Several visits to the cemetery were made in February and March, 1999. During that time, extensive areas of wet ground surface conditions were observed and mapped (see Drawing L-1.) The total area of wet ground includes approximately 1/3 of the site, with the largest area in the lowest part of the cemetery and another smaller area above the chapel. While the winter of 1998/99 was 50% wetter than normal, staff advise that wet ground conditions typically occur from November to March each year, making access for visitors and maintenance of the site difficult. Drains carry runoff water from the adjacent golf course along the southern, western, and northern edges of the cemetery. Water was observed running in these drains in March. There are remnants of old drain pipes in the lower cemetery area which appear to discharge into the golf course drain system. However, no plans of a cemetery drain system exist.

Six test pits were dug to determine the soil characteristics in different parts of the cemetery. The upper (western part of the site contained a 12" to 14" layer of silty or sandy loam underlain by a 4" to 5" layer of cobbled gravel. Below this, a compact clay layer was found. Soils in the lower part of the site were silty loam over clay, with no gravel layer. Wet surface conditions coincided with areas of silty loam over clay. It is believed that clay forms an impervious layer to water penetration, during the winter wet season, and that the dense silt loam soil traps water in the surface layer until dry weather conditions return. Tree roots are generally confined to the surface layer of soil and do not penetrate the clay layer.

There has been a history of storm damage to trees in the cemetery, resulting in the loss of large conifers primarily in the lower part of the site. Two incidents in the 1990s have been photographically documented. In both cases, trees were uprooted during winter storms. The most severe storms experienced in Victoria typically come from the southeast, and to a lesser extent from the southwest. Tree uprooting is related to the above-ground mass of large conifers and shall roots in water-saturated soil, combined with high exposure to winds from the south and west. Some thinning of remaining conifers has reduced their vulnerability to wind damage. Recommendations for future tree stabilization are contained the arborist's report in Appendix B.

The largest concentration of trees is in the central part of the cemetery, creating year-round shade in those areas and sun in the remaining areas of the site. The lack of trees in the southeastern corner of the site results in poor definition of the cemetery boundary and visual impact from a nearby residential area.

Access to the cemetery is across a fairway of the Gorge Vale Golf Course. Iron gates and rock wall sections define the entrance to the cemetery. A widening of the roadway between the gates and chapel is used for vehicle parking and loading/unloading. Parking for funerals utilizes the lower road loop. Hearses disembark on the upper loop road. However, trees encroaching on the edge of the southern road section limit the extent of vehicle access. A central road provides a pedestrian and service route to the upper and lower ends of the site.

The cemetery was built during a time when designing for disabled access was not generally considered. Chapel stairs and curbs on the road edge restrict wheelchair access to paved areas.

Paved surfaces are in generally good condition. Where surfaces have buckled as a result of tree roots, patching has been undertaken. Curbs are a mixture of granite slabs and poured-in-place concrete. Areas of broken curbs are found east and south of the chapel.

The Veterans Cemetery is a focal point for annual Remembrance Day activities. Veterans participate in a service and wreath laying ceremony at the Cross of Sacrifice. The area between the entrance gate and chapel is used as a gathering place to observe the event. Participating veterans line up north of the chapel opposite the Cross of Sacrifice.

Lighting is presently limited to the chapel interior and office interior. Outdoor lighting in the main entrance area would help deter vandalism and provide light for late afternoon winter use.

The present irrigation system requires manual connection of each spray head. This is both time consuming and limits irrigation to the staff hours of operation. Underground lines are of unknown condition. An automated irrigation system would allow night-time watering which is less water consumptive and allows visitor use and grounds maintenance to take place when ground conditions are dry.

A number of grounds maintenance issues have been identified on the cemetery site. Each grave marker has four sides that require mowing and edging. Seasonally wet surface conditions and uneven ground where grave markers have subsided make lawn mowing and edging difficult. The manual irrigation system is both labour and water consumptive. The isolated location of the cemetery and lack of night lighting makes the site vulnerable to vandalism, resulting in some damage to headstones over the years.

3. ISSUES AND OPTIONS

In addressing the design requirements for the cemetery, issues and options were examined related to drainage improvements, grave marker treatment, disabled access, planting, irrigation, lighting, and site furnishings.

Drainage Improvements

Two options for drainage improvements were examined. The first option was to install drains between each row of grave markers in wet areas and collect and discharge water away from the cemetery site. A thin top dressing of sand would be placed over grass areas. A problem with this option is that surface water may continue to be trapped in the dense silt loam soil layer, resulting in wet surface conditions. A further problem is the discharge of water from the site. The choices are to connect into the golf course drainage system or to install a drain across the golf course south into the Department of National Defence property. Plans for the golf course include additional drainage piping, which will maximize their present collector system. Routing the cemetery drains across D.N.D. property and connecting into storm drains on Colville Road would be expensive. Either choice would require agreements with the landowners on easements and maintenance of the storm water lines.

The second and recommended option for drainage improvements is to remove the silt loam soils down to the clay layer and install a layer of drain rock and a top layer of mixed soil and sand under sod. This will allow both surface and subsurface water to drain more freely, providing a dry ground surface.

Grave Marker Treatment

Drainage improvements will require the removal and re-placement of grave markers. This is also an opportunity to examine alternative ways of placing markers to minimize problems of subsidence and lawn mowing and edging. One option is to create a continuous concrete slab with integral grave marker holders running the length of each row of markers. This would ensure that all markers are kept upright and would stabilize the ground. Lawn edging would be considerably reduced. Problems with this option are the very high cost and marker placement difficulties on sloping ground. A less expensive solution would be to re-set markers including bases onto new concrete bases to provide stability and place a pea gravel layer over landscape cloth around markers in each row, with an edge restraint where gravel joins sod. This option would also reduce lawn maintenance. A result of either of these options is to create a visual distinction between the modified and unchanged areas of the cemetery. **The third and recommended alternative is to re-install markers with bases on new concrete bases set on compacted gravel, with sod between the grave markers. The result will be stable bases at the correct elevation, with markers in the redeveloped area identical in appearance to the rest of the cemetery.**

Disabled Access

At present, disabled visitors have some difficulty accessing cemetery lawn areas. Drier ground conditions will improve this, and ten concrete ramps are proposed to negotiate the grade change from roadways to grass areas. The feasibility of providing a ramp to the chapel was examined, and a route along the north side of the building has been identified for future consideration.

Planting

Planting improvements to the cemetery grounds are intended to serve a number of purposes. Deciduous trees are proposed to provide visual interest in open parts of the site. **Species are chosen for wet ground tolerance and seasonal interest in terms of flowers, fall colour, and winter form. Trees are also intended to absorb water and help maintain drier ground conditions.** A combination of conifers, deciduous trees, and tall shrubs are proposed for the southeast boundary of the cemetery to afford visual screening of the nearby residential area. Broadleaf evergreen shrubs are recommended for the entrance and chapel area, as well as under large conifers to offer colour and interest at different seasons. The eastern boundary of the cemetery has been set aside for naturescape planting. The concept is to plant species which will attract birds and butterflies. A future shallow pond would provide additional habitat for fish and amphibians.

Irrigation

The present irrigation system is of unknown origin. A main supply line originates on the east property boundary and runs up the centre of the site north of the chapel. Laterals supply water to turf valves throughout the cemetery. Each valve is manually operated and can be used for irrigation spray heads or as sources for power washing to clean headstones. Irrigation must take place during work days to coincide with staff schedules. **An automated irrigation system would permit night watering, with the advantages of a drier grass during day time hours for visitors and staff, and less evaporation loss, thereby reducing water use. A rain sensor is proposed to further adjust irrigation requirements to rainfall patterns.** Since the existing main water line is of unknown condition and is not well located in terms of a new system, it is recommended that it be replaced. **The new system is designed to provide full coverage of grass and planted areas, as well as power washing take-off points and three standpipes for visitor use.**

Lighting

Currently, there is **no outdoor lighting** in the cemetery. Lighting in the entrance area would provide **illumination** for late afternoon activities during winter months, and a **motion detector** would activate the light if an **intruder entered the cemetery at night**. A similar motion-activated light outside the office is also recommended. The pole lamp proposed is of traditional design in keeping with the history and dignity of the site. **The electrical engineer has assessed the potential for additional lighting to illuminate all walkways as well as trees in the entrance area, and has advised that the present supply would accommodate these future uses.**

Site Furnishings

The only site furnishings, at present, are an old painted metal bench and a garbage can. Three new benches are proposed, located near the entrance and in the upper and lower areas of the cemetery. The design is traditional, with a wood seat and back and metal end supports. They are intended to complement existing design elements such as the entry gates and chapel. A waste container is to be located near the cemetery entrance.

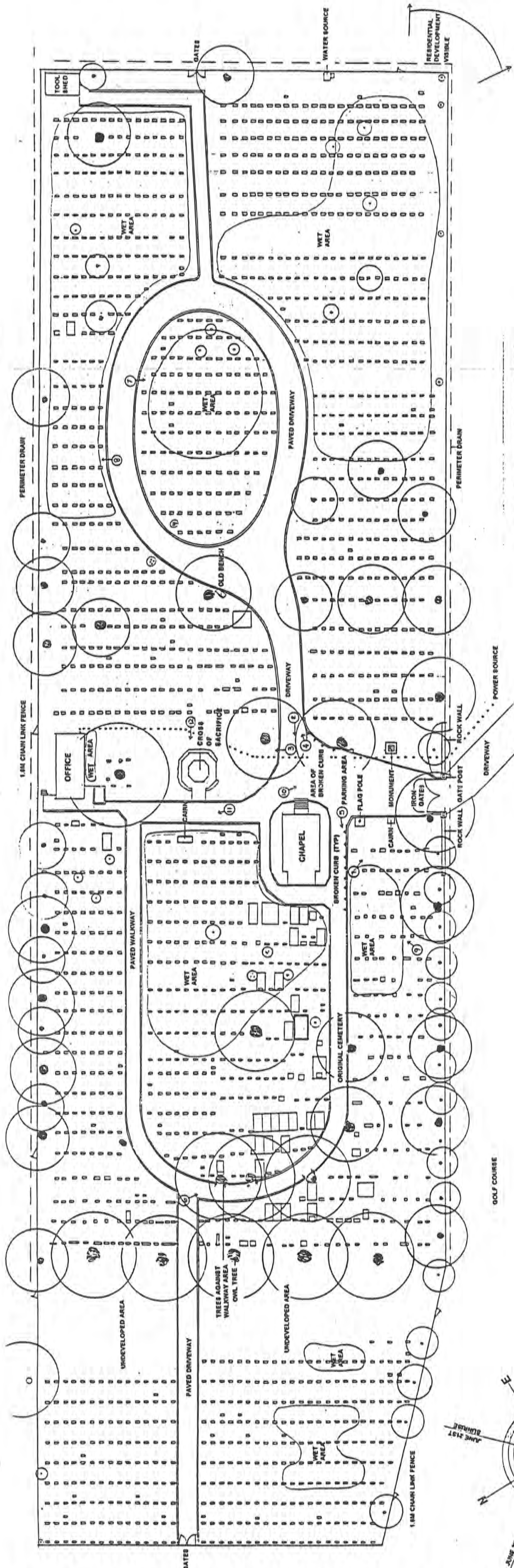
Cross of Sacrifice

The Cross of Sacrifice plays an important role in Remembrance Day ceremonies and is a central focus and vantage point in the cemetery. To reinforce its symbolic importance, and to provide a place to reflect, seating is proposed around the Cross of Sacrifice. Four solid concrete benches are to be constructed parallel to the base, allowing visitors to face inward, or outward, looking across the cemetery. Drainage improvements and new concrete paving around the Cross of Sacrifice are also proposed.

Signage

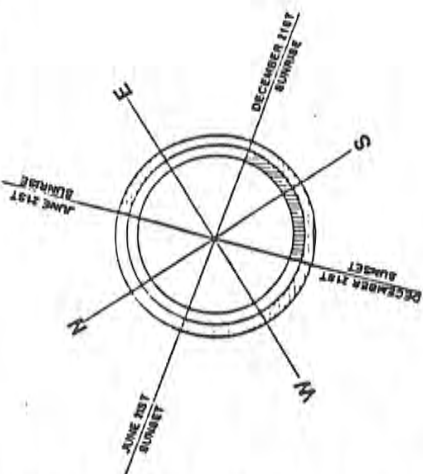
The Veterans Cemetery is becoming increasingly popular with the general public and visitors. People want to learn more about local history and cemeteries are a way for school children and others to connect with the past. This cemetery is also of interest for the chapel, which is a designated heritage site. A plaque on the chapel outlining the history of the Veterans Cemetery would provide visitors with information on this important Victoria landmark, and a sign near the Cross of Sacrifice would link this cemetery to other Commonwealth war memorials around the world.

GOLF COURSE



GROUND MAINTENANCE AND OTHER ISSUES

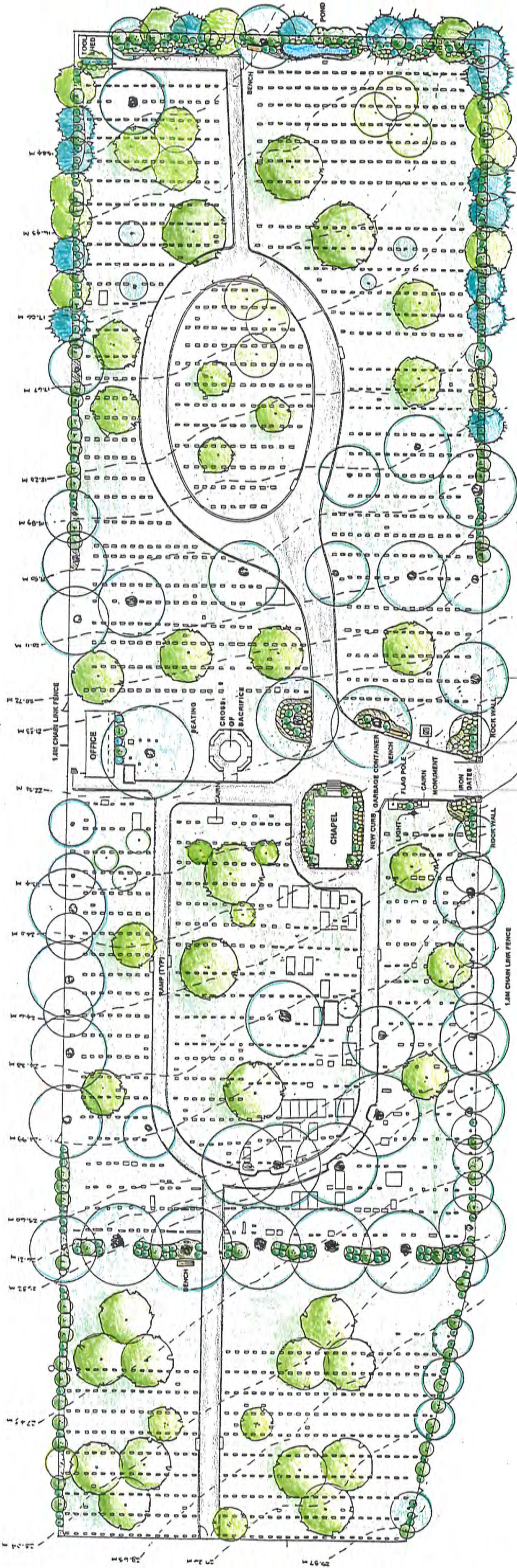
- SOME GROUND SUBSIDENCE AROUND INDIVIDUAL GRAVE MARKERS
- MANUAL IRRIGATION SYSTEM IS LABOUR INTENSIVE
- RAISED CURBS MAKE WHEELCHAIR ACCESS DIFFICULT
- LIMITED SEASONAL COLOUR IN PLANTINGS PARTICULARLY IN MAIN USE AREA AND OPEN AREAS
- WATER SUPPLY POINTS FOR POWER WASHING REQUIRED THROUGHOUT CEMETERY
- LOWER BOUNDARY LACKS DEFINITION
- SOME SCREENING OF URBAN DEVELOPMENT DESIRED
- NIGHT SECURITY LIGHT WOULD DETER VANDALISM
- NO COMMEMORATIVE MARKER DEDICATING CHAPEL AS HERITAGE BUILDING, OR INFORMATION ON HISTORY OF CEMETERY



Michael Bocking Landscape Architect Limited
 405 HAZELTINE ROAD TEL: 437-0744 FAX: 437-0744
 VICTORIA, B.C. V8W 2A1
 PRINTED

VETERANS CEMETERY ESQUIMALT, BC

DRAWING: EXISTING SITE CONDITIONS L-1
 DATE: March 25, 1999
 SCALE: 1:250
 PROJECT: 99-001



Michael Bocking Landscape Architect Limited
 45 HAZLETT CREEK ROAD
 VICTORIA, B.C. V8E 2A3
 PHONE: (250) 478-4848
 FAX: (250) 478-4843
 FIDUCIARY: 99 (001)

VETERANS CEMETERY
ESQUIMALT, BC

DRAWNO: _____
SITE PLAN L-2
 DATE: March 25, 1999
 SCALE: 1:250

May 10, 1999

APPENDIX A

COST ESTIMATE VETERANS CEMETERY UPGRADING

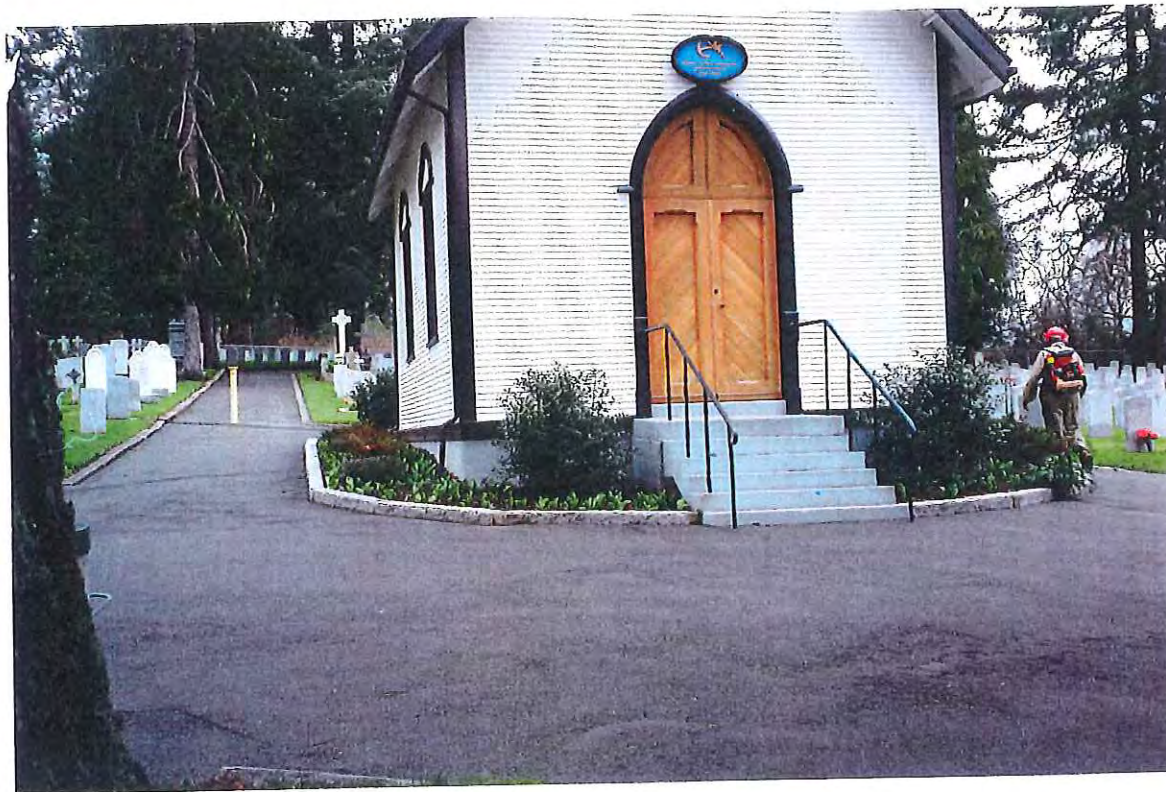
| | A | B | C | TOTAL |
|---|----------------|---------------|---------------|----------------|
| 1. Wet area improvements (earthworks, gravel, sand, sod, marker re-setting) | \$115,000 | | | |
| 2. Asphalt removal and patching | 900 | | | |
| 3. Irrigation system Automatic system New main waterline | 15,750 | | | |
| 4. Electrical work Entry area lighting Walkway lighting Storage shed lighting Tree uplighting (six trees) | 3,850 | | 36,300 | |
| | | | 2,100 | |
| | | | | 7,750 |
| | | | | |
| 5. Tree stabilization | 5,000 | 4,000 | | |
| 6. Remove and replace broken curbs | 2,500 | | | |
| 7. Ten ramps to plot areas | 1,200 | | | |
| 8. Upgrade Cross of Sacrifice (drainage improvements, benches, walkway) | 13,300 | | | |
| 9. Commonwealth War Graves Commission Sign (design & production) | 2,500 | | | |
| 10. Three benches on concrete footings | 4,500 | | | |
| 11. One waste containers on concrete footing | 800 | | | |
| 12. New plantings (trees, shrubs, groundcover) | 15,800 | | | |
| 13. Pond with recirculating pump | | | 1,200 | |
| 14. Heritage plaque (design & production) | 2,500 | | | |
| TOTAL ITEMS 1- 15 | 183,600 | 42,400 | 8,950 | |
| 15% contingency | 27,540 | 6,360 | 1,342 | |
| GRAND TOTAL | 211,140 | 48,760 | 10,292 | 270,192 |

2/3 cost
underground
1/3 cost
above i.e.
fixtures.

to be pursued by common wealth
war Graves.



1. Cemetery Entrance Area



2. Chapel Entrance



3. Cross of Sacrifice



4. Curbs Restrict Accessibility, Residential Area Visible Beyond



5. Broken Curb



6. Trees Growing into Roadway



7. Typical Wet Area



8. Tree Damage in Lower Part of Site



9. Tree Damage in Old Cemetery



10. Assembly Area on Remembrance Day



11. Remembrance Day Ceremonies



12. Remembrance Day Ceremonies



ARBOUR-CARE
TREE CONSERVATION SERVICES LTD.

Suite 201 - 8167 Main St. Vancouver, B.C. V5X-3L2 Ph: 322-1375 Fax: 325-6060 Page: 231-4340

March 31, 1999

Michael Bocking -- Landscape Architect
405 Hazlitt Creek Road
Victoria, B.C. V9E 2A3
Tel: 478-4868 Fax: 478-4862

Attention: Michael Bocking

Re: Veteran's Cemetery, 1900 Coville Road, Victoria

Dear Michael,

Please find enclosed my final report for the above site. The report presents the following:

1. An assessment of the site's soils and hydrology, in so far as these factors affect tree health and stability.
2. An inventory of the tree population and the species fractions that comprise it.
3. An age profile of the trees.
4. An assessment of the pest and disease profile susceptibility associated with species growing on site.
5. A summary of a tree-by-tree assessment of the biological and mechanical condition of the resource.
6. I have also included preliminary tree maintenance recommendations and an estimate of costs.

The tree resource at the cemetery is comprised of 65 trees from 9 separate species. All but one of these trees (a Garry oak) are coniferous. The exotic Lawson's cypress accounts for close to half of this population (31 trees). The next most plentiful species is Douglas fir (14 trees), accounting for perhaps a quarter of the resource. The balance of the trees are made up of a variety of species, as presented below in Table-1. Of the nine species represented, only three are indigenous to the area: Garry oak, Douglas fir and red cedar. By population, these species account for perhaps 28% of the total inventory.



| | |
|-----------|-----------------------|
| 1 | Garry oak |
| 1 | deodar cedar |
| 1 | incense cedar |
| 1 | red cedar |
| 2 | pyramid cedar |
| 2 | red cedar cv. Sabrina |
| 5 | Blue Atlas Cedar |
| 7 | Norway spruce |
| 14 | Douglas fir |
| 31 | Lawson's cypress |
| 65 | |

Table 1

There is considerable variability in the size of the trees when the resource is considered as a whole. The smallest specimens measure six inches, while the largest (a Douglas fir) measures 48" (The average diameter, measured at breast height, is 22".) Within each species cadre, however, the sizing is more homogeneous, with the greatest variation observed amongst the Lawson's cypress. The Douglas fir are the largest of the conifer species. Despite accounting for only 22% of the tree population, they account for more than half of the total bio-mass.

From a maintenance perspective, there are three concerns. They are, in order of diminishing priority:

1. Safety
2. Prevention of further structural deterioration
3. Aesthetics

There is a history of wind throw on the site. The attached photographic record (source: Michael Bocking), documents the failure of a Norway spruce and a Lawson's cypress from the roots. The spruce was located at the lower most eastern end of the cemetery in an exposed location subject to winter flooding and strong south-east winds. The cypress was in a more protected area of the cemetery to the left of the main gate. Poor root growth on the north side of the cypress due to road construction may have been a factor in this tree's failure.

Recent pruning procedures have reduced the hazard potential of the tree resource significantly. The only residual concerns I was able to observe arise from the threat of limb or leader failure in high winds, particularly from the Douglas fir and Blue Atlas cedar specimens. It is these species that are



also at greatest risk of further structural deterioration due to limb or loss or stem fractures. Careful specifications are required to mitigate this hazard any further than has already been accomplished with the most recent spate of pruning. These specifications should address the following types of abatement work:

1. Aerial inspection of old topping wounds for incipient decay;
2. some bracing of opposing co-dominant leaders that have arisen since the topping episodes;
3. careful lightening and reduction of heavy limbs at risk of failure from high winds or wet snow loading.

There is approximately \$3,500 - \$5,000 in costs estimated to complete this work. A certain degree of risk, however, must be accepted even in a best case scenario, if one is going to enjoy the presence of mature trees within this environment. A further \$3,000 - \$4,000 in structural pruning and minor dead-wooding is estimated for work that may be considered of aesthetic concern.

A significant number of trees (predominantly Douglas fir and blue atlas cedars) are approaching over-maturity and their gradual replacement should be considered as a management priority for the next period (of 20 - 50 years). In addition, approximately half of the Lawson cypress trees inventoried are in poor condition or suppressed beneath more dominant trees and should be considered for replacement. Additional criteria affecting the scope, species and location of tree replacement within the cemetery are as follows:

- Vertical heterogeneity (i.e. establishing a more distinct mid-story and under-story amongst the existing trees;
- Available planting space;
- Shading and competition for limited resources;
- Pest and disease susceptibility;
- Wind throw susceptibility;
- Maintenance considerations;
- The symbolic or interpretive significance to the Veteran's community of particular tree species and other design considerations.¹

In selecting tree species for the eastern or lower end of the cemetery, care should be taken to select for trees that will prove wind firm and biologically viable in wet soils (winter and spring) and seasonally

¹ The maple, for instance, is referenced on p. 10 of the cemetery pamphlet "Gods Acre" (Government of Canada, Veterans Affairs) as a symbol of "life, growth and peace". A March 30, 1998 article in the Lookout CFB Esquimalt



high winds. Deciduous leafy and coniferous species (eg. maple, oak, swamp cypress, dawn redwood) are preferred or smaller ornamental species (e.g. cherry species resistant to Bacterial Canker, hawthornes resistant to leaf blight, japanese snowbell, eastern redbud, or the stewartia tree).

With respect to on site soil considerations, six soil excavations were undertaken throughout the cemetery to establish the nature of the organic, top soil and sub-soil horizons affecting tree root growth and hydrology. The excavations were undertaken on Friday March 12, 1999, approximately three days after the last sustained rainy period. The locations of the six sites are shown on the attached site map. Site locations were determined in consultation with the Landscape Architect and the Caretaker (Mr. David Smith). Each excavation was approximately 16" square. Excavation depths ranged from 13" to 22" in depth.

In general, the site excavation revealed a 'B' horizon of between 12" – 14" in depth and ranging from a silty loam (hole #s 1, 3, 4 and 5) to a loamy silt (hole # 2) to a sandy loam (hole # 6) in texture. At the west (or upper) end of the site, this was followed by a 4" – 5" layer of cobbled gravel. Below this layer, a compact beige clay (or perhaps a silty clay) was encountered. This is the predominant parent material and is reported to extend down to a significant depth. In the middle and east (lower) sections of the site, no gravel layer was encountered. (This observation should not be given too much weight, given the relatively small number of samples and their random distribution.) Soil from hole #s 3, 4 5, and 6 exhibited good aggregation. Earth worms were plentiful at all sites. Organic content in the upper 6 – 8" of soil appeared plentiful in all but the first site.

The excavated soils were uniformly well drained. There was no pooling or standing water within the holes during the 15 – 20 minutes required to excavate the sample. Certain areas within the cemetery, however, are prone to flooding, according to interview data provided by the Caretaker. The lower east end of the cemetery is particularly prone in this respect. Tree vigor and condition is observed to decline toward this end of the site. This area has also been the subject of a number of blow downs in recent years (source: Michael Bocking, photographic archive; interview data provided by the Caretaker). Adequate drainage should be a major concern with respect to any re-vegetation initiatives within this portion of the site.

newspaper notes that "predominantly local veterans are buried..." in the cemetery. A significant local tree, reflected in both the cemetery and its local environs, is the Garry Oak.



ARBOUR-CARE TREE CONSERVATION SERVICES

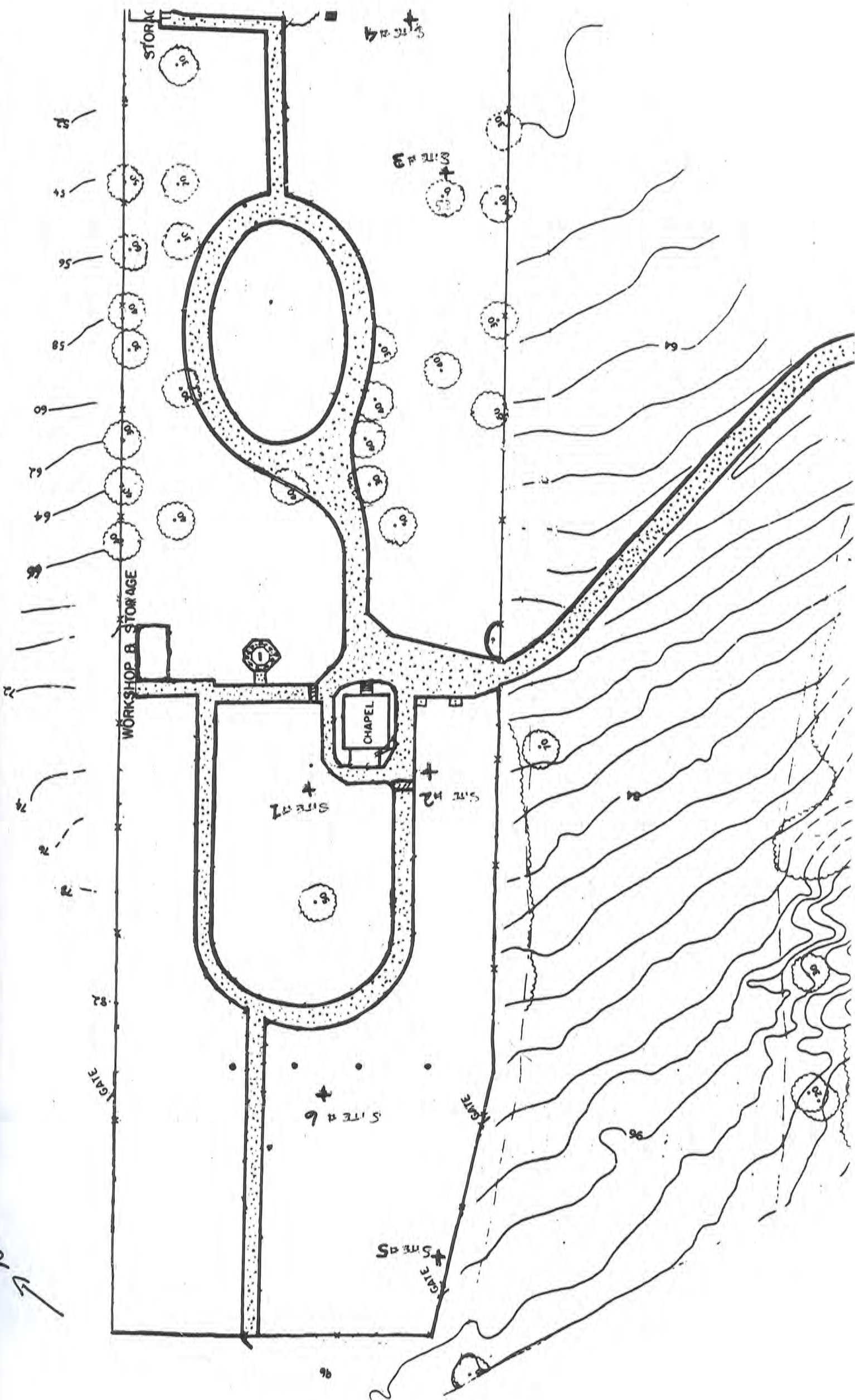
Excavation sites 3, 4 and 6 were located within the root zone of adjacent trees. The excavations revealed that the active rooting horizon extended down to a depth ranging from 10" – 14" (generally the depth of the 'B' horizon). In no cases did the root system extend into the compact clay layer. This is consistent with the opportunistic habit of roots. **Roots will seek out the path of least mechanical resistance in soils that provide a relative abundance of oxygen, nutrients and moisture. In coastal soils, this results in a typical superficial rooting habit for most species.**

No major pest or disease problems were identified. White scale or plate-like fungal fruiting structures were identified on the side of the trunk of the one mature Garry oak on site. The wood beneath these fruiting structures should be examined more closely by means of an increment bore sample and microscope and a sample of the fungus sent for identification to a pathology lab.

Respectfully submitted,

Jeremy Gye - Consulting Arborist
I.S.A. Certification # PN-0144

Attachments



APPENDIX 2

| Tree # | Common Name | Diameter (inches) |
|--------|------------------|-------------------|
| 1 | Garry oak | 28 |
| 2 | Lawson's cypress | 15 |
| 3 | Lawson's cypress | 9 |
| 4 | Douglas fir | 42 |
| 5 | Lawson's cypress | 7 |
| 6 | Lawson's cypress | 10 |
| 7 | Lawson's cypress | 6 |
| 8 | Lawson's cypress | 11 |
| 9 | Douglas fir | 42 |
| 10 | Lawson's cypress | 8 |
| 11 | Norway spruce | 21 |
| 12 | Lawson's cypress | 8 |
| 13 | Douglas fir | 40 |
| 14 | Lawson's cypress | 18 |
| 15 | Lawson's cypress | 9 |
| 16 | Lawson's cypress | 7 |
| 17 | Blue Atlas Cedar | 32 |
| 18 | Lawson's cypress | 14 |
| 19 | Lawson's cypress | 11 & 8 |
| 20 | Lawson's cypress | 8 |
| 21 | Douglas fir | 35 |
| 22 | Douglas fir | 42 |
| 23 | Douglas fir | 41 |
| 24 | Lawson's cypress | 9 |
| 25 | Lawson's cypress | 11 |
| 26 | Lawson's cypress | 9 |
| 27 | Lawson's cypress | 9 |
| 28 | Douglas fir | 37 |
| 29 | Douglas fir | 37 |
| 30 | Lawson's cypress | 15 |

| Tree # | Common Name | Diameter (inches) |
|--------|----------------------------|----------------------|
| 31 | Douglas fir | 29 |
| 32 | Lawson's cypress | 15 |
| 33 | Lawson's cypress | 8 |
| 34 | Douglas fir | 35 |
| 35 | Lawson's cypress | 10 |
| 36 | Douglas fir | 32 |
| 37 | Lawson's cypress | 9 |
| 38 | Douglas fir | 30 |
| 39 | Lawson's cypress | 11 |
| 40 | Lawson's cypress | 13 |
| 41 | Blue Atlas Cedar | 40 |
| 42 | Norway spruce | 24 |
| 43 | red cedar (Varigated form) | 25 |
| 44 | deodar cedar | 34 |
| 45 | Norway spruce | 25 |
| 46 | Norway spruce | 9 |
| 47 | Norway spruce | 22 |
| 48 | red cedar (Varigated form) | 8,11,11 & 10 |
| 49 | pyramid cedar | 7,7,7 & 7 |
| 50 | incense cedar | 28 |
| 51 | Lawson's cypress | 6 |
| 52 | Norway spruce | 22 |
| 53 | pyramid cedar | 3,3,4,5,6 & 8 |
| 54 | Lawson's cypress | 16 |
| 55 | Lawson's cypress | 31 |
| 56 | red cedar | 38 |
| 57 | Blue Atlas Cedar | 35 |
| 58 | Lawson's cypress | 16 |
| 59 | Norway spruce | 16 |
| 60 | Lawson's cypress | 27 |

| Tree # | Common Name | Diameter (inches) |
|--------|------------------|----------------------|
| 61 | Douglas fir | 48 |
| 62 | Douglas fir | 42 |
| 63 | Lawson's cypress | 30 |
| 64 | Blue Atlas Cedar | 33 |
| 65 | Blue Atlas Cedar | 26 |

of Specimens

- 1 Garry oak
- 1 deodar cedar
- 1 incense cedar
- 1 red cedar
- 2 pyramid cedar
- 2 red cedar cv. Sabrina
- 5 Blue Atlas Cedar
- 7 Norway spruce
- 14 Douglas fir
- 31 Lawson's cypress
- 65**



APPENDIX 3



1



2



3



4



5



6

Cemetery

- organize a work stop out here + put together a Cultural Resource Plan 3 or 4 days.
- Dave will send copy of Viny Plan.
- Ken to write to Al Purley about putting together plan.
- Lyle Dick. local expert.
Superintendent of Fort Red Hill.
- Put the proposal in in the meanwhile.
- Planting -
 - justification
 - use historical site design?
 - what was there before?
 - aerial photo graphs
 - plant what was there before?
 - why not?
- tie to other gov't initiative
 - green plan
 - Natural Conservation
 - rest + contemplation.
- send to Drafts + David Pantom.

APPENDIX C



**Pre-Demolition Hazardous
Building Materials Assessment**

Veteran's Cemetery:

Equipment Shed and Office and
Maintenance Shed

1190 Colville Road, Esquimalt BC

September 24, 2018

Prepared for:

Public Services and Procurement Canada
Pacific Region
219-800 Burrard Street
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Prepared by:

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Project No.: 123221204

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PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

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Executive Summary

Stantec Consulting Ltd. (Stantec) was commissioned by Public Services and Procurement Canada on behalf of Veteran's Affairs Canada (collectively referred to as "the Client") to conduct a pre-demolition hazardous building materials assessment for the following buildings (subject buildings) at the Veteran's Cemetery located at 1190 Colville Road in Esquimalt, British Columbia:

- Equipment Storage Shed and Office (referred to in previous documentation as "Equipment Storage Shed/Office")
- Maintenance Shed (referred to in previous documentation as "Maintenance Shed")

The purpose of the assessment was to check for potential hazardous building materials that may require special attention in accordance with applicable federal and provincial regulations, prior to planned significant renovation and/or demolition activities.

The project was conducted to supplement the information provided in the following report:

- Stantec Report No.123220983 entitled *Asbestos Building Materials Assessment; Chapel, Equipment Storage; Shed/Office, and Maintenance shed at Veteran's Cemetery—1190 Colville Road, Esquimalt BC*, dated November 2, 2017, prepared for Public Services and Procurement Canada (2017 Stantec Report)

The work was carried out in accordance with the requirements of the Canada Labour Code, Part II Canada Occupational Health and Safety Regulations (COHSR) and British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97).

The hazardous building materials considered during this assessment included asbestos-containing materials (ACMs), lead including lead-containing paints (LCPs), polychlorinated biphenyls (PCBs), mould-impacted materials, equipment with elemental mercury, equipment with ozone-depleting substances (ODSs) and silica.

Based on Stantec's visual assessment and the laboratory analyses performed on the samples collected, as well as a review of previous reports or sampling records/reports, limited hazardous building materials were identified to be present.

A summary of our findings is presented in Table ES 1, below. Recommendations pertaining to the handling, removal, transportation and disposal of identified hazardous building materials are provided in the body of this report.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Table ES 1 Summary of Findings

| Building Materials | Comments |
|----------------------------------|---|
| Asbestos | <p>The following ACMs were identified through the 2017 Stantec Report and were visually confirmed to remain during the current assessment:</p> <ul style="list-style-type: none"> • Equipment Storage Shed and office: <ul style="list-style-type: none"> – Black window pane caulking on window above washroom door (observed by Stantec to be present and in good condition) – Light gray putty applied to electrical penetrations (observed by Stantec to be present and in good condition) – Dark gray putty applied to electrical penetrations (observed by Stantec to be present and in good condition) • Maintenance Shed <ul style="list-style-type: none"> – No ACMs identified <p>No additional ACMs were identified through the current assessment.</p> |
| Lead | <p>The following LCPs were identified through the current assessment:</p> <ul style="list-style-type: none"> • Equipment Storage Shed and Office: <ul style="list-style-type: none"> – Off-white coloured paint on interior plywood wall and wood door/trim – Beige coloured paint on interior and exterior concrete floor/foundation • Maintenance Shed: <ul style="list-style-type: none"> – Green coloured paint on exterior wood trim – White coloured paint on exterior wood siding <p>Analysis of bulk samples that were collected in forms presumed to be representative of waste generated during demolition indicated that the following materials contain lead in a dispersible form such that their leachates contain greater than 5.0 milligrams per litre (mg/L) lead, and will require special disposal:</p> <ul style="list-style-type: none"> • Maintenance Shed: <ul style="list-style-type: none"> – Green painted exterior wood trim – White painted exterior wood siding <p>Lead may also be present in the following materials:</p> <ul style="list-style-type: none"> • Equipment Storage Shed and Office: <ul style="list-style-type: none"> – Older electrical wiring materials – Solder used on domestic water lines • Maintenance shed: <ul style="list-style-type: none"> – Older electrical wiring materials |
| Polychlorinated biphenyls (PCBs) | No suspected PCB-containing equipment was observed within either of the subject buildings. |
| Mould | Suspect mould or moisture-impacted building materials were not observed within either of the subject buildings. |
| Mercury | <p>Mercury vapour is present in the seven light tubes within the four fluorescent light fixtures observed within the Equipment Storage Shed and Office</p> <p>Items suspected to contain liquid mercury or mercury vapour were not observed within Maintenance Shed.</p> |
| Ozone-depleting substance (ODS) | Building related cooling, refrigeration or fire suppression equipment suspected to be ODS-containing was not observed within either of the subject buildings. |



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Table ES 1 Summary of Findings

| Building Materials | Comments |
|---------------------------|---|
| Silica | Silica is expected to be present in the following, which were observed in various locations throughout the subject buildings: <ul style="list-style-type: none">• Cement products such as concrete foundations• Asphalt and asphalt products containing rock or stone (e.g., roof sheeting or shingles). |

The statements made in this Executive Summary text are subject to the same limitations included in this report and are to be read in conjunction with the remainder of this report.



Abbreviations

| | |
|-------|---|
| ACGIH | American Conference of Governmental Industrial Hygienists |
| ACM | asbestos-containing material |
| BC | British Columbia |
| CEPA | Canadian <i>Environmental Protection Act</i> |
| CFC | chlorofluorocarbon |
| COHSR | Canada Occupational Health and Safety Regulations |
| ELLAP | Environmental Lead Laboratory Approval Program |
| EMSL | EMSL Canada Inc. |
| HCFC | hydrochlorofluorocarbon |
| HUD | Housing and Urban Development |
| HVAC | heating, ventilation and air conditioning |
| LCP | lead-containing paint |
| NVLAP | National Voluntary Laboratory Accreditation Program |
| ODS | ozone-depleting substance |
| OEL | occupational exposure limit |
| PCB | polychlorinated biphenyl |
| PLM | polarized light microscopy |
| USEPA | United States Environmental Protection Agency |



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Introduction
September 24, 2018

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was commissioned by Public Services and Procurement Canada on behalf of Veteran's Affairs Canada (collectively referred to as "the Client") to conduct a pre-demolition hazardous building materials assessment for the following buildings (subject buildings) at the Veteran's Cemetery located at 1190 Colville Road in Esquimalt, British Columbia (BC):

- Equipment Storage Shed and Office (referred to in previous documentation as "Equipment Storage Shed/Office")
- Maintenance Shed (referred to in previous documentation as "Maintenance Shed")

The purpose of the assessment was to check for potential hazardous building materials that may require special attention in accordance with applicable federal and provincial regulations, prior to planned significant renovation and/or demolition activities.

The project was conducted to supplement the information provided in the following report:

- Stantec Report No.123220983 entitled *Asbestos Building Materials Assessment; Chapel, Equipment Storage; Shed/Office, and Maintenance shed at Veteran's Cemetery—1190 Colville Road, Esquimalt BC*, dated November 2, 2017, prepared for Public Services and Procurement Canada (2017 Stantec Report)

The work was carried out in accordance with the requirements of the Canada Labour Code, Part II Canada Occupational Health and Safety Regulations (COHSR) and British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97).

The hazardous building materials considered during this assessment included asbestos-containing materials (ACMs), lead including lead-containing paints (LCPs), polychlorinated biphenyls (PCBs), mould-impacted materials, equipment with elemental mercury, equipment with ozone-depleting substances (ODSs) and silica.

The site work was conducted by Mr. Sean Brigden on August 16, 2018.

1.1 UNDERSTANDING OF THE PROJECT

Stantec understands that the information pertaining to the identity, location and approximate extent of hazardous building materials (if any) within the subject buildings was limited to information on ACMs and was not prepared for significant renovation or demolition purposes. As such, and as the buildings are planned for significant renovation (Equipment Storage Shed and Office) or demolition (Maintenance Shed), the Client commissioned this assessment as a measure of diligence in maintaining compliance with the COHSR and BC Reg. 296/97 pertaining to the identification of hazardous materials prior to planned renovation/demolition work.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Scope
September 24, 2018

2.0 SCOPE

The scope of work for this assessment involved the following:

- Review of existing information, including site drawings and the 2017 Stantec Report
- Visual assessment of readily accessible areas for the presence of suspected hazardous building materials
- Collection of representative bulk samples from building materials suspected to contain asbestos fibres—for those not sampled previously, for additional materials identified, or to supplement the information in the 2017 Stantec Report
- Collection of paint chip samples for the determination of the lead content in paint finishes
- Collection of bulk samples of painted building materials forms presumed to be representative of waste generated during renovation or demolition for the determination of whether waste may be considered a toxic leachate (and require special disposal)
- Submission of samples collected for laboratory analysis
- Evaluation and interpretation of field findings and sample analytical results along with current and previous sample analytical results to develop conclusions and recommendations pertaining to hazardous building materials identified

2.1 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 accessible and accessed areas of the subject buildings, and the results of analyses performed on the specific material sampled during the assessment/previously sampled by Stantec. Analytical results reflect the sampled materials at the specific sample locations.

This report has been prepared for the exclusive use of the Client for the purpose of assessing general conditions in the subject buildings. Any use that a third party makes of this report, or reliance on, or decisions to be made on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

2.1.1 Physical and Sampling Limitations

Sampling was conducted only pertaining to suspected ACMs, suspected LCPs and bulk building materials coated with paint presumed to be destined for landfill disposal. 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.

Due to limitations on the agreed to scope of work for this project there are specific limitations to the information that can be provided to each hazardous building material considered in this assessment, as outlined below.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Scope

September 24, 2018

- Building materials that may contain asbestos but were not accessible for sampling include, but are not limited to the following:
 - Sub-grade materials (e.g., asbestos cement drainage pipe)
 - Insulation material present inside walls
 - Drywall and/or wall plaster and associated finish materials concealed behind new and/or additional walls
 - Mechanical (e.g., piping and ducting) insulation within wall cavities or other concealed spaces
- Samples of paint applications suspected to contain lead were collected 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 were presumed to be the same, regardless of differing sub surface paints, if any.
- Sampling for analysis of lead leachate was conducted such that building material samples were collected in a form presumed to be representative of waste generated during demolition. The lead leachate samples are meant to represent the general waste that would be created when painted surfaces are demolished, without having paint removed.
 - Materials such as metal and concrete that are coated with LCPs are typically not tested for leachable lead content for the following reasons:
 - o If removed with paint in-tact, these materials are expected to be recycled, not disposed of via landfill. As such, the leachable lead content will not impact the “disposal” option, as recycling facilities will typically accept metal or concrete with lead-containing paint.
 - o If removal of the paint from the substrate is considered, the waste associated with that process (paint chips and removal substrate—sand, beads, etc.) is typically presumed to be hazardous waste (leachable for lead in excess of 5.0 mg/L) or must be tested in its actual form (once removed, with the removal substrate) to confirm.
 - o In most cases, during an initial assessment, it is not practical to try to remove sufficient paint from the substrate in order to appropriately analyze for lead leachate, as a significant area would have to be “scraped” (50–100g of sample is required).
- Conclusions and recommendations regarding the presence of PCBs are based on limited observations and is presented to provide guidance regarding the likelihood that PCB-containing equipment is or is not present. The exact extent and/or number of fluorescent lamp ballasts containing PCBs, if any, will not be commented on.
 - Although they may also be present in other items in limited amounts (e.g., plastics, molded rubber parts, applied dried paints, coatings or sealants, caulking, adhesives, paper, sound-deadening materials, insulation, or felt and fabric products such as gaskets), PCBs are not expected to be present in those materials in concentrations that would necessitate the requirement for PCB-specific handling procedures, separate removal and/or disposal considerations for renovation or demolition. As such, these items were not considered in our assessment.
- 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) was conducted. The conclusions made in this report provide description(s) of the potential source(s) of moisture that may have led to suitable conditions for mould growth, only in those cases where potential source(s) of moisture were identified. The visual assessment did not include an intrusive assessment. The conclusions provided herein will not necessarily identify all sources of moisture leading to suitable conditions for mould growth 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.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Hazardous Building Materials Assessment
September 24, 2018

- Potential presence of mercury or mercury-containing equipment in inaccessible areas or as internal parts of HVAC mechanisms or other equipment was not assessed
 - Although limited amounts of mercury may be present in paints and adhesives, mercury is not expected to be present in those materials in concentrations that would necessitate the requirement for mercury-specific handling procedures, separate removal and/or disposal considerations for renovation or demolition. As such, these items were not considered in our assessment.
- Investigation was limited to a visual review in accessed areas of readily accessible building-related cooling and refrigeration equipment which could contain ODSs. Testing was not conducted. Equipment or materials that were not included as part of this assessment but that may contain ODSs included, but were not limited to, portable equipment (including domestic-type refrigerators and water coolers), flexible plastic foam or rigid insulation foam, solvents, aerosol spray propellants and fire extinguishing equipment.
- In general, the assessment for the presence of hazardous building materials was visual in nature and was conducted pertaining to readily visible surfaces within accessible accessed spaces only. Additional hazardous building materials are potentially present in inaccessible areas not assessed including, but not limited to: wall cavities, and buried materials.

2.1.2 Information from Previous Reports

Stantec reviewed the 2017 Stantec Report for information purposes, and the information provided was considered in developing the current assessment and sampling plan.

Where previous sampling and analytical data indicated the presence of asbestos, additional sampling was not conducted, and the material was considered to be ACM.

3.0 HAZARDOUS BUILDING MATERIALS ASSESSMENT

Building information and the results of the assessment for each of the considered hazardous building materials are provided in the following sub-sections.

Background information and health effects information, as well as information regarding regulatory framework and relevant legislation with respect to hazardous building materials are provided in Appendix A.

Floor plans showing the locations of samples collected during this assessment as well as identified hazardous building materials (where practical) are provided in 0.

3.1 FACILITY DESCRIPTION

The subject buildings are located at 1190 Colville Road, Esquimalt, BC and consist of the following:

- Equipment Storage Shed and Office
 - One story wood-framed structure built on concrete slab with wood interior/exterior walls and an asphalt sheet roof
- Maintenance Shed
 - Small one-story wood-framed outdoor shed built slab on concrete with wood exterior walls and an asphalt shingle roof



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Hazardous Building Materials Assessment
September 24, 2018

Although the construction dates of the subject buildings are unknown they were reportedly constructed prior to 1990. These dates of construction would be consistent with those dates when hazardous building materials were commonly used and/or may be present.

3.2 ASBESTOS

A summary list of the bulk samples collected by Stantec during the current assessment, including a description of the material, sampling location and laboratory test results is provided in Appendix C. Copies of the Laboratory Certificates of Analysis for bulk samples analyzed are provided in Appendix D.

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of the analytical results of suspected ACMs collected through this assessment as well as the 2017 Stantec Report as outlined herein, the materials presented in the table in Appendix E were identified as ACMs. The following information is included for each identified ACM:

- Type of material that contains asbestos
- Location/approximate extent of the ACM within the building
- Asbestos type and percentage identified
- Friability
- Condition
- Representative photographs, where available

Our assessment methodologies and findings are further summarized in the following sub-sections.

3.2.1 Methodology

Asbestos-containing materials are grouped into two classifications, friable and non-friable materials. Friable ACMs are those that can easily be crumbled or broken apart by mere hand pressure. When these materials break apart asbestos fibres are then released into the atmosphere. Non-friable ACMs are materials that by the nature of their manufacturing and/or construction do not readily allow the release of asbestos fibres. Some non-friable materials such as plaster, drywall joint compound and ceiling tiles that are considered to be non-friable in an undisturbed state can more readily release fibres when damaged or disturbed.

The presence of asbestos in federal workplaces and pertaining to federally regulated workers is governed by the COHSR. According to the COHSR, ACM means:

- Any article that is manufactured and contains 1% or more asbestos (by weight) at the time of manufacture, or any material that contains 1% or more asbestos when tested in accordance with accepted methods.

The presence of asbestos in the workplace in British Columbia pertaining to provincially regulated workers is governed by BC Reg. 296/97. According to the current version of BC Reg. 296/97, ACM means:

- Any material containing at least 0.5% asbestos, or vermiculite insulation with any asbestos



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Hazardous Building Materials Assessment
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As both federally regulated workers and provincially regulated workers (e.g., contractors) are expected to carry out work activities within the subject building, and as the provincial regulations have a more stringent definition of ACM, and generally include the requirements noted in the COHSR, this assessment was conducted to meet the requirements of BC Reg. 296/97.

Based on these criteria, a visual assessment of accessible areas was undertaken to check for the presence of additional suspected ACMs not previously sampled and/or materials for which information could be supplemented through additional sampling. Locations to collect discrete bulk samples of suspected ACMs were identified and 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 (USEPA) 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, on the recommendations provided in the 2017 WorkSafeBC publication *Safe Work Practices for Handling Asbestos (Asbestos Guide)*, and on 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).

3.2.1.1 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 block or brick walls, which are typical areas where vermiculite is found.

3.2.1.2 Sample Results Interpretation

When asbestos is detected in concentrations greater than 0.5% percent 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 is then considered to be an ACM.

3.2.1.3 Asbestos Sampling Quality Assurance/Quality Control

Sampling activities pertaining to asbestos were conducted in accordance with Stantec’s safe work practices, which take into account current provincial and/or territorial 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 analysis. 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.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Hazardous Building Materials Assessment
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All 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.

3.2.1.4 Assessment of Material Condition

A visual assessment of the condition and accessibility was also completed for each occurrence of suspect ACM. A description of the criteria used in evaluating the condition, accessibility and exposure risk of ACMs is provided below. The criteria are generally based on the June 5, 2017 Public Services and Procurement Canada "Asbestos Management Standard", and industry standards of practice.

Friable ACMs other than Mechanical Insulation

In evaluating the condition of friable ACMs other than mechanical insulation (e.g., spray-applied as fireproofing, texture, decorative or acoustic finishes), the following criteria apply:

- **Good**
 - Surface of material shows no significant signs of damage, deterioration or delamination. Up to one percent visible damage to surface is allowed within range of GOOD. Evaluation of sprayed fireproofing requires the Assessor to be familiar with the irregular surface texture typical of sprayed asbestos products. GOOD condition includes un-encapsulated or un-painted fireproofing or texture finishes, where no delamination or damage is observed, and encapsulated fireproofing or texture finishes where the encapsulation has been applied after the damage or fallout occurred.
- **Poor**
 - Sprayed materials show signs of damage, delamination or deterioration. More than one percent damage to surface of ACM spray

In observation areas, where damage exists in isolated locations, both GOOD and POOR condition may be reported. The extent or percentage of each condition will be recorded on the Assessor's assessment form.

Fair condition is not utilized or considered as a valid criterion in the evaluation of sprayed fireproofing, sprayed insulation, or texture coat finishes.

The evaluation of ACM spray-applied as fireproofing, non-mechanical thermal insulation, or texture, decorative or acoustic finishes, which are present above ceilings, may be limited by the number of observations made, and by building components such as ducts or full height walls that obstruct the above ceiling observations. Persons entering the ceiling area are advised to be watchful for ACM DEBRIS prior to accessing or working above ceilings in areas of building with ACM, regardless of the reported condition.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Hazardous Building Materials Assessment
September 24, 2018

Mechanical Insulation

In evaluating the condition of mechanical insulation (on boilers, breaching, ductwork, piping, tanks, equipment, etc.) the following criteria are used:

- **Good**
 - Insulation is completely covered in jacketing and exhibits no evidence of damage or deterioration. No insulation is exposed. Includes conditions where the jacketing has minor surface damage (i.e., scuffs or stains), but the jacketing is not penetrated.
- **Fair**
 - Minor penetration damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination) or undamaged insulation that has never been jacketed. Insulation is exposed but not showing surface disintegration. The extent of missing insulation ranges should be minor to none.
- **Poor**
 - Original insulation jacket is missing, damaged, deteriorated or delaminated. Insulation is exposed, and significant areas have been dislodged. Damage cannot be readily repaired. The evaluation of mechanical insulation may be limited by the number of observations made and building components such as ducts or full height walls that obstruct observations. In these circumstances, it is not possible to observe each foot of mechanical insulation from all angles.

Non-Friable and Potentially Friable Materials

Non-friable materials generally have little potential to release airborne fibres, even when damaged by mechanical breakage. However, some non-friable materials, i.e., exterior asbestos cement products, may have deteriorated so that the binder no longer effectively contains the asbestos fibres. In such cases of significantly deteriorated non-friable material, the material will be treated as a friable product, and evaluated per the above criteria.

3.2.2 Findings

A summary of the ACMs that were identified within the subject buildings as indicated in the 2017 Stantec Report is provided below, complete with notes regarding current conditions of identified ACMs, where applicable:

- Equipment Storage Shed and office:
 - Black window pane caulking on window above washroom door (observed by Stantec to be present and in good condition)
 - Light gray putty applied to electrical penetrations (observed by Stantec to be present and in good condition)
 - Dark gray putty applied to electrical penetrations (observed by Stantec to be present and in good condition)
- Maintenance Shed
 - No ACMs identified

Additional ACMs were not identified through the current assessment.

3.2.2.1 Non-Asbestos-Containing Materials

The bulk samples collected during this assessment for which no asbestos was detected through laboratory analysis can be seen in the table in Appendix C.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Hazardous Building Materials Assessment
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3.2.2.2 Potential for 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 block or brick walls, which are typical areas where vermiculite is found. No vermiculite or locations that may potentially contain vermiculite (that could not otherwise be assessed) were observed.

3.2.3 Recommendations

Based on the visual assessment and results of laboratory analyses and our review of the 2017 Stantec Report, Stantec recommends the following with regards to meeting the requirements of the COHSR and BC Reg. 296/97 as they pertain managing asbestos during renovation or demolition projects:

- ACMs that may be impacted during the renovation or demolition activities should be removed by appropriately trained personnel (e.g., asbestos abatement contractor personnel), in accordance with the requirements of the COHSR, BC Reg. 296/97 and the Asbestos Guide, and prior to the initiation of project work that will disturb them.
- Should a material suspected to contain asbestos fibres become uncovered during renovation 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 ACMs should be handled in accordance with applicable guidelines and regulations.
- Suspected ACMs deemed visually similar to the ACMs identified in this report 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 at any time when excavation is required.
- Ensure asbestos containing waste is handled, stored, transported 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).

3.3 LEAD

A summary list of the samples collected including a description of the samples, sampling locations and laboratory analytical results is provided in Appendix F. Copies of the Laboratory Certificates of Analysis for paint chip samples analyzed are included in Appendix G.

Based on our observations and interpretations of suspected LCP sample analytical results, the paints presented in the table in Appendix H were identified as LCPs.

The following information is included for each identified LCP:

- Paint colour
- Substrate to which paint is applied
- Location/approximate extent of the LCP within the building
- Lead content of paint
- Condition
- Representative photographs, where available

Our assessment methodologies and findings are further summarized in the following sub-sections.



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3.3.1 Methodology

A visual assessment of accessible areas was undertaken in order to check for the presence of materials that may contain lead. These materials included paint applications, wiring and plumbing, batteries, etc.

3.3.1.1 Lead in Paint

With respect to potential lead exposures associated with disturbance to surfaces coated with lead-containing products, the 2011 WorkSafeBC manual titled *Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry*, indicates the following:

- Improper removal of lead paint containing 600 mg/kg lead results in airborne lead concentrations that exceed half of the exposure limit
 - Exposure limit indicated in both the COHSR and BC Reg. 296/97 is 0.05 mg/m³
 - Potential for exposure exceeding half of the occupational exposure limit would be the trigger for implementation of an exposure control plan
- Lead concentrations as low as 90 mg/kg may present a risk to pregnant women and children
 - Any risk assessment should include for the presence of high risk individuals within the workplace

In addition to the above, the 2017 WorkSafeBC publication *Safe Work Practices for Handling Lead* (Lead Guideline) indicates the following:

Unlike for asbestos-containing material, WorkSafeBC does not numerically define what would be considered a lead-containing paint or coating. All suspected paints or coatings should be tested for lead because, depending on the nature of the work, even a small amount could pose a risk to workers. In order to determine which controls and personal protective equipment would be required for a particular job, a qualified person must consider this information as part of the risk assessment.

When reviewing the above, “high risk” individuals are not expected to be present in the workplace associated with the buildings during building material alteration activities (i.e., renovation/demolition) that would create significant disturbance to paint with such individuals present. As such, Stantec will reference a value of greater than 600 ppm in defining paints as “lead-containing” for the purpose of this report, such that appropriate risk assessments can be completed for demolition planning. However, information regarding the lead content of all paints tested is provided herein, for reference and risk assessment should the consideration of high risk individuals be necessary, based on the requirements of a particular situation.

Based on the above, samples of potential LCPs were collected from major paint applications, in sufficient quantity to conduct analysis for total lead content. The sampling of paint applications involved the collection of paint chip samples of paint layers to the substrate, where possible. A minimum volume of 5 cc or a half teaspoon of paint chips was typically collected. Wherever necessary and possible, paint was separated from any backing material such as paper, concrete or wood and placed in a sealed, clearly labelled plastic bag.

Samples collected were submitted to EMSL for analysis of total lead content using EPA Method SW 846 3050B*/7000B. EMSL’s analytical laboratory is also accredited by the AIHA Environmental Lead Laboratory Approval Program (ELLAP).



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Welding, Burning or Torch Cutting

Although a concentration of 600 ppm lead has been used to define paint coatings as LCPs, it should be noted that this is related to painted surfaces and the determination of appropriate provisions to protect occupants and employees from exposure to elevated concentrations of lead during typical operations and maintenance or simple renovation. This does not include painted metal surfaces that are to be welded, burned or torch-cut.

Using an arc welder or oxyacetylene torch on steel that is coated with lead-containing paint can create hazardous lead fumes and is prohibited by section 12.115 of BC Reg. 296/97.

Regulatory excerpt: **12.115 Coatings on metals**

A coating on metal which could emit harmful contaminants (such as lead, chromium, organic materials, or toxic combustion products) must be removed from the base metal, whenever practicable, before welding or cutting begins.

In addition, the following information is provided in the Lead Guideline:

- Welding or torch cutting of paints or coatings on metal can create very high concentrations of airborne lead fumes. Torch cutting structural steel, coated with paint containing as little as 130 mg/kg (equivalent to ppm) lead, can release airborne levels of lead as high as 0.8 mg/m³ (16 times the exposure limit).

Given this information and that the analytical detection limit for lead paint analysis is approximately 80–90 ppm (not significantly different than 130 ppm, which, per above, may release airborne lead levels 16 times the exposure limit), any paint coating on a metal surface to be welded, burned or torch-cut must be removed prior to that action being undertaken, unless a project-specific or tasks-specific risk assessment and safe work practices are developed by a qualified person.

3.3.1.2 Building Materials—Leachable Lead Content

According to BC Reg. 63/88, lead waste may be considered a toxic leachate (and require special disposal) if lead is in a dispersible form and its leachate contains greater than 5.0 mg/L lead.

Based on the above, bulk samples of painted building materials that would be expected to be disposed-of via landfill were collected in a form presumed to be representative of waste generated during demolition, each sample containing over 50 g in weight. The samples were submitted to EMSL in Indianapolis, Indiana.

Upon receipt and review of paint chip sample analytical results for total lead content, leachate analysis of building materials coated with identified LCPs was requested. Leachate analysis was conducted by EMSL through toxicity characteristic leaching procedure, using US EPA Method SW846, 1311/7420.



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3.3.1.3 Assessment of Paint Condition

The criteria for condition evaluation pertaining to LCPs described herein are generally based on the United States Housing and Urban Development (HUD) 2012 *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*.

When evaluating the condition of LCPs, an attempt should be made to determine whether the deterioration is due to a moisture problem or some other existing building deficiency.

“**Poor**” surfaces are considered to be a hazard and should be corrected. “**Fair**” surfaces should be repaired but are not yet considered to be a hazard; if not repaired, they should be monitored frequently. “**Good/intact**” surfaces should be monitored to ensure that they remain in a nonhazardous condition.

In addition, the presence of paint debris must be considered in evaluating condition. Given the variety of paint uses, there are many applications that can have a tendency for the paint to “wear” from the surface slowly, over an extended period of time. Conditions where paint has worn from a surface are worth noting for maintenance discussions (i.e., related to re-coating the surface should, for example, the coating provide weather protection), however, in the absence of loose paint chip debris/dust, such conditions would not represent a potential exposure situation related to lead.

The condition evaluation criteria for LCPs are summarized in Table 1, below.

Table 1 Lead-Containing Paint Condition Categories

| Type of Building Component ¹ | Total Area of Deteriorated Paint on Each Component | | |
|--|--|---|--|
| | Good/Intact | Fair ² | Poor ³ |
| Exterior components with large surface areas. | Entire surface is intact. | Less than or equal to 10 ft ² | More than 10 ft ² |
| Interior components with large surface areas (walls, ceilings, floors, doors). | Entire surface is intact. | Less than or equal to 2 ft ² | More than 2 ft ² |
| Interior and exterior components with small surface areas (window sills, baseboards, soffits, trim). | Entire surface is intact. | Less than or equal to 10% of the total surface area of the component. | More than 10% of the total surface area of the component |
| <p>NOTES:</p> <p>¹ Building component in this table refers to each individual component or side of building, not the combined surface area of all similar components in a room (e.g., a wall with 1 ft² of deteriorated paint is in “fair” condition, even if the other three walls in a room are intact).</p> <p>² Surfaces in “fair” condition should be repaired and/or monitored but are not considered to be “lead-containing paint hazards”.</p> <p>³ Surfaces in “poor” condition are considered to be “lead-containing paint hazards” and should be addressed through abatement or interim controls.</p> | | | |



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3.3.2 Findings

Lead is expected to be present in the following within the subject buildings:

- Equipment Storage Shed and Office:
 - Older electrical wiring materials
 - Solder used on domestic water lines
- Maintenance Shed:
 - Older electrical wiring materials

3.3.2.1 Lead in Paint

Greater than 600 ppm lead was detected through laboratory analysis of chip samples of the following paints:

- Equipment Storage Shed and Office:
 - Off-white coloured paint on interior plywood wall and wood door/trim
 - Beige coloured paint on interior and exterior concrete floor/foundation
- Maintenance Shed:
 - Green coloured paint on exterior wood trim
 - White coloured paint on exterior wood siding

Additional information regarding extent and current condition of identified LCPs, including photographs (where available) is provided in Appendix H.

3.3.2.2 Building Materials—Leachable Lead Content

Bulk samples of building materials that are expected to be disposed of via landfill and that are coated with the herein identified LCPs were collected in a form presumed to be representative of waste generated during demolition and were submitted to EMSL for analysis of leachable lead content.

A summary of the sample types, locations and analytical results is presented in Table 2, below. A copy of the certificate of analysis provided by EMSL for the bulk painted building material samples submitted is included in Appendix G.

**Table 2 Painted Building Material Sample Collection and Lead Leachate Analysis Summary
Veteran's Cemetery, 1190 Colville Road, Esquimalt, BC**

| Sample Number | Paint Description and Application | Initial Result (Total Lead, ppm) | Leachate Result (mg/L) |
|--|--|----------------------------------|------------------------|
| Equipment Storage Shed and Office | | | |
| O-L03 | Off-white—interior plywood wall and wood door/trim | 720 | <0.40 |
| Maintenance Shed | | | |
| S-L01 | Green—exterior wood trim | 11,000 | 6.1 |
| S-L02 | White—exterior wood siding | 47,000 | 6.1 |
| NOTE: Bold highlighted text indicates material that contains lead in a dispersible form such that its leachate contains greater than 5.0 mg/L lead. | | | |



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Analytical results indicate that the following materials contain lead in a dispersible form such that their leachates contain greater than 5.0 mg/L lead, indicating that the materials will require segregation and special disposal during demolition:

- Maintenance Shed
 - Green painted exterior wood trim
 - White painted exterior wood siding

3.3.3 Recommendations

LCPs in poor condition (beige floor paint) should be addressed during the renovation project within the Equipment Storage Shed and Office.

When paints or other lead-containing equipment/materials within the subject buildings are to be disturbed and/or removed, including in instances where poor condition LCPs are addressed, ensure compliance with the following:

- Exposure protection requirements of the COHSR and BC Reg. 296/97, including the provisions of the Lead Guideline
- Transportation and disposal requirements of the 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 COHSR and BC Reg. 296/97 eight-hour occupational exposure limit (OEL) of 0.05 mg/m³ 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 personal protective equipment or devices as necessary to protect the worker against the hazards to which the worker may be exposed
- Providing workers with adequate 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.



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3.3.3.1 Welding, Burning or Torch Cutting

Any paint coating on a metal surface to be welded, burned or torch-cut must be removed prior to that action being undertaken, unless a project-specific or tasks-specific risk assessment and safe work practices are developed by a qualified person. Development of such risk assessments and work practices will involve consideration of information including, but not limited to, the following:

- Composition of the material to be disturbed
- Lead content of the paint coating
- Methods and tools to be used, including exhaust ventilation
- Duration of the work/work shift
- Training of the personnel conducting the task
- Respiratory protection program in effect

3.4 POLYCHLORINATED BIPHENYLS

3.4.1 Methodology

A visual review for the presence of PCBs in electrical equipment was completed. Equipment that is generally suspected of containing PCBs includes lamp ballasts, transformers, hydraulic systems, compressors, switchgear and capacitors.

No sampling of dielectric fluids was undertaken as part of this assessment.

3.4.2 Findings

No suspected PCB-containing equipment was observed within either of the subject buildings.

3.4.3 Recommendations

As PCB-containing equipment was not identified, no recommendations have been provided.



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3.5 MOULD

3.5.1 Methodology

The presence of suspect visible mould was assessed through visual observations. Material observed with dark-coloured staining and/or a textured and discoloured appearance is described as “suspected mould”. Mould identified visually is defined as “suspected mould” unless it is confirmed as mould by laboratory analysis.

The scope of work and procedures utilized for the visual assessment were based on the recommendations for such 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 and Mental Hygiene, November 2008 (referred to as the NYC Guidelines)
- *Fungal Contamination in Public Buildings: Health 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)
- *Field Guide for the Determination of Biological Contaminants in Environmental Samples*, AIHA, Second Edition 2005

3.5.2 Findings

Suspect mould or moisture-impacted building materials were not observed within either of the subject buildings.

3.5.3 Recommendations

As no mould and/or moisture-impacted building materials were observed within the subject buildings during the assessment, no recommendations have been provided.

3.6 MERCURY

3.6.1 Methodology

An assessment for equipment that is likely to contain mercury (such as thermostats, thermometers and fluorescent light tubes) was completed visually. Information on the type of equipment (i.e., gauges, switches, batteries, thermometers, etc.), model and serial numbers and quantities was recorded, where such information was available.

3.6.2 Findings

Mercury vapour is present in the seven light tubes within the four fluorescent light fixtures observed within the Equipment Storage Shed and Office.

Items suspected to contain liquid mercury or mercury vapour were not observed within Maintenance Shed.



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3.6.3 Recommendations

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 tubes) are removed, ensure all mercury waste is handled, stored transported and disposed of in accordance with the requirements the following:

- Transportation and disposal requirements of the 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/m³ as per the COHRS and BC Reg. 296/97 This can be achieved by providing respiratory and skin protection applicable to the hazard and task to be completed.

3.7 OZONE DEPLETING SUBSTANCES

3.7.1 Methodology

An assessment for equipment or systems likely to contain ODSs (such as refrigeration/cooling equipment or fire suppression systems) was completed visually. Information on the type of equipment, manufacturer and type and quantity of refrigerants was recorded, where available.

3.7.2 Findings

Building related cooling, refrigeration or fire suppression equipment suspected to be ODS-containing was not observed within either of the subject buildings.

3.7.3 Recommendations

As no suspect ODS-containing equipment was observed within the subject buildings during the assessment, no recommendations have been provided.

3.8 SILICA

3.8.1 Methodology

An assessment for the presence of silica was conducted visually. The presence of typical silica-containing building materials such as concrete, masonry, stone, terrazzo, refractory brick, gypsum, ceramic tile, ceiling tile and other items, was noted.



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3.8.2 Findings

Silica is expected to be present in the following, which were observed in various locations throughout the Equipment Storage Shed and Office and maintenance shed:

- Cement products such as concrete foundations
- Asphalt and asphalt products containing rock or stone (e.g., roof sheeting or shingles).

3.8.3 Recommendations

If silica-containing materials within the subject buildings are to be disturbed and/or removed (e.g., coring through or demolishing concrete slabs, removal of roofing), ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by the COHSR and BC Reg. 296/97 (cristobalite and quartz—each 0.025 mg/m³). This would include, but not be limited to, the following:

- Providing workers with respiratory protection
- Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
- Providing workers with facilities to properly wash prior to exiting the work area

4.0 CLOSURE

This report has been prepared for the sole benefit of the Client. Any use which a third party makes of this report, or any reliance on decisions 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 information and conclusions contained in this report are based upon work undertaken by trained professionals and technical staff in accordance with generally accepted engineering, scientific and occupational health and safety practices current at the time the work was performed. Conclusions presented in this report should not be construed as legal advice.

The conclusions presented in this report represent the best technical judgment of Stantec Consulting Ltd. based on the data obtained from the work. The conclusions are based on the site conditions encountered by Stantec Consulting Ltd. at the time the work was performed at the specific assessment and/or sampling locations and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on building construction and conditions, weather, building usage and other factors. Due to the nature of the investigation and the limited data available, Stantec Consulting Ltd. cannot warrant against undiscovered environmental or health and safety liabilities.

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.



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We trust that the above is satisfactory for your purposes at this time. Should you have any questions or concerns, or require additional information, please do not hesitate to contact the Stantec Project Manager at your convenience.

Regards,

Stantec Consulting Ltd.

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**APPENDIX A
HAZARDOUS BUILDING MATERIALS
BACKGROUND INFORMATION, HEALTH
EFFECTS INFORMATION AND
REGULATORY FRAMEWORK**

Appendix A HAZARDOUS BUILDING MATERIALS BACKGROUND INFORMATION, HEALTH EFFECTS INFORMATION AND REGULATORY FRAMEWORK

A.1 ASBESTOS

Asbestos is a naturally occurring form of fibrous silicate that is durable and flexible; has high thermal and tensile strength; is resistant to heat, chemical corrosion and friction; does not conduct electricity; and insulates well against condensation, heat and noise. Due to these properties, asbestos was used in over 3,000 commercial products, and it is estimated that approximately 70% of the asbestos that was used in North America was used in building materials.

In buildings, and among many other potential asbestos-containing materials, asbestos is typically found in plaster, mechanical insulation, gaskets, thermal insulation on pipes, refractory material, roofing felts, floor tiles, ceiling tiles and parging, heat resistant panels, incandescent light fixture reflector plates, and any other material requiring a high degree of durability or thermal resistance.

Asbestos-containing materials are grouped into two classifications, friable and non-friable materials. Friable ACMs are those that can easily be crumbled or broken apart by mere hand pressure. When these materials break apart asbestos fibres are then released into the atmosphere. Non-friable ACMs or “manufactured products” are materials that by the nature of their manufacturing/construction do not readily allow the release of asbestos fibres. These materials should not be cut or shaped with power tools, since this procedure may allow for the release of the asbestos fibres. Some materials or “manufactured products”, such as plaster, drywall and ceiling tiles that are considered to be non-friable in an undisturbed state can become friable when damaged or disturbed.

The common use of friable (breakable by hand) asbestos-containing materials (ACMs) in construction ceased voluntarily in the mid-1970s; however, the spray application of asbestos-containing fireproofing was not prohibited until 1986. A material known as vermiculite, which was commonly used for insulation within attics, floor spaces or within masonry block wall systems and may be contaminated with asbestos due to its production processes, was used into the mid-1990s. In addition, asbestos cement products and roofing products (e.g., sealants) currently used in the construction of buildings may still contain asbestos.

A.1.1 Health Effects

Undisturbed asbestos within building materials poses no health risks. Asbestos poses a risk when building materials containing asbestos are impacted, or disturbed, thereby releasing the asbestos fibres into the air.

Asbestos-related diseases are caused when suspended airborne asbestos fibres are inhaled and the fibres settle into various regions of the lungs and remain for extended periods. Once embedded in the lungs the asbestos fibres cause scarring within the lung tissue, ultimately leading to impaired lung function (asbestosis) and/or various cancers (lung cancer; mesothelioma). These asbestos-related diseases are irreversible and fatal. The risk of lung-related cancers is increased in individuals who smoke.



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These asbestos-related diseases most often occur in individuals who have been exposed to high concentrations of airborne asbestos over a long period of time, though mesothelioma has been found in individuals with short-term exposures. Symptoms or the development of these asbestos-related diseases usually occur 10 to 25 years after exposure.

A.1.2 Regulatory Framework

Asbestos is included in the Canada Labour Code, Part II Canada Occupational Health and Safety Regulations (COHSR) and British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97). Included in both regulatory instruments are provisions for the general duties of employers, requirements for health assessments, training and project notification. There are also sections that will also apply to abatement projects, depending on the work procedures and specific work site hazards.

The COHSR and BC Reg. 296/97 also established an 8-hour occupational exposure limit (OEL) for asbestos (all forms) to be 0.1 fibre/cubic centimetre.

The 2017 WorkSafeBC publication *Safe Work Practices for Handling Asbestos* (Asbestos Guide) is used by Occupational Health and Safety officers as a guide when reviewing abatement work practices and employer codes of practice, and generally meets the requirements of the COHSR.

The Asbestos Guide also provides significant additional background information pertaining to asbestos, along with details on health effects and other applicable legislation within the province of British Columbia (e.g., the federal *Hazardous Products Act*, the BC Building Code and waste disposal regulations).

According to the COHSR, ACM means:

- Any article that is manufactured and contains 1% or more asbestos (by weight) at the time of manufacture, or any material that contains 1% or more asbestos when tested in accordance with accepted methods.

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.

Disposal of asbestos waste is governed by the British Columbia Hazardous Waste Regulation (BC Reg. 63/88). The Federal Transportation of Dangerous Goods Regulation and BC Reg. 63/88 set out the requirements for the proper transport of asbestos waste in British Columbia. In general, and for transportation and disposal, the waste must be placed in a double sealed container, properly labeled, free of cuts, tears or punctures and disposed of at a licensed waste station which has been properly notified of the presence of asbestos waste.

A.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.



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Organic lead compounds contain a lead atom covalently bonded to carbon. Common examples of organic lead compounds include lead “soaps” such as lead oleates, high pressure lubricants, and anti-knock agents in gasoline.

Inorganic lead compounds (or lead salts) result when lead is combined with an element other than carbon. Examples are lead oxide, lead chromate, lead carbonate and lead nitrate. Inorganic lead compounds may occur as solids or in solutions, and are used in insecticides, pigments, paints, frits, glasses, plastics, and rubber compounds.

Lead is commonly found in buildings in items such as the solder used on copper domestic pipes; the caulking on bell fittings of cast iron drainage pipes; electrical equipment/wiring; batteries (e.g., emergency exit signage batteries); lead sheeting (e.g., x-ray rooms); vent and pipe flashings; and paints and ceramic tile glazes.

A.2.1 Health Effects

Elemental lead and inorganic lead compounds are absorbed through ingestion or inhalation and can incorporate into the bone marrow, nerve tissue, brain, and kidneys. In children, symptoms of lead poisoning can include headaches, irritability, abdominal pain, vomiting, anemia, weight loss, poor attention span, noticeable learning difficulty, slowed speech development, and hyperactivity. In adults, symptoms of lead poisoning can include pain, numbness or tingling of the extremities, muscular weakness, headache, abdominal pain, memory loss, unsteady gait, pale skin, weight loss, vomiting, irritability, and anemia. Although adults are susceptible to the toxic effects of lead, children are at high risk due to the nature of a child's activities that involve the introduction of non-food items into their bodies.

Excessive airborne lead and surface contamination can be transferred to employees' hands and may result in lead ingestion. Therefore, work practices intended to minimize surface lead concentrations, such as frequent cleaning of work surfaces should be included in an overall lead exposure control plan.

A.2.2 Regulatory Framework

In the past, the United States Department of Housing and Urban Development (HUD) set a criteria of lead-based paint as 0.5% lead (by weight) or 5,000 parts per million (ppm) for evaluating whether lead is a hazard in a residential setting.

In Canada, the Surface Coating Materials Regulations (SOR/2005-109) under the federal *Hazardous Products Act* provides a concentration of lead that must not be exceeded in surface coatings that are presently sold in this country. This value has recently been reduced from 600 ppm (2005) to 90 ppm (2010). However, it is important to note that this regulation does not comment on the potential occupational exposure if the material is disturbed.

Under the COHSR and BC Reg. 296/97, a regulatory limit has been established for occupational exposure to airborne lead that may be present in a workplace. The OEL for airborne lead dust or fumes per both regulatory instruments should not exceed the TWA value of 0.05 milligram per cubic metre of air (mg/m³). The OEL represents the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects.

With respect to potential lead exposures associated with disturbance to surfaces coated with lead-containing products, the 2011 WorkSafeBC manual titled *Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry*, indicates the following:



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- Improper removal of lead paint containing 600 mg/kg lead results in airborne lead concentrations that exceed half of the exposure limit
 - This potential for exposure exceeding half of the occupational exposure limit would be the trigger for implementation of an exposure control plan
- Lead concentrations as low as 90 mg/kg may present a risk to pregnant women and children
 - Any risk assessment should include for the presence of high risk individuals within the workplace

In addition to the above, the 2017 WorkSafeBC publication *Safe Work Practices for Handling Lead* (Lead Guideline) indicates the following:

Unlike for asbestos-containing material, WorkSafeBC does not numerically define what would be considered a lead-containing paint or coating. All suspected paints or coatings should be tested for lead because, depending on the nature of the work, even a small amount could pose a risk to workers. In order to determine which controls and personal protective equipment would be required for a particular job, a qualified person must consider this information as part of the risk assessment.

Work procedures that can be used to assist in protecting workers and adjacent work areas from exposure to lead during disturbance activities can also be found in this document.

According to the British Columbia Hazardous Waste Regulation (BC Reg. 63/88), lead waste may be considered a toxic leachate (and require special disposal) if lead is in a dispersible form and its leachate contains greater than 5.0 milligrams per litre (mg/L) lead.

The Federal Transportation of Dangerous Goods Regulation and BC Reg. 63/88 set out the requirements for the proper transport of lead waste in British Columbia.

A.3 POLYCHLORINATED BIPHENYLS (PCBS)

PCBs are man-made toxic chemicals whose physical and chemical properties produce the following attributes: fire resistance, low electrical conductivity, high resistance to thermal breakdown, high chemical stability and resistance to oxidants and other chemical.

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. Stocks of items such as ballasts containing PCBs may have been used into the early or mid-1980s.

A.3.1 Health Effects

PCBs are insoluble in water; however, they readily dissolve in fats and other organic compounds. It is these attributes and fat-solubility that allow PCBs to persist in the environment and bio-accumulate in humans and animals. Exposure to PCBs can affect the immune system, reproductive system, nervous system and endocrine system. In humans, PCBs are potentially cancer-causing.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix A Hazardous Building Materials Background Information, Health Effects Information and Regulatory Framework
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A.3.2 Regulatory Framework

As of September 5, 2008, under subsection 93(1) of the Canadian *Environmental Protection Act*, (CEPA), Federal PCB regulations were published by the Canada Gazette Part II (SOR/2008-273) that imposed specific deadlines for the elimination of all PCBs in concentrations at or above 50 milligrams/kilogram (mg/kg). This regulation required the elimination of all PCBs and PCB-containing materials currently in-use and in storage and limited the period of time PCB materials could be stored before being eliminated. Other aspects of the regulation govern the labelling and reporting of stored PCB materials and equipment as well as improved practices for the management of PCBs that remain in use (i.e., those with PCB concentrations less than 50 mg/kg) until their eventual elimination.

Under SOR/2008-273, the following end-of-use dates were established:

- December 31, 2009
 - Equipment containing PCBs in a concentration of 500 mg/kg or more
 - Equipment containing PCBs in a concentration of at least 50 mg/kg but less than 500 mg/kg when located in sensitive locations (i.e., drinking-water treatment plant, food or feed processing plant, child care facility, preschool, primary or secondary school, hospital, or senior citizen care facility or the property on which the plant or facility is located, within 100 m of it)
- December 31, 2014
 - Certain specified equipment not replaced by the 2009 deadline due to technical constraints for engineered-to-order equipment or if the facility is scheduled for permanent closure before 2014
- December 31, 2025
 - Equipment containing PCBs in a concentration of at least 50 mg/kg but less than 500 mg/kg when located in non-sensitive locations

In addition to the above, a maximum storage period of one year is allowed for PCBs and products that contain PCBs at each of the following non-sensitive locations:

- Owner's PCB storage site
- PCB storage site of an authorized facility for decontamination or of an authorized transfer site
- PCB storage site of an authorized destruction facility

For British Columbia, according to the British Columbia Hazardous Waste Regulation (BC Reg. 63/88):

- PCB wastes are defined as: PCB liquid, PCB solid, and PCB equipment that have been taken out of service for the purpose of treatment, recycling, reuse, or disposal, or for the purpose of storage prior to treatment, recycling, reuse, or disposal
 - "PCB liquid" means any liquid containing more than 50 parts per million (ppm) by weight of PCB
 - "PCB solid" means any material or substance other than PCB liquid that contains or is contaminated with chlorobiphenyls at a concentration greater than 50 ppm by weight of chlorobiphenyls
 - "PCB Equipment" means any manufactured item that contains or is contaminated with a PCB liquid or PCB solid is PCB equipment. While items of PCB equipment are often electrical components such as transformers or capacitors, the definition includes other items such as contaminated drums and containers.
 - o NOTE: An item of equipment from which PCB liquid or PCB solid has been removed is still PCB equipment until it has been decontaminated by an approved protocol. This is because the removal is a treatment process and the equipment, until decontaminated, is a residue from the treatment

In British Columbia, PCB equipment becomes PCB wastes as soon as it is removed from service. This is the case even if the intent is to treat, recycle, or reuse the equipment.



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When PCB wastes are stored in British Columbia, the full requirements of BC Reg. 63/88 apply to:

- 1.0 kg or more of pure PCB
- 100 L or more of any liquid containing more than 50 ppm of PCB
- 100 kg or more of any material other than a liquid, contaminated with more than 50 ppm of PCB

These amounts are the total of all amounts at a single location owned or controlled by the same person. They include PCB equipment. BC Reg. 63/88 also provides packaging requirements for storage, labeling requirements, waste destruction requirements, and references SOR/2008-273, indicating

NOTE: The federal PCB Regulations also apply to stored PCBs and have strict maximum allowable storage periods which would prohibit provisions in [BC Reg 63/88] related to storage prior to 1 April 1992. In event of a conflict between [BC Reg 63/88] and [SOR/2008-273], follow [SOR/2008-273].

The Federal Transportation of Dangerous Goods Regulation sets out the requirements for the proper transport of PCB waste across provincial boundaries.

In British Columbia, a manifest issued by the Ministry of Environment (or equivalent federal document) must be used for hazardous wastes shipped from sites in British Columbia. A manifest must be used to transport:

- 5 kg or more of PCB solids
- 5 L or more of PCB liquids
- Amount of a PCB solid or PCB liquid containing more than 500 g of PCB within BC
- 500 g or more of solids, liquids, or mixtures of these containing 50 mg/kg of PCB outside of BC

A.4 MOULD

Mould can be found everywhere in the outside environment—on plants, in soil and on dead and decaying matter (i.e., dead leaves). Mould requires two main conditions in order to grow—a source of food (a substrate typically comprised of cellulose) and water. Sources of food for mould are plentiful in outdoor and indoor environments; however, it is the presence of water in an indoor environment that will determine mould growth. The source of water can be a result of a water pipe leak or even excess condensation. Thus, the key to controlling mould indoors is to control the presence of water.

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.

A.4.1 Health Effects

There are a number of documented cases of health problems related to exposure to indoor fungi. Both high-level, short-term exposures and lower-level, long-term exposures can result in illness. The most common symptoms from exposure to mould in indoor environments are runny nose, eye irritation, cough, congestion, aggravation of asthma, headache, flu-like symptoms, fatigue, and skin rash. People with suppressed immune systems may be susceptible to fungal infections as a result of exposure to indoor moulds.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix A Hazardous Building Materials Background Information, Health Effects Information and Regulatory Framework
September 24, 2018

People who are exposed to mould growth on building materials will not necessarily exhibit adverse health effects. However, the mould must still be removed. Humans are at risk from indoor mould when fungal spores, fragments or metabolites are released into the air and inhaled or physically contacted (dermal exposure).

Not everyone experiences allergic reaction; the susceptibility to exposure varies with the individual's genetic predisposition, age, state of health, and concurrent exposures. For these reasons, and because the measurement of exposure is not standardized and biological markers of exposure to fungi are largely unknown, it is not possible to establish "safe" or "unsafe" levels of exposure. However, federal and provincial policies have been written to minimize mould exposure and the elimination of mould indoors.

A.4.2 Susceptibility to Mould Exposure

People's reaction to mould exposure is quite varied, and although anyone can be affected, some people may be more susceptible and at greater risk, including:

- Infants and children
- Elderly
- Pregnant women
- Individuals with respiratory conditions or allergies and asthma
- Persons with weakened immune system (e.g., chemotherapy patients, organ or bone marrow transplant recipients, and people with HIV infections or autoimmune diseases)

People with specific health concerns should consult their doctor if concerned about mould exposure. Symptoms that may appear to stem from mould exposure may be due to other causes such as bacterial or viral infections or other allergies.

A.4.3 Regulatory Framework

At present, there are no specific laws or regulations governing acceptable levels of mould in buildings. The lack of specific regulatory standards is due in part to an inability to establish exposure-response relationships. Variation in individual susceptibility, limitations in sampling and analytical techniques, and the vast number of fungal agents and their products make it difficult to establish safe levels of exposure for all individuals. With a lack of defined exposure criteria, current Health Canada and other agency guidelines on the assessment and control of mould contamination in public buildings are largely based on prudent avoidance (i.e., remove any indoor growth or amplification site of mould, regardless of the concentration of moulds or their products in the indoor environment).

Although there are currently no regulations in Canada pertaining specifically to mould in buildings, occupational health and safety regulations typically require employers to take every precaution reasonable in the circumstances for the protection of workers. For example, BC Reg. 296/97 indicates the following:

- Section 4.79(1):
 - Employer must ensure that the indoor air quality is investigated when
 - a) complaints are reported
- Section 4.79(2):
 - Air quality investigation must include
 - c) sampling for airborne contaminants suspected to be present in concentrations associated with the reported complaints



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The WorkSafeBC Guideline for Part 4 of BC Reg. 296/97 discusses the application of the Regulation to workplaces with mould showing on exposed or hidden surfaces, or where mould may be a factor in complaints regarding indoor air quality. The guideline provides information for investigating indoor air quality complaints with respect to mould contamination, including information on sampling for the presence of moulds in buildings. Information is also provided on possible health effects and for cleanup personnel involved in the remediation of buildings damaged by water and mould.

Several additional guidelines and other resources describe procedures for the investigation and remediation of mould. The following documents indicate that mould observed in occupied building should be remediated in accordance with these procedures:

- Environmental Abatement Council of Ontario's (EACO) *Mould Abatement Guidelines*, 2010—Edition 2
- *Mould Guidelines for The Canadian Construction Industry*, Canadian Construction Association—82, 2004
- *Guidelines on Assessment and Remediation of Fungi in Indoor Environment*, New York City Department of Health and Mental Hygiene, November 2008
- *Bioaerosols: Assessment and Control*, ACGIH 1999
- *Fungal Contamination in Public Buildings: Health Effects and Investigation Methods*, Federal-Provincial Committee on Environmental and Occupational Health 2004
- *Field Guide for the Determination of Biological Contaminants in Environmental Samples*, AIHA 1996
- *Clean-Up Procedures for Mould in Houses*, Canada Mortgage and Housing Corporation (CMHC) 2004

A.5 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. If mercury is exposed to the air, odourless vapours are formed.

A.5.1 Health Effects

Routes of exposure for mercury and mercury compounds include inhalation, ingestion, skin and/or eye contact. Mercury is hazardous if it is inhaled or absorbed through the skin, therefore exposure controls (including both respiratory protection and skin protection) are important to consider.

Elemental (metallic) mercury most often causes health effects through inhalation of its vapour, which can be absorbed through the lungs. This kind of exposure can result when elemental mercury is spilled (or products that contain elemental mercury break) and the mercury is exposed to the air. Vapour concentrations can vary especially in warm or poorly-ventilated indoor spaces where the airborne concentration can exceed the permissible exposure limit (provincially set).

Chronic mercury “poisoning” can be caused by long-term exposure to low airborne concentrations (or low levels) of mercury. Symptoms or effects of mercury exposure include: tremors, emotional changes (e.g., mood swings, nervousness, irritability, etc.), neuromuscular effects (e.g., muscular weakness, twitching), mental changes/disturbances, digestive disturbances, headaches, insomnia, and changes in nervous response.



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Factors that determine the severity of the health effects from mercury exposure include the following:

- Chemical form of mercury (e.g., elemental, methylmercury, inorganic and organic)
- Dose
- Age of individual exposed
- Duration of exposure
- Route of exposure—as listed above
- Health of individual exposed

A.5.2 Regulatory Framework

In Canada, the Surface Coating Materials Regulations (SOR/2005-109) under the federal *Hazardous Products Act* provides a concentration of mercury that must not be exceeded in surface coatings that are presently sold in this country. This value was set at 10 ppm in 2005. However, it is important to note that there is not a direct correlation between the concentration of mercury in a material to the potential occupational exposure if the material is disturbed.

Exposure to mercury is regulated by the COHSR and BC Reg. 296/97. The regulated occupational exposure limit for airborne mercury according to both regulatory instruments is 0.025 mg/m³ (eight-hour TWA).

Mercury disposal should be through a scrap dealer (elemental mercury), recycling firm for mercury vapour and returned to the manufacturer for light tubes and fixtures. Disposal of mercury waste is governed by BC Reg. 63/88.

The Federal Transportation of Dangerous Goods Regulation and BC Reg. 63/88 set out the requirements for the proper transport of mercury waste in British Columbia.

A.6 OZONE-DEPLETING SUBSTANCES

Ozone-depleting substances (ODSs) are chemical agents known as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) used in various refrigeration equipment including air-conditioning, heat pump, refrigeration or freezer units. They have also been used in solvents, as aerosol additives in the production of foam insulation and in fire extinguishing equipment.

A.6.1 Health Effects

Health effects are not typically related to exposure to ODSs directly, but to the consequences of ODS release to the atmosphere, subsequent degradation of the earth's ozone layer, and implications associated with increased UVB light exposure.

A.6.2 Regulatory Framework

ODSs are regulated in British Columbia 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).



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On federal land, aboriginal land and federal works, buildings and undertakings, the Federal Halocarbon Regulation 2003 (SOR/2003-289) applies. All other buildings and uses of refrigerants and other agents are under the Ozone-Depleting Substances Regulations 1998 (SOR/99-7), under CEPA. The regulations prohibit the release of halocarbons contained in refrigeration systems, air conditioning systems, fire extinguishers (except to fight a fire that is not a fire caused for training purposes) or containers or equipment used in the re-use, recycling, reclamation or storage of a halocarbon.

The regulations also impose restrictions on the servicing and dismantling, disposing of or decommissioning of any system containing halocarbons and requires the recovery of halocarbons into an appropriate container by a certified individual. The regulation also details an owner's record-keeping obligations.

If ODS-containing materials are to be removed and disposed of, all ODSs must be handled, recycled, stored, and/or disposed of in accordance with the requirements of BC Reg. 63/88.

The Federal Transportation of Dangerous Goods Regulation and BC Reg. 63/88 set out the requirements for the proper transport of ODS waste in British Columbia.

A.7 SILICA

Silica is a scientific name that refers to a mineral group made up of silicon and oxygen. It is the crystalline form of silica that is of concern when considering health effects. Crystalline silica occurs in several forms including quartz, cristobalite and tridymite. Silica's many uses include sand in golf courses and playgrounds, sandblasting abrasives, glass, ceramics, building materials (concrete, grout, bricks, blocks, asphalt, acoustical tiles, floor tiles, and plaster), electronic components.

Dust containing respirable crystalline silica is produced during construction-related activities such as the following:

- Demolition
- Masonry, bricklaying and/or stone setting
- Rock drilling
- Repair and/or finishing of concrete materials
- Abrasive blasting
- Dry sweeping
- Quarrying and mining

A.7.1 Health Effects

Crystalline silica dust particles, which are small enough to be inhaled into the lungs (respirable size), can cause a number of health problems. As with asbestos, silica within building materials poses no threat to human health if left undisturbed.

Exposure to crystalline silica airborne dust may cause scarring of the lungs with coughing and shortness of breath—also known as “silicosis”, a form of disabling, progressive, and sometimes fatal pulmonary fibrosis.



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix A Hazardous Building Materials Background Information, Health Effects Information and Regulatory Framework
September 24, 2018

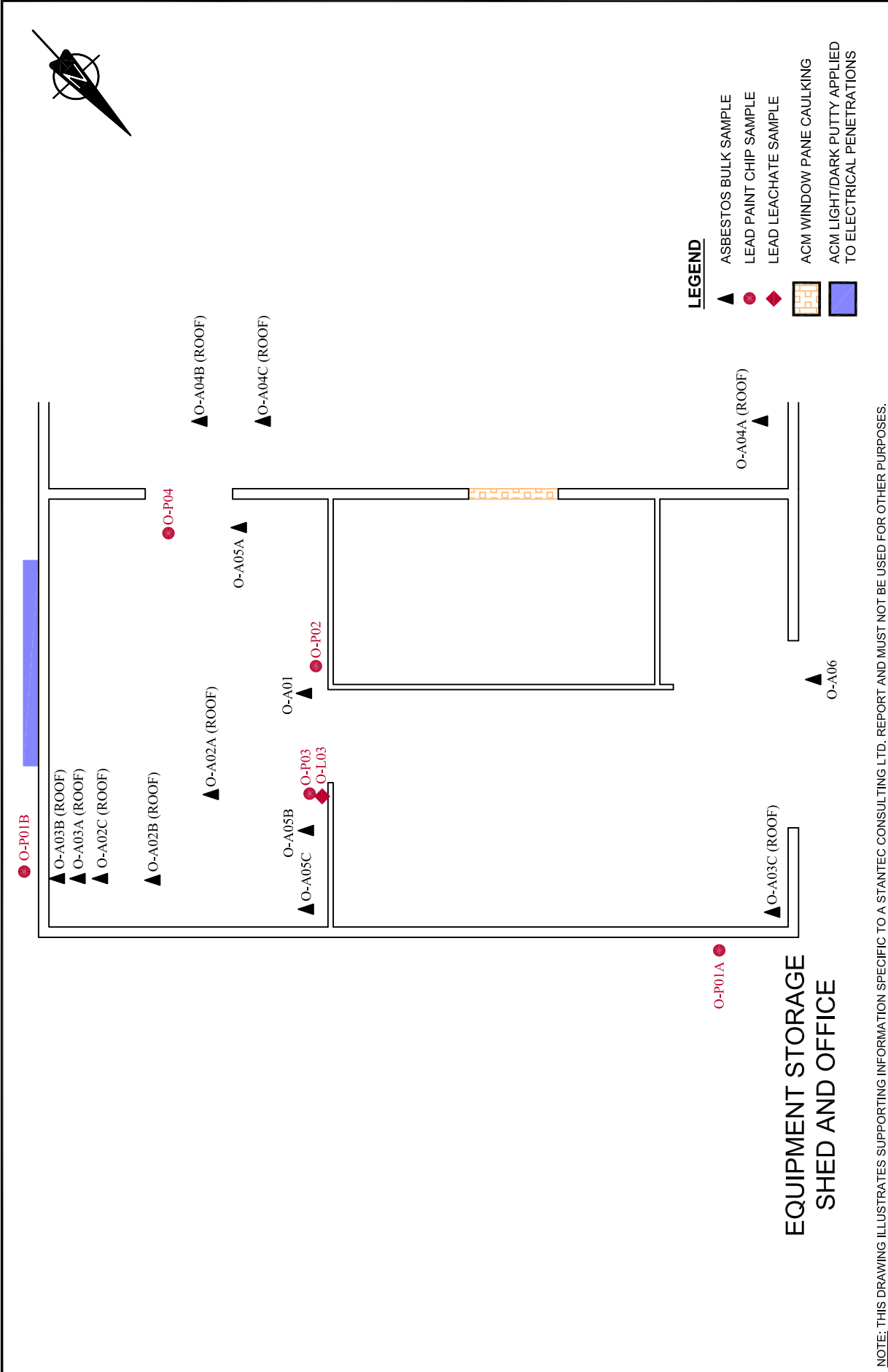
A.7.2 Regulatory Framework

Regulations pertaining to silica are provided in BC Reg. 296/97. Included are general provisions (minimizing release; keeping worksite clear of unnecessary accumulations; ensuring methods for decontamination prevent generation of airborne silica), provisions for “restricted areas” (where there is a reasonable chance that the airborne concentration of silica exceeds or may exceed the occupational exposure limit), provisions for use in abrasive blasting, and provisions for health assessments for workers exposed to silica.

BC Reg. 296/97 and the COHSR also established the eight-hour OEL for silica to be 0.025 mg/m³ for each cristobalite and quartz.



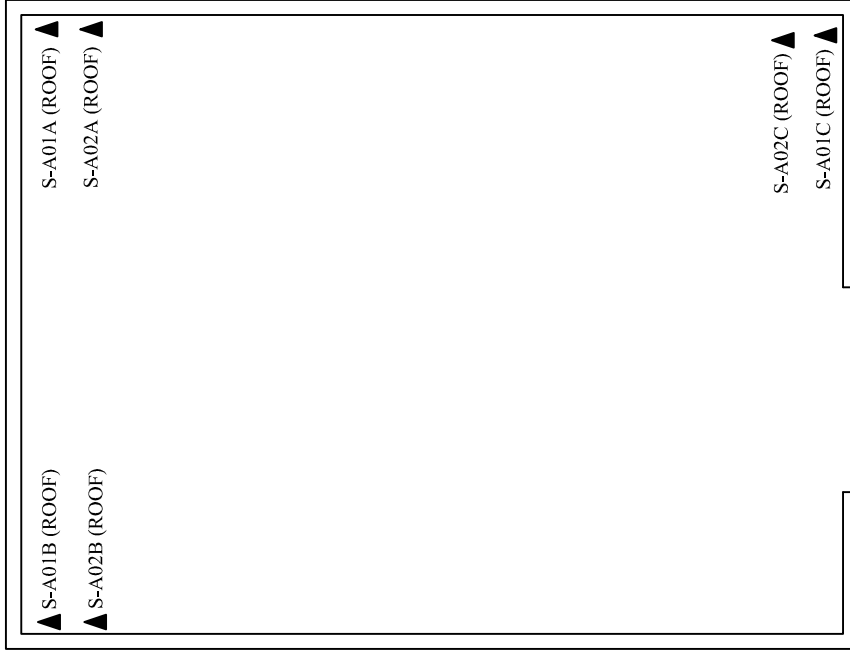
APPENDIX B FLOOR PLANS



**EQUIPMENT STORAGE
SHED AND OFFICE**

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

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| Project No.: 123221204 Scale: N.T.S. | | Dwg. No.: 1 | | |
| | | Date: 18/09/13 | | |
| Project No.: 123221204 | | Date: 18/09/13 | | Client: VETERAN'S CEMETERY - 1190 COLVILLE ROAD, ESQUIMALT, BC PUBLIC SERVICES AND PROCUREMENT CANADA (PSPC) |
| Scale: N.T.S. | | Dwn. By: CD CS/DM | | |
| Date: 18/09/13 | | App'd By: TW | | |
| Dwn. By: CD CS/DM | | | | |



MAINTENANCE SHED

LEGEND

- ▲ ASBESTOS BULK SAMPLE
- LEAD PAINT CHIP SAMPLE
- ◆ LEAD LEACHATE SAMPLE

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

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| Project No.: | 123221204 |
| Scale: | N.T.S. |
| Date: | 18/09/13 |
| Dwn. By: | CD SL2018090092 CS/DM |
| App'd By: | TW |

| | |
|--|----------|
| FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS | |
| VETERAN'S CEMETERY - 1190 COLVILLE ROAD, ESQUIMALT, BC | |
| PUBLIC SERVICES AND PROCUREMENT CANADA (PSPC) | |
| Dwg. No.: | 2 |
| | |

APPENDIX C
SUMMARY OF RESULTS: ANALYSIS OF
BULK SAMPLES FOR ASBESTOS

PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix C Summary of Results: Analysis of Bulk Samples for Asbestos
September 24, 2018

Appendix C SUMMARY OF RESULTS: ANALYSIS OF BULK SAMPLES FOR ASBESTOS

**Table C-1 Suspected ACM Bulk Sample and Analytical Results Summary
Equipment Storage Shed and Office, and Maintenance Shed
Veteran’s Cemetery, 1190 Colville Road, Esquimalt, BC**

| Material/Homogenous Application Description | Sample Number | Sample Location | Result (% Asbestos) |
|--|---------------|---|---------------------|
| Equipment Storage Shed and Office | | | |
| Mastic on roof penetration (one penetration, not enough material for multiple samples) | O-A01 | Roof—central penetration | None Detected |
| Mastic on seams of asphalt roofing | O-A02A | Roof—north central | None Detected |
| | O-A02B | Roof—northeast central | None Detected |
| | O-A02C | Roof—northeast | None Detected |
| Mastic on seams and fasteners of roof flashing | O-A03A | Roof—north flashing—east (fastener) | None Detected |
| | O-A03B | Roof—north flashing—east (seam) | None Detected |
| | O-A03C | Roof—north flashing—west (seam) | None Detected |
| Asphalt roof sheets | O-A04A | Roof—south edge - west | None Detected |
| | O-A04B | Roof—south edge - east | None Detected |
| | O-A04C | Roof—south edge - central | None Detected |
| Sealant/caulking on interior plywood wall seams | O-A05A | Seam adjacent to door | None Detected |
| | O-A05B | Seam adjacent to interior door | None Detected |
| | O-A05C | Seam in northwest corner of office | None Detected |
| Insulation inside metal fire doors. | O-A06 | Inside south door of double fire doors in west wall | None Detected |
| Maintenance Shed | | | |
| Asphalt roof shingles | S-A01A | Roof—southwest corner | None Detected |
| | S-A01B | Roof—northwest corner | None Detected |
| | S-A01C | Roof—southeast corner | None Detected |
| Roof underlay paper | S-A02A | Roof—southwest corner | None Detected |
| | S-A02B | Roof—northwest corner | None Detected |
| | S-A02C | Roof—southeast corner | None Detected |



APPENDIX D
LABORATORY ANALYTICAL REPORT—
ASBESTOS: POLARIZED LIGHT
MICROSCOPY



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EMSL Canada Order 551809719
Customer ID: 55STBC42
Customer PO: 123221204
Project ID:

Attn: Sean Brigden
Stantec Consulting Ltd.
11-2042 Mills Road
Sidney, BC V8L 5X4
Phone: (902) 565-0662
Fax:
Collected:
Received: 8/17/2018
Analyzed: 8/23/2018
Proj: 123221204

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: O-A01 **Lab Sample ID:** 551809719-0007

Sample Description: Equipment Storage/Office / Roof - Central Penetration

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 0.0% | 100% | None Detected | |

Client Sample ID: O-A02A **Lab Sample ID:** 551809719-0008

Sample Description: Equipment Storage/Office / Roof - North Central

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 0.0% | 100% | None Detected | |

Client Sample ID: O-A02B **Lab Sample ID:** 551809719-0009

Sample Description: Equipment Storage/Office / Roof - Northeast Central

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 0.0% | 100% | None Detected | |

Client Sample ID: O-A02C **Lab Sample ID:** 551809719-0010

Sample Description: Equipment Storage/Office / Roof - Northeast

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 0.0% | 100% | None Detected | |

Client Sample ID: O-A03A **Lab Sample ID:** 551809719-0011

Sample Description: Equipment Storage/Office / Roof - North Flashing - East (Fastener)

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Brown | 0.0% | 100% | None Detected | |

Client Sample ID: O-A03B **Lab Sample ID:** 551809719-0012

Sample Description: Equipment Storage/Office / Roof - North Flashing - East (Seam)

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Brown | 0.0% | 100% | None Detected | |

Client Sample ID: O-A03C **Lab Sample ID:** 551809719-0013

Sample Description: Equipment Storage/Office / Roof - North Flashing - West (Seam)

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Brown | 0.0% | 100% | None Detected | |



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EMSL Canada Order 551809719
Customer ID: 55STBC42
Customer PO: 123221204
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: O-A04A **Lab Sample ID:** 551809719-0014

Sample Description: Equipment Storage/Office / Roof - South Edge - West

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 3.1% | 96.9% | None Detected | |

Client Sample ID: O-A04B **Lab Sample ID:** 551809719-0015

Sample Description: Equipment Storage/Office / Roof - South Edge - East

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 0.54% | 99.5% | None Detected | |

Client Sample ID: O-A04C **Lab Sample ID:** 551809719-0016

Sample Description: Equipment Storage/Office / Roof - South Edge - Central

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 1.8% | 98.2% | None Detected | |

Client Sample ID: O-A05A **Lab Sample ID:** 551809719-0017

Sample Description: Equipment Storage/Office / Seam Adjacent to Door

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | White | 0.0% | 100% | None Detected | |

Client Sample ID: O-A05B **Lab Sample ID:** 551809719-0018

Sample Description: Equipment Storage/Office / Seam Adjacent to Interior Door

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | White | 0.0% | 100% | None Detected | |

Client Sample ID: O-A05C **Lab Sample ID:** 551809719-0019

Sample Description: Equipment Storage/Office / Seam in Northwest Corner of Office

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | White | 0.0% | 100% | None Detected | |

Client Sample ID: O-A06 **Lab Sample ID:** 551809719-0020

Sample Description: Equipment Storage/Office / Inside South Door of Double Fire Doors in West Wall

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 8/23/2018 | Tan | 95% | 5% | 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 551809719
Customer ID: 55STBC42
Customer PO: 123221204
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):

Caroline Allen PLM (1)
PLM Grav. Reduction (9)
Michelle Lung PLM Grav. Reduction (4)

Reviewed and approved by:

Matthew Davis or other approved signatory
or Other Approved Signatory

None Detected = <0.1%. 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: 08/23/2018 14:55:25



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 551809719
Customer ID: 55STBC42
Customer PO: 123221204
Project ID:

Attn: Sean Brigden
Stantec Consulting Ltd.
11-2042 Mills Road
Sidney, BC V8L 5X4

Phone: (902) 565-0662
Fax:
Collected:
Received: 8/17/2018
Analyzed: 8/23/2018

Proj: 123221204

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: S-A01A **Lab Sample ID:** 551809719-0001

Sample Description: Maintenance Shed / Roof - Southwest Corner

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 4.1% | 95.9% | None Detected | |

Client Sample ID: S-A01B **Lab Sample ID:** 551809719-0002

Sample Description: Maintenance Shed / Roof - Northwest Corner

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 5.9% | 94.1% | None Detected | |

Client Sample ID: S-A01C **Lab Sample ID:** 551809719-0003

Sample Description: Maintenance Shed / Roof - Southeast Corner

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 8/23/2018 | Black | 4.5% | 95.5% | None Detected | |

Client Sample ID: S-A02A **Lab Sample ID:** 551809719-0004

Sample Description: Maintenance Shed / Roof - Southwest Corner

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 8/23/2018 | Brown | 80% | 20% | None Detected | |

Client Sample ID: S-A02B **Lab Sample ID:** 551809719-0005

Sample Description: Maintenance Shed / Roof - Northwest Corner

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 8/23/2018 | Brown | 80% | 20% | None Detected | |

Client Sample ID: S-A02C **Lab Sample ID:** 551809719-0006

Sample Description: Maintenance Shed / Roof - Southeast Corner

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 8/23/2018 | Brown | 80% | 20% | 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 551809719
Customer ID: 55STBC42
Customer PO: 123221204
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):

Caroline Allen PLM (3)
PLM Grav. Reduction (2)
Michelle Lung PLM Grav. Reduction (1)

Reviewed and approved by:

Matthew Davis or other approved signatory
or Other Approved Signatory

None Detected = <0.1%. 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: 08/23/2018 14:53:43


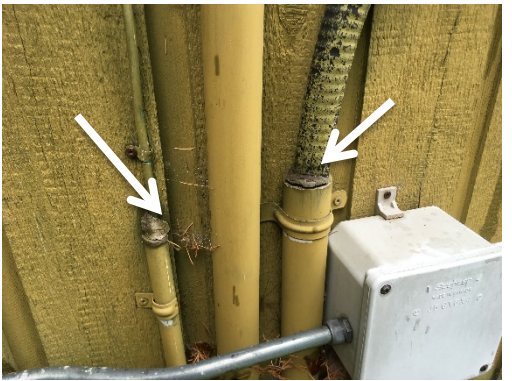

APPENDIX E
SUMMARY OF IDENTIFIED ASBESTOS-
CONTAINING MATERIALS

PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix E Summary of Identified Asbestos-Containing Materials
September 24, 2018

Appendix E SUMMARY OF IDENTIFIED ASBESTOS-CONTAINING MATERIALS

**Table E-1 Summary of Identified Asbestos-Containing Materials
Equipment Storage Shed and Office, and Maintenance Shed
Veteran’s Cemetery, 1190 Colville Road, Esquimalt, BC**

| Identified ACM Description and Condition Information | | |
|---|--|--|
| Equipment Storage Shed and Office—black window pane caulking on window above washroom door | |  |
| % Type | 3.8% Chrysotile (2017 Stantec Report) | |
| Friability | Non-friable | |
| Total Quantity | Approximately 3 linear metres | |
| Condition | Good | |
| Equipment Storage Shed and Office—light gray putty applied to electrical penetrations | |  |
| % Type | 0.25 to 1.1% Chrysotile (2017 Stantec Report) | |
| Friability | Non-friable | |
| Total Quantity | Approximately 10 square centimetres | |
| Condition | Good | |
| Equipment Storage Shed and Office—dark gray putty applied to electrical penetrations | |  |
| % Type | 2.4% Chrysotile (2017 Stantec Report) | |
| Friability | Non-friable | |
| Total Quantity | Approximately 5 square centimetres | |
| Condition | Good | |



APENDIX F
SUMMARY OF RESULTS: ANALYSIS OF
PAINT CHIP SAMPLES FOR LEAD

PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix F Summary of Results: Analysis of Paint Chip Samples for Lead
September 24, 2018

Appendix F SUMMARY OF RESULTS: ANALYSIS OF PAINT CHIP SAMPLES FOR LEAD

**Table F-1 Suspected Lead-Containing Paint Sample and Analytical Results Summary
Equipment Storage Shed and Office, and Maintenance Shed
Veteran’s Cemetery, 1190 Colville Road, Esquimalt, BC**

| Sample Number | Paint Colour/Application | Sample Location | Result (ppm) |
|---|--|--|---------------|
| Equipment Storage Shed and Office | | | |
| O-P01A | Green—exterior wood siding and trim | Northwest corner—siding | <83 |
| O-P01B | Green—exterior wood siding and trim | Northeast corner—siding (faded) | <81 |
| O-P02 | White—interior plywood wall and wood door/trim | Office—north wall of bathroom build-out | <82 |
| O-P03 | Off-white—interior plywood wall and wood door/trim | Office—trim of doorway to equipment storage | 720 |
| O-P04 | Beige—interior and exterior concrete floor/foundation | Office—floor at entry | 740 |
| Maintenance Shed | | | |
| S-P01 | Green—exterior wood trim | Northwest corner—trim | 11,000 |
| S-P02 | White—exterior wood siding | Northwest corner—siding | 47,000 |
| NOTE: Bold, highlighted text indicates confirmed LCP | | | |



APPENDIX G
LABORATORY ANALYTICAL REPORT—
LEAD: PAINT CHIP ANALYSIS

**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 | 551809617 |
| CustomerID: | 55STBC42 |
| CustomerPO: | 123221204 |
| ProjectID: | |

Attn: **Sean Brigden**
Stantec Consulting Ltd.
11-2042 Mills Road
Sidney, BC V8L 5X4

Phone: (902) 565-0662
 Fax:
 Received: 08/17/18 11:09 AM
 Collected:

Project: 123221204

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| <i>Client SampleDescription</i> | <i>Collected</i> | <i>Analyzed</i> | <i>Weight</i> | <i>RDL</i> | <i>Lead Concentration</i> |
|---------------------------------|--|-----------------|---------------|------------|---------------------------|
| S-P01 551809617-0001 | | 8/23/2018 | 0.2432 g | 410 ppm | 11000 ppm |
| | Site: Maintenance Shed - Northwest Corner - Trim Desc: Green - Exterior Wood Trim | | | | |
| S-P02 551809617-0002 | | 8/23/2018 | 0.2477 g | 1600 ppm | 47000 ppm |
| | Site: Maintenance Shed - Northwest Corner - Siding Desc: Green - Exterior Wood Siding | | | | |

Rowena Fanto, Lead Supervisor
 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 unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 08/24/2018 08:18:33

**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 551809617

CustomerID: 55STBC42

CustomerPO: 123221204

ProjectID:

Attn: **Sean Brigden**
Stantec Consulting Ltd.
11-2042 Mills Road
Sidney, BC V8L 5X4

Phone: (902) 565-0662
 Fax:
 Received: 08/17/18 11:09 AM
 Collected:

Project: 123221204

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| <i>Client SampleDescription</i> | <i>Collected</i> | <i>Analyzed</i> | <i>Weight</i> | <i>RDL</i> | <i>Lead Concentration</i> |
|---------------------------------|---|-----------------|---------------|------------|---------------------------|
| O-P01A 551809617-0003 | | 8/23/2018 | 0.2405 g | 83 ppm | <83 ppm |
| | Site: Equipment Storage / Office - Northwest Corner Siding Desc: Green - Exterior Wood Siding and Trim | | | | |
| O-P01B 551809617-0004 | | 8/23/2018 | 0.2456 g | 81 ppm | <81 ppm |
| | Site: Equipment Storage / Office - Northwest Corner Siding (faded) Desc: Green - Exterior Wood Siding and Trim | | | | |
| O-P02 551809617-0005 | | 8/23/2018 | 0.2446 g | 82 ppm | <82 ppm |
| | Site: Equipment Storage / Office - Office- North Wall of Bathroom Build Out Desc: White - Interior Plywood Wall and Wood Door/Trim | | | | |
| O-P03 551809617-0006 | | 8/23/2018 | 0.2448 g | 82 ppm | 720 ppm |
| | Site: Equipment Storage / Office - Office- Trim of Doorway to Equipment Storage Desc: Off-White - Interior Plywood Wall and Wood Door/Trim | | | | |
| O-P04 551809617-0007 | | 8/23/2018 | 0.2426 g | 82 ppm | 740 ppm |
| | Site: Equipment Storage / Office - Office - Floor at Entry Desc: Beige - Interior and Exterior Concrete Floor/ Foundation | | | | |

Rowena Fanto, Lead Supervisor
 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 unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 08/24/2018 08:19:12

**EMSL Analytical, Inc.**

6340 CastlePlace Dr., Indianapolis, IN 46250

Phone/Fax: (317) 803-2997 / (317) 803-3047

<http://www.EMSL.com>indianapolislab@emsl.com

EMSL Order: 161816651

CustomerID: STBC42

CustomerPO: 123221204

ProjectID:

Attn: **Sean Bridgen**
Stantec Consulting Ltd.
11-2042 Mills Road
Sidney, BC V8L 5X4

Phone: (902) 565-0662
 Fax:
 Received: 08/27/18 10:00 AM
 Collected:

Project: 123221204

Test Report: Toxicity Characteristic Leachate Procedure (1311/7000B)

| <i>Client SampleDescription</i> | <i>Collected</i> | <i>Analyzed</i> | <i>RDL</i> | <i>Lead Concentration</i> |
|---------------------------------|--|-----------------|------------|---------------------------|
| S - L01 161816651-0001 | | 8/31/2018 | 0.40 mg/L | 6.1 mg/L |
| | Site: GREEN PAINTED EXTERIOR WOOD TRIM | | | |
| S - L02 161816651-0002 | | 8/31/2018 | 0.40 mg/L | 6.1 mg/L |
| | Site: WHITE PAINTED EXTERIOR WOOD SIDING | | | |
| O - L03 161816651-0003 | | 8/31/2018 | 0.40 mg/L | <0.40 mg/L |
| | Site: OFF-WHITE PAINTED INTERIOR PLYWOOD WALL AND WOOD DOOR/TRIM | | | |

Doug Wiegand, Laboratory Manager
 or other approved signatory

This report relates only to those items tested. Samples received in good condition unless otherwise noted. Quality Control Data associated with this sample set is within acceptable limits, unless otherwise noted

Samples analyzed by EMSL Analytical, Inc. Indianapolis, IN

Initial report from 08/31/2018 15:47:16




APPENDIX H
SUMMARY OF IDENTIFIED LCPS

PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix H Summary of Identified LCPs
September 24, 2018

Appendix H SUMMARY OF IDENTIFIED LCPS

**Table H-1 Summary of Identified LCPs
Equipment Storage Shed and Office, and Maintenance Shed
Veteran’s Cemetery, 1190 Colville Road, Esquimalt, BC**


| LCP Description | | Photo |
|-------------------------|--|--|
| Paint colour | Off-white |  |
| Substrate | Plywood and wood | |
| Location/approx. extent | Equipment Storage Shed and Office – interior plywood wall and wood door/trim | |
| Lead content | 720 ppm <0.40 mg/L lead content in leachate | |
| Condition | Good | |
| Paint colour | Beige |  |
| Substrate | Concrete | |
| Location/approx. extent | Equipment Storage Shed and Office – interior and exterior floor/foundation | |
| Lead content | 740 ppm | |
| Condition | Good in most locations, though worn from the surface. Flaking and peeling in locations near the front door. | |
| Paint colour | Green |  |
| Substrate | Wood | |
| Location/approx. extent | Maintenance Shed – exterior trim | |
| Lead content | 11,000 ppm 6.1 mg/L lead content in leachate | |
| Condition | Good | |



PRE-DEMOLITION HAZARDOUS BUILDING MATERIALS ASSESSMENT

Appendix H Summary of Identified LCPs
September 24, 2018

**Table H-1 Summary of Identified LCPs
Equipment Storage Shed and Office, and Maintenance Shed
Veteran’s Cemetery, 1190 Colville Road, Esquimalt, BC**

| LCP Description | | Photo |
|-------------------------|---|--|
| Paint colour | White |  |
| Substrate | Wood | |
| Location/approx. extent | Maintenance Shed – exterior siding | |
| Lead content | 47,000 ppm 6.1 mg/L lead content in leachate | |
| Condition | Good | |



APPENDIX D



RYZUK GEOTECHNICAL
ENGINEERING & MATERIALS TESTING

28 Crease Avenue
Victoria, B.C.
V8Z 1S3
Tel: 250-475-3131
Fax: 250-475-3611
mail@ryzuk.com

Geotechnical Field Review

Project No: 8-4070-7

Project: God's Acre - Veteran Cemetery - Improvements - 1190 Colville Road - Esquimalt, BC

Client: CWMM Consulting Engineers Ltd.

Contact: Patrick Lam

Email / Fax No: patlam@cwmm.com

Date: October 9, 2018

Copy to:
Carlos Rincon CarlosR@thinkratio.com
Craig Stantos CSantos@cwmm.com

Copy to:

As requested, we have completed a geotechnical review of the above referenced site in regards to the expected soil conditions, frost penetration depth, bearing resistance, and seismic site classification. Our recommendations are summarized below but are subject to change once further site-specific geotechnical information becomes available during construction. All our work has been undertaken in accordance with, and is subject to, the attached Terms of Engagement.

It is understood that the work will include the construction of a new 95 square metre (m²) operations building and the repaving of 500 metres (m) of pathway within the site. It is further understood that the pathways will support light vehicle traffic and that there is an existing septic field adjacent to the proposed operations building.

Based on our review of the available subsurface information and our experience with projects in the area, the soil conditions likely consist of a thin veneer of topsoil overlying, non-select fills, silty clay and bedrock, respectively.

Bearing Resistance

Provided the proposed footing locations are stripped of topsoil and non-select fills, we expect that foundations designed based on serviceability/ultimate limit state (SLS/ULS) bearing resistances of 100/150 kilopascals (kPa) will be appropriate. Subgrade should be approved once exposed by a qualified geotechnical professional, prior to placing engineered fill or formwork.

Additionally, based on the provided drawings (dated 2018-10-02), the new operations/storage building will be located in close proximity to an existing septic field. Depending on the presence of fills in this area, building foundations may have to be lowered in order to avoid fills being within a 1H:1V splay of proposed foundation.

Frost

For frost protection, the base of all footings should extend to a depth of at least 450 mm below adjacent finished grades.

Seismic

In accordance with the 2012 and 2015 BC Building Code, we expect a seismic site classification of 'D' to be appropriate based on our desktop study. For use in design, the Peak Ground Acceleration (PGA) and Spectral Acceleration Values (S(t)) for Site Class 'D' with reference values for Site Class 'C' are summarized in Table 1. These values have been interpolated from 2010 National Building Code of Canada (NBCC) Seismic Hazard Calculation, for a 2% probability of exceedance in 50 years.

Table 1 - Summary of PGA and Spectral Acceleration Values (NBCC 2010)

| Period (sec) | 0.2 | 0.5 | 1.0 | 2.0 | PGA (g) |
|--|-------------|-------------|-------------|-------------|-------------|
| Response (g) Site Class 'D' | 1.22 | 0.91 | 0.34 | 0.17 | 0.60 |

| | | | | | |
|--------------------------------|------|------|------|------|------|
| Response (g) Site Class 'C' | 1.20 | 0.80 | 0.37 | 0.18 | 0.60 |
|--------------------------------|------|------|------|------|------|

Note that at the time of writing this report, the 2015 NBCC had been published. Similarly, the 2015 NBCC Seismic Hazard Calculation, which includes new methods of calculating hazard values, has been released. Generally, British Columbia adopts the NBCC two to three years after the publication date. It is anticipated that the adoption of the 2015 NBCC in the form of the British Columbia Building Code will occur sometime in 2018. In the event that the proposed development is designed and constructed based on a new version of the BC Building Code, the following seismic hazard values, based on the 2015 NBCC Seismic Hazard Calculation, including the Peak Ground Velocity (PGA) and Peak Ground Velocity (PGV), can be used during design and are summarized in Table 2.

Table 2 - Summary of PGA, PGV and Spectral Accelerations Values (NBCC 2015)

| Period (sec) | 0.2 | 0.5 | 1.0 | 2.0 | 5.0 | 10.0 | PGA (g) | PGV (m/s) |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Response (g) Site Class 'D' | 1.18 | 1.28 | 0.83 | 0.51 | 0.17 | 0.06 | 0.51 | 0.92 |
| Response (g) Site Class 'C' | 1.31 | 1.17 | 0.69 | 0.41 | 0.13 | 0.04 | 0.59 | 0.84 |

We trust the preceding is suitable for your purposes at present. If you have any questions with respect to the above, or require anything further, please contact the undersigned.

Kind regards,
Ryzuk Geotechnical


Richard Moser, P.Eng.
Project Engineer




Antoine Letendre, M.Eng., P.Eng.
Project Engineer



Attachment - Terms of Engagement

TERMS OF ENGAGEMENT

GENERAL

Ryzuk Geotechnical (the Consultant) shall render the Services, as specified in the agreed Scope of Services, to the Client for this Project in accordance with the following terms of engagement. The Services, and any other associated documents, records or data, shall be carried out and/or prepared in accordance with generally accepted engineering practices in the location where the Services were performed. No other warranty, expressed or implied is made. The Consultant may, at its discretion and at any stage, engage sub-consultants to perform all or any part of the Services.

Ryzuk Geotechnical is a wholly owned subsidiary of C. N. Ryzuk & Associates Ltd.

COMPENSATION

All charges will be payable in Canadian Dollars. Invoices will be due and payable by the Client on receipt of the invoice without hold back. Interest on overdue accounts is 24% per annum.

REPRESENTATIVES

Each party shall designate a representative who is authorized to act on behalf of that party and receive notices under this Agreement.

TERMINATION

Either party may terminate this engagement without cause upon thirty (30) days' notice in writing. On termination by either party under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed, including all expenses and other charges incurred by the Consultant for this Project.

If either party breaches this engagement, the non-defaulting party may terminate this engagement after giving seven (7) days' notice to remedy the breach. On termination by the Consultant under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed to the date of termination, including all fees and charges for this Project.

ENVIRONMENTAL

The Consultant's field investigation, laboratory testing and engineering recommendations will not address or evaluate pollution of soil or pollution of groundwater. The Consultant will cooperate with the Client's environmental consultant during the field work phase of the investigation.

PROFESSIONAL RESPONSIBILITY

In performing the Services, the Consultant will provide and exercise the standard of care, skill and diligence required by customarily accepted professional practices and procedures normally provided in the performance of the Services contemplated in this engagement at the time when and the location in which the Services were performed.

INSURANCE

Ryzuk Geotechnical is covered by Professional Indemnity Insurance as follows:

1. \$ 2,000,000 each and every claim
2. \$ 4,000,000 aggregate
3. \$ 5,000,000 commercial/general liability coverage

LIMITATION OF LIABILITY

The Consultant shall not be responsible for:

1. the failure of a contractor, retained by the Client, to perform the work required for the Project in accordance with the applicable contract documents;
2. the design of or defects in equipment supplied or provided by the Client for incorporation into the Project;
3. any cross-contamination resulting from subsurface investigations;
4. any Project decisions made by the Client if the decisions were made without the advice of the Consultant or contrary to or inconsistent with the Consultant's advice;
5. any consequential loss, injury or damages suffered by the Client, including but not limited to loss of use, earnings and business interruption;
6. the unauthorized distribution of any confidential document or report prepared by or on behalf of the consultant for the exclusive use of the Client
7. Subsurface structures and utilities

The Consultant will make all reasonable efforts prior to and during subsurface site investigations to minimize the risk of damaging any subsurface utilities/mains. If, in the unlikely event that damage is incurred where utilities were unmarked and/or undetected, the Consultant will not be held responsible for damages to the site or surrounding areas, utilities/mains or drilling equipment or the cost of any repairs.

The total amount of all claims the Client may have against the Consultant or any present or former partner, executive officer, director, stockholder or employee thereof under this engagement, including but not limited to claims for negligence, negligent misrepresentation and breach of contract, shall be strictly limited to the amount of any professional liability insurance the Consultant may have available for such claims.

No claim may be brought against the Consultant in contract or tort more than two (2) years after the date of discovery of such defect.

DOCUMENTS AND REPORTING

All of the documents prepared by the Consultant or on behalf of the Consultant in connection with the Project are instruments of service for the execution of the Project. The Consultant retains the property and copyright in these documents, whether the Project is executed or not. These documents may not be used on any other project without the prior written agreement of the Consultant.

The documents have been prepared specifically for the Project, and are applicable only in the case where there has been no physical alteration to, or deviation from any of the information provided to the Consultant by the Client or agents of the Client. The Client may, in light of such alterations or deviations, request that the Consultant review and revise these documents.

The identification and classification as to the extent, properties or type of soils or other materials at the Project site has been based upon investigation and interpretation consistent with the accepted standard of care in the engineering consulting practice in the location where the Services were performed. Due to the nature of geotechnical engineering, there is an inherent risk that some conditions will not be detected at the Project site, and that actual subsurface conditions may vary considerably from investigation points. The Client must be aware of, and accept this risk, as must any other party making use of any documents prepared by the Consultant regarding the Project.

Any conclusions and recommendations provided within any document prepared by the Consultant for the Client has been based on the investigative information undertaken by the Consultant, and any additional information provided to the Consultant by the Client or agents of the Client. The Consultant accepts no responsibility for any associated deficiency or inaccuracy as the result of a miss-statement or receipt of fraudulent information.

JOBSITE SAFETY AND CONTROL

The Client acknowledges that control of the jobsite lies solely with the Client, his agents or contractors. The presence of the Consultant's personnel on the site does not relieve the Client, his agents or contractors from their responsibilities for site safety. Accordingly, the Client must endeavor to inform the Consultant of all hazardous or otherwise dangerous conditions at the Project site of which the Client is aware.

The client must acknowledge that during the course of a geotechnical investigation, it is possible that a previously unknown hazard may be discovered. In this event, the Client recognizes that such a hazard may result in the necessity to undertake procedures which ensure the safety and protection of personnel and/or the environment. The Client shall be responsible for payment of any additional expenses incurred as a result of such discoveries, and recognizes that under certain circumstances, discovery of hazardous conditions or elements requires that regulatory agencies must be informed. The Client shall not bring about any action or dispute against the Consultant as a result of such notification.

FIELD SERVICES

Where applicable, field services recommended for the Project are the minimum necessary, in the sole discretion of the Consultant, to observe whether the work or a contractor retained by the Client is being carried out in general conformity with the intent of the Services. Any reduction from the level of services recommended will result in the Consultant providing qualified certifications for the work.

DISPUTE RESOLUTION

If requested in writing by either the Client or the Consultant, the Client and the Consultant shall attempt to resolve any dispute between them arising out of or in connection with this Agreement by entering into structured non-binding negotiations with the assistance of a mediator on a without prejudice basis. The mediator shall be appointed by agreement of the parties. If a dispute cannot be settled within a period of thirty (30) calendar days with the mediator, the dispute shall be referred to and finally resolved by arbitration under the rules of the arbitrator appointed by agreement of the parties or by reference to a Judge of the British Columbia Court.



RYZUK GEOTECHNICAL
ENGINEERING & MATERIALS TESTING

28 Crease Avenue
Victoria, B.C.
V8Z 1S3
Tel: 250-475-3131
Fax: 250-475-3611
mail@ryzuk.com

Geotechnical Field Review

Project No: 8-4070-7

Project: God's Acre - Veteran Cemetery - Improvements - 1190 Colville Road - Esquimalt, BC

Client: CWMM Consulting Engineers Ltd.

Contact: Patrick Lam

Email / Fax No: patlam@cwmm.com

Date: November 28, 2018

Copy to:

Carlos Rincon CarlosR@thinkratio.com
Craig Stantos CSantos@cwmm.com

Copy to:

As requested, we have completed a geotechnical review of the above referenced site regarding the expected soil conditions, frost penetration depth, bearing resistance, and seismic site classification. Our recommendations are summarized below but are subject to change once further site-specific geotechnical information becomes available during construction. All our work has been undertaken in accordance with, and is subject to, the previously provided Terms of Engagement.

It is understood that the work will include the construction of a new 95 square metre (m²) operations building and the repaving of 500 metres (m) of pathway within the site. It is further understood that the pathways will support light vehicle traffic and that there is an existing septic field adjacent to the proposed operations building.

Based on our review of the available subsurface information and our experience with projects in the area, the soil conditions likely consist of a thin veneer of topsoil overlying, non-select fills, silty clay and bedrock, respectively.

Bearing Resistance

Provided the proposed footing locations are stripped of topsoil and non-select fills, we expect that foundations designed based on serviceability/ultimate limit state (SLS/ULS) bearing resistances of 100/150 kilopascals (kPa) will be appropriate. Subgrade should be approved once exposed by a qualified geotechnical professional, prior to placing engineered fill or formwork.

Additionally, based on the provided drawings (dated 2018-10-02), the new operations/storage building will be located in close proximity to an existing septic field. Depending on the presence of fills in this area, building foundations may have to be lowered in order to avoid fills being within a 1H:1V splay of proposed foundation.

Frost

For frost protection, the base of all footings should extend to a depth of at least 450 mm below adjacent finished grades.

Pavement Considerations

Areas to be paved should be stripped of all loose and deleterious material. Assuming the paved areas are to support pedestrian and light to moderate vehicle traffic, the pavement structure should consist of 50 mm of asphalt overlying, 150 mm of 19 mm minus crushed gravel (base), and 300 mm of 75 mm minus crushed gravel (sub-base), respectively. The base and sub-base materials should be compacted to a minimum of 95% of the material's Modified Proctor Maximum Dry Density (MPMDD). Compaction can be verified during construction using in-situ methods such as nuclear densometer gauges operated by qualified personnel.

Seismic

In accordance with the 2015 BC Building Code, we expect a seismic site classification of 'D' to be appropriate based on our desktop study. For use in design, the Peak Ground Acceleration (PGA), Peak Ground Velocity (PGV) and Spectral Acceleration Values (S(t)) for Site Class 'D' with reference values for Site Class 'C' are summarized in Table

1. These values have been interpolated from 2015 National Building Code of Canada (NBCC) Seismic Hazard Calculation, for a 2% probability of exceedance in 50 years.

Table 1 - Summary of PGA, PGV and Spectral Accelerations Values (NBCC 2015)

| Period (sec) | 0.2 | 0.5 | 1.0 | 2.0 | 5.0 | 10.0 | PGA (g) | PGV (m/s) |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Response (g) Site Class 'D' | 1.18 | 1.28 | 0.83 | 0.51 | 0.17 | 0.06 | 0.51 | 0.92 |
| Response (g) Site Class 'C' | 1.31 | 1.17 | 0.69 | 0.41 | 0.13 | 0.04 | 0.59 | 0.84 |

We trust the preceding is suitable for your purposes at present. If you have any questions with respect to the above, or require anything further, please contact the undersigned.

Kind regards,
Ryzuk Geotechnical

Richard Moser, P.Eng.
Project Engineer

Antoine Letendre, M.Eng., P.Eng.
Project Engineer

APPENDIX E



GeoScan Utility Locate Work Order

conducted at

**God's Acre Cemetery 1190
Colville Road VICTORIA, BC
V9A 4P7**

Client

ISL Engineering & Land Services Ltd

GeoScan Reference

J 181023-06

Locate Date

2018-10-23

Table of Contents

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| GEOSCAN UTILITY LOCATE WORK ORDER | 1 |
| SUMMARY | 3 |
| LOCATE | 4 |
| Scope of Work: | 4 |
| Utilities: | 4 |
| GENERAL NOTES & LIMITATIONS | 7 |
| | 9 |

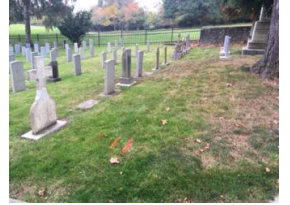
Summary

| Item | | Details | |
|---|-------------|-------------------------------------|--|
| Site Contact | | Erica Messam - Matt Tremble | |
| GeoScan Technician(s) and Signature | L. Gosselin | | |
| Single Call Out | | <input checked="" type="checkbox"/> | |
| Time on site | | 0800 to 13:30pm | |
| Travel Time (One Way) | | 30min | |
| Job Complete? | | Yes | |
| Further reporting required? | | No | |
| One Call Information Provided By: | | GeoScan | |
| One Call Number: | | 2018 424 369 | |
| PLEASE ENSURE THAT A BC ONE CALL IS CARRIED OUT BY YOU AND THE CONTRACTOR BREAKING GROUND BEFORE ANY WORKS ARE CARRIED OUT (AS PER CURRENT LEGAL REQUIREMENTS). UTILITY OWNERS WHO ARE NOT PART OF THE BC ONE CALL SYSTEM SHOULD ALSO BE CONTACTED TO VERIFY WHETHER THEY HAVE UTILITIES BURIED IN THE AREA | | | |
| P.O Number | | | |

Locate


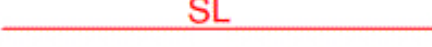


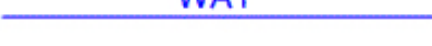

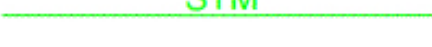
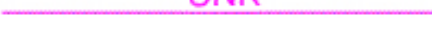


| Item | Details |
|--|--|
| Scope of Work: | |
| Excavation/Trench | <input checked="" type="checkbox"/> |
| Approximate Size of Trench/Excavation: | |
| Pre-Design/SUE | <input checked="" type="checkbox"/> |
| Approximate Size of Pre-Design/SUE: | Large site see site Image |
| Utilities: | |
| Marked With: | Paint |
| Gas Line(s) Located? | No |
| Details: | N/ A |
| Electrical Line(s) Located? | Yes |
| Equipment Used: | EM Locator, Ground Penetrating Radar |
| Signal Quality: | Good |
| General Depth: | 0.3m to 0.9m |
| Other Notes: | Please see locate drawing. |
| Communication Line(s) Located? | Yes |
| Equipment Used: | EM Locator, Ground Penetrating Radar |
| Signal Quality: | Good |
| General Depth: | 0.9m |
| Other Notes: | Please see locate drawing. |
| Water Line(s) Located? | Yes |
| Equipment Used: | EM Locator, Ground Penetrating Radar |
| Signal Quality: | Good |
| General Depth: | 0.8m |
| Other Notes: | Water line located from water well head to groundskeeper building. |

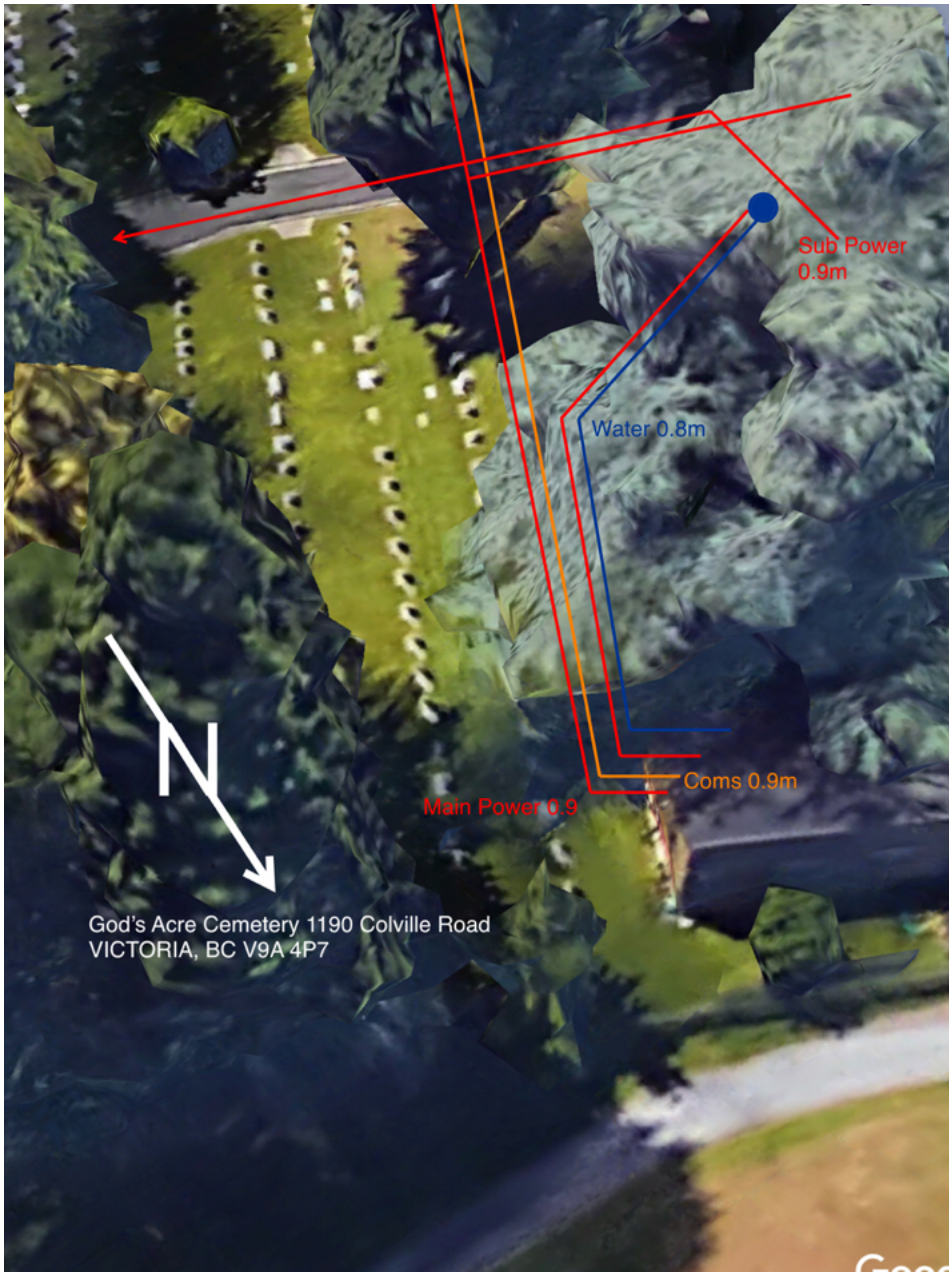
| Item | Details |
|--|--|
| Storm Sewer Line(s) Located? | No |
| Details: | Not in project scope |
| Sanitary Sewer Line(s) Located? | No |
| Details: | Suspected septic field. |
| Other Line(s) Located? | Yes |
| Line 1 | |
| Type of Line: | Electrical Sub Power |
| Equipment Used: | EM Locator, Ground Penetrating Radar |
| Signal Quality: | Good |
| General Depth: | 0.3m to 0.6m |
| Other Notes: | Please see locate drawing for Electrical sub Power location. |
| Locate Drawing: | |
|  | |
| Site Images: | |
|  | |



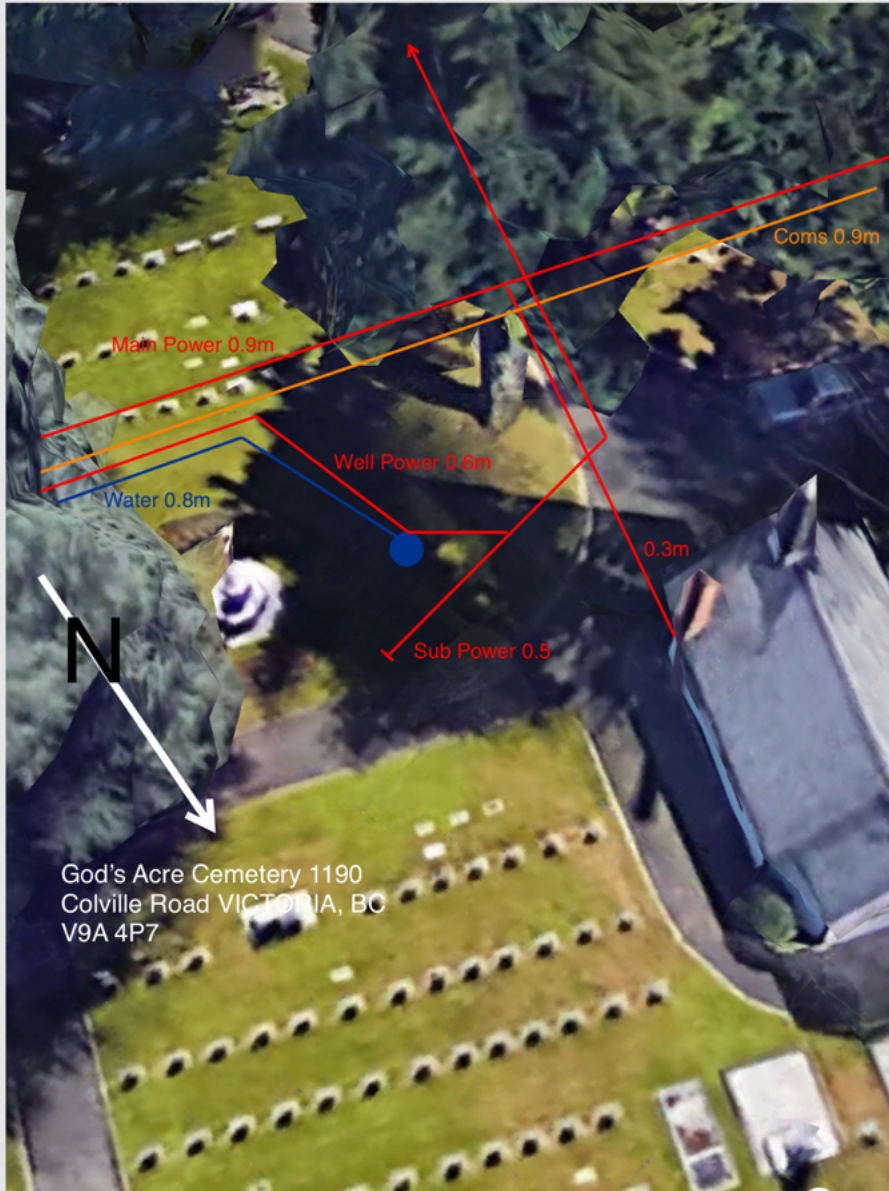
General Notes & Limitations

| Item | Details |
|--|--|
| Maximum Penetration Depth of Ground Penetrating Radar at time of locate: | 1.2m |
| The presence and location of utilities below this depth cannot be confirmed using GPR alone. | |
| Utilities Based on: | Proposed Trench |
| Recommended Hydrovaccing or Hand Exposing | <input checked="" type="checkbox"/> |
| <ul style="list-style-type: none"> - Hydrovaccing or hand exposing is recommended within 2 meters of all marked lines. Do not drill, dig and/or excavate within 2 meters of all marked utilities. - Unable to scan within 0.5m of an object on the surface of the ground. The presence and location of targets below the ground within 0.5m of an object on the surface cannot be confirmed. - Stated depths of targets below the surface of the ground identified using GPR are accurate to within 20%. - Poor radar signal in areas of standing water. Where standing water is present, the presence and location of utilities below the surface of the ground cannot be confirmed in these areas using GPR alone. - Utilities outside of the location boundary have not been located and their presence and location cannot be confirmed. - Drawings provided are not to scale and should not be relied upon for locating the utilities. - Any changes to the to the project (including but not limited to the location of boreholes or trenches) require a new locate and the results of the previous locate are not to be relied upon. | |
| Additional Notes: | <p>Please refer to BC one Call and locate drawings prior to excavation.</p> <p>Sanitary line unsuccessfully fish taped from removed toilet in groundskeeper buildings.</p> <p>Suspect city water connection by the cemetery 's south fence.</p> <p>Septic field may be located outside the cemetery east side fence.</p> |
| <p>Where:</p> <ol style="list-style-type: none"> 1. The presence and/or location and/or depth of utilities below the surface of the ground cannot be confirmed due to any of the limitations set out above; 2. The recommendations set out above are not followed; 3. The presence of a utility is impossible to detect by GPR or electromagnetic scans due to ground conditions at the time the utility locate is carried out; or 4. The markings on the ground indicating the location of utilities are no longer present, <p>GeoScan shall not be liable for any loss or damage caused in respect of any such utilities hit when breaking ground.</p> | |

| Item | Details | | |
|---|---|--|--|
| <u>LEGEND</u> | | | |
|  | ELECTRICAL | | |
|  | ELECTRICAL STREET LIGHT | | |
|  | GAS | | |
|  | COMMUNICATIONS | | |
|  | WATER | | |
|  | SANITARY | | |
|  | STORM | | |
|  | UNKNOWN SERVICE | | |
|  | UTILITY LINE CONTINUES BEYOND SITE BOUNDARY | | |
|  | UNABLE TO LOCATE UTILITY LINE PAST THIS POINT | | |
| Client Representative and Signature | | | |



1



2



3



4



5



6



7



8



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12



13



14



Possible Septic Line

15



16



17



18



19

APPENDIX F

ISL Engineering and Land Services Ltd.
8506 200th Street
Langley, BC, V2Y 0M1

November 7, 2018

Attention: Erica Messam, P.Eng.

**Regarding: Onsite Sewerage System Review for
God's Acres Cemetery at 1190 Colville Road, Esquimalt, BC
Project No. 41971-66**

Introduction

Valley Geo has been retained by ISL Engineering and Land Services Ltd. to provide recommendations for the on-site sewerage system. This report summarizes our investigation, observations, conclusions and recommendations.

Site & Project Description

The subject site is the God's Acres Cemetery located at 1190 Colville Road in Esquimalt. The cemetery is surrounded by a golf course. The existing maintenance building is serviced by an existing on-site sewerage system and possibly an on-site water well. The site is relatively flat with no major grading features. Several large mature trees exist on the site. No water courses or water bodies were observed in the vicinity of the proposed works. See the attached site plan for additional site information.

It is proposed to demolish the existing maintenance building and construct a new 11.6m by 8.2m building. It was identified to us that the new building will service three employees in an office capacity. The architectural site plan is attached with this report.

Site Work and Observations

A Valley Geo and Canadian Sewerage Solutions Inc. representative visited the site to review the soil conditions, locate the existing system, and review its performance to determine if the existing system will meet today's code. We also reviewed the feasibility of installing a new system, if required. Our investigation was limited to one auger hole due to limitations associated with the site use. The following site works were completed:

- Single auger hole to 0.9m below existing grade
- Percolation testing
- Locate the existing system with an underground sensor and shallow hand dug exploration holes
- Insert a camera into the existing system
- Site reconnaissance to review the site for possible design constraints.



The below bulleted list summarizes the inspection results and observations.

- Soil conditions consisted of up to 0.3m of loose sandy topsoil over stiff clayey silt (impervious).
- The septic tank is either located partially under or immediately beside the existing building
- The liquid level of the effluent is below the outlet to the in-ground dispersal system
- No effluent filter existed
- The effluent was directed to a single lateral by gravity
- The lateral consisted of clay tile
- Camera access was limited due to the volume of roots present in the lateral.
- Existing well head observed as close as 5m from the system.

See attached for a copy of the Canadian Sewerage Solutions Inc. report.

Discussions and Recommendations

Based on the above, Valley Geo concludes that the existing system does not meet minimum design and performance requirements for the following reasons:

- Insufficient vertical separation from the underside of the trenches to an impervious layer or water table
- Septic Tank appears to be leaking (effluent level below the outlet)
- Minimum horizontal separation from the tank and dispersal system to a well not met (30m).
- Existing clay tile laterals appear heavily plugged with tree roots.

A new sewerage system is therefore required. The following summarizes two possible options:

- A new septic system consisting of an above grade pressurized sand mound technology with a minimum bottom of mound footprint of 9.8m x 4.9m. Based on our site measurements and grave orientation, it is unlikely that the new system will fit within the area of the proposed new building. In addition, a 30m setback from the tank and dispersal system is required. Possible options for the system include at the edge of the existing golf course or another area within the cemetery.
- A septic holding tank that is pumped out on regular intervals. The holding tank is required to be located 15m from the existing well unless a hydrologist provides confirmation that we are able to reduce this setback.

For budgeting purposes Valley Geo has completed a high-level cost analysis. Further consultation with an installer should be considered to provide a more accurate budget.

- New Septic System – \$30,000
- Holding Tank - \$15,000

Once further discussion and a decision has been made on which option is preferred, Valley Geo will complete a detailed design.

Closure

We trust that this letter provides you with the required information. If you have any questions or require any additional information do not hesitate to contact the undersigned.

Yours truly,

Valley Geotechnical Engineering Services Ltd.

DRAFT

DRAFT

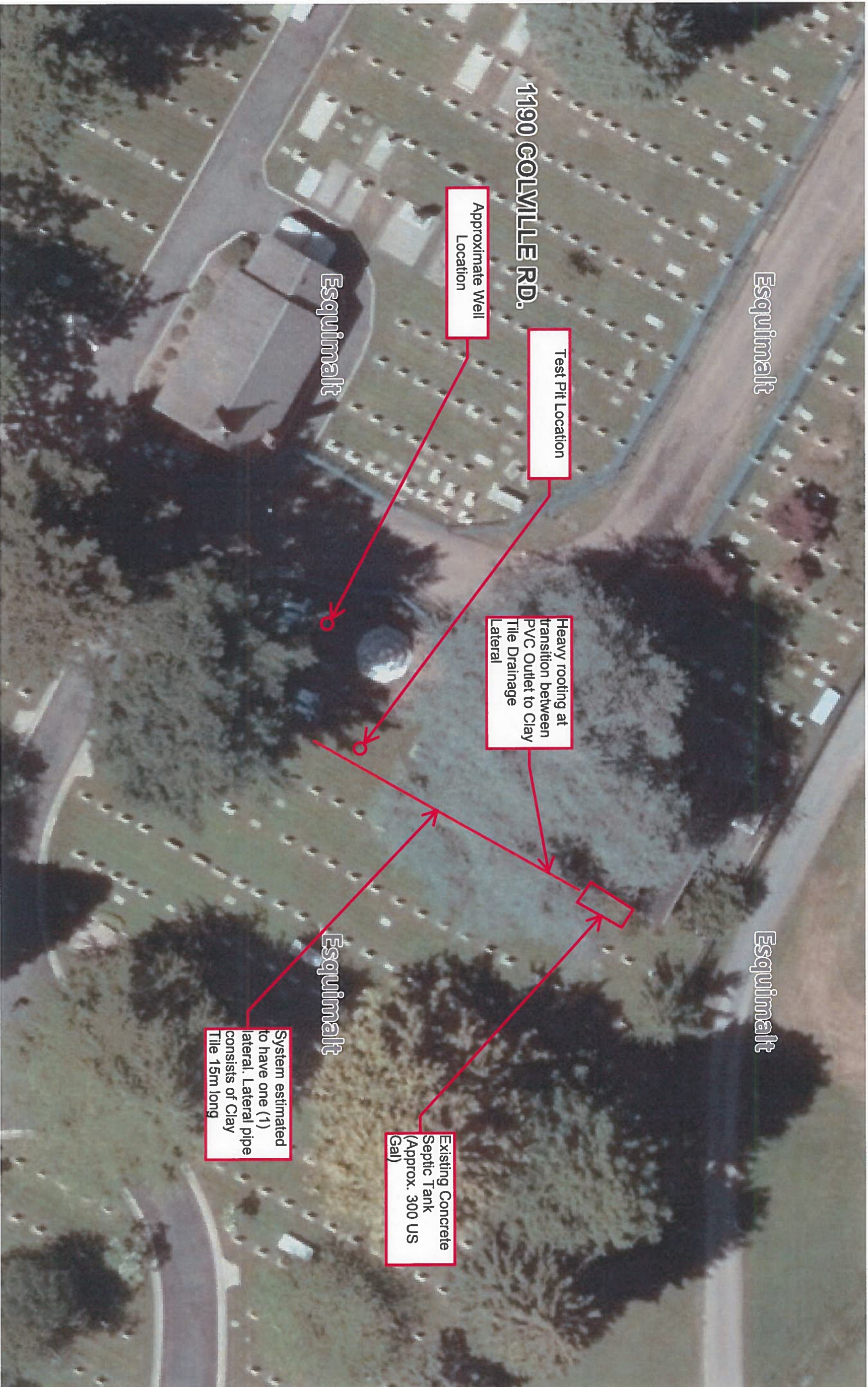
Raul Valverde, P.Eng.
Principal Geotechnical Engineer

Bradley VanDelft, AScT, Eng.L.
Geotechnical Engineer- Principal

Attachments:

- Site Location Plan
- Proposed Construction
- Canadian Sewerage Solutions Inc. Report

\\Vges-srv-dc1\vges\VGES-PROJECTS\41900\41971-66\2018-11-07 report.doc



Legend
 □ Victoria Parcels

General Notes:

1. Clay tile drainage lateral was observed to be plugged/ full of tree roots. (Multiple large old growth trees within drainage lateral area).
2. Test pit resulted in 0.3m of topsoil (percolation rate = 2.5mins/inch) underlain by stiff silty clay (impermeable, percolation rate = >20mins/inch)
3. Fluid level in concrete tank observed to be below outlet pipe invert. Believed to be leaking.

1: 200

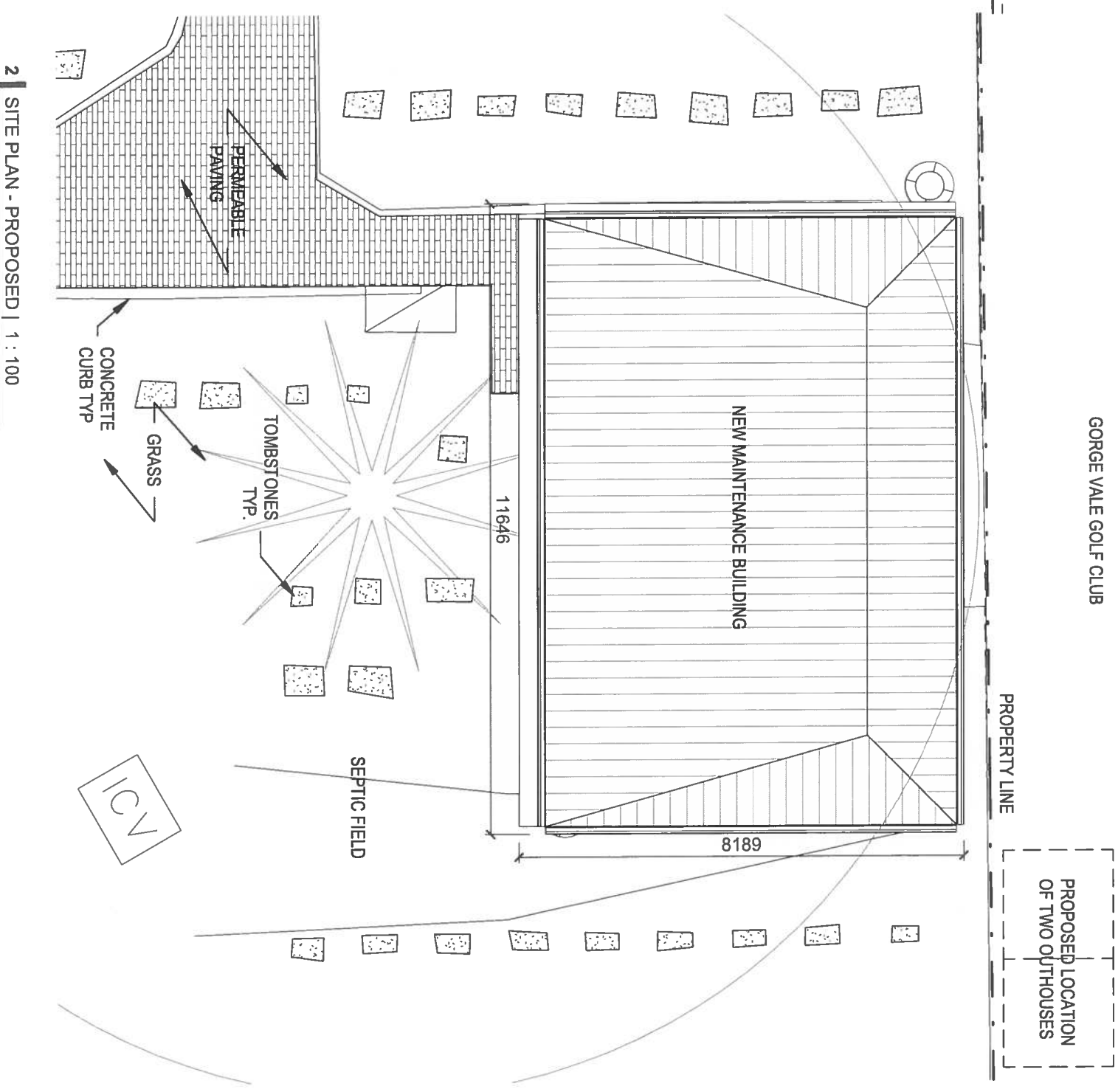
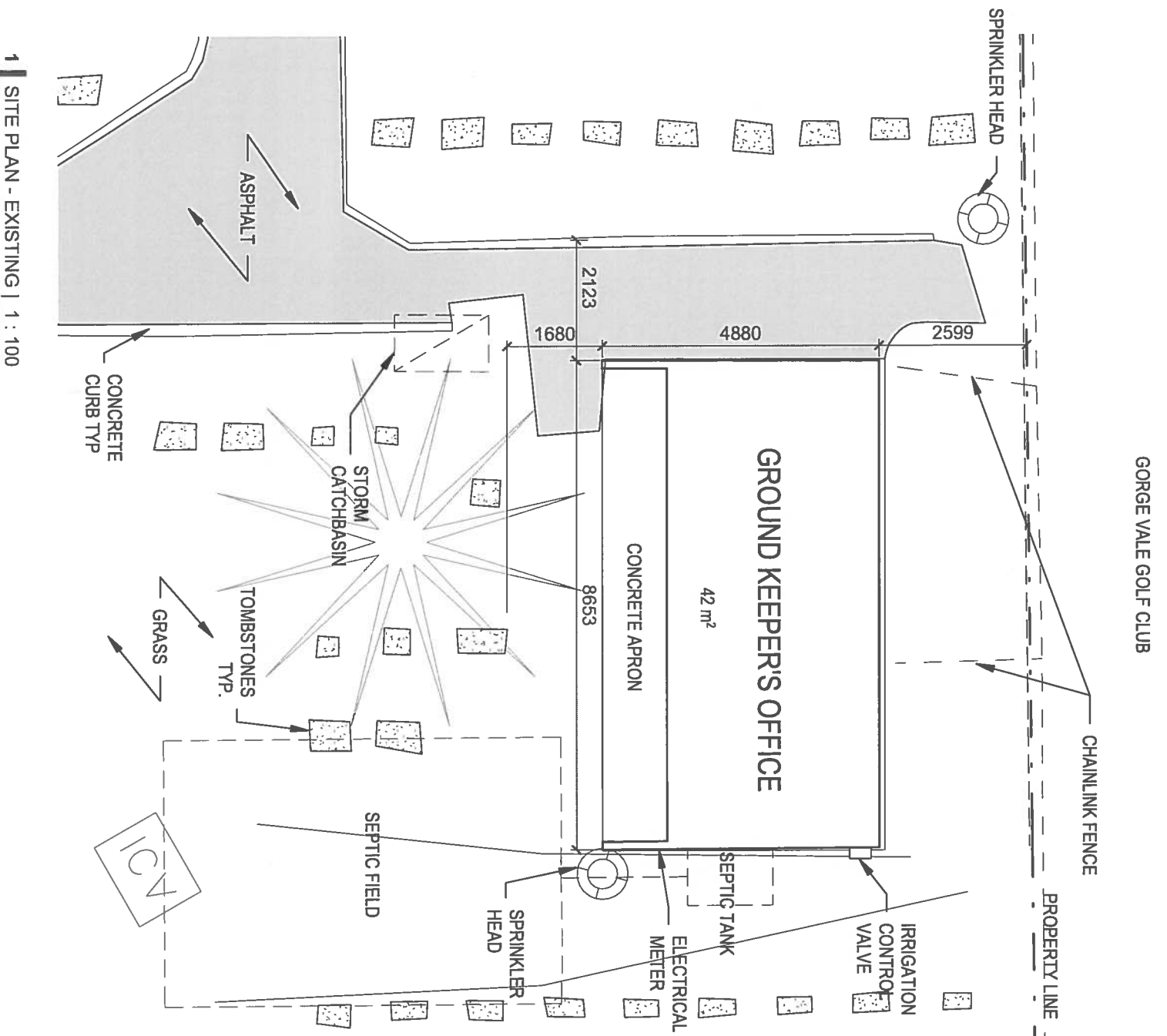


Notes

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. Public domain: can be freely printed, copied and distributed without permission. THIS MAP IS NOT TO BE USED FOR NAVIGATION

10 0 5 10Meters

NAD_1983_CSRS_UTM_Zone_10N



R : Veterans Cemetery, God's Acre

DRAWING TITLE
SITE PLAN

CLIENT
Veterans Affairs Canada

DATE
2018.10.02

A002



809 Industrial Way
Victoria, BC V9B 6E2
Ph.: (250) 478-1158
Fax: (250) 385-1169
kelly@sewagesolutions.com

November 6, 2018

RE: Good Acres Cemetery, 1190 Colville Road, Esquimalt, BC

Dear Brad:

Attached is our onsite sewage system inspection report. The report includes our observations, conclusions and recommendations for the onsite sewage system at the subject property.

If you have any questions, please do not hesitate to contact me by email (kelly@sewagesolutions.com).

Yours truly,

Kelly Karr, P.Eng.

Senior Design Engineer and Principal
Canadian Sewage Solutions Inc.
Ph: 250 478-1158
Cell: 250-514-9989
Email: Kelly@sewagesolutions.com
Web: sewagesolutions.com

Canadian Sewage Solutions Inc. was retained to assess the existing onsite sewage system for a maintenance building at the Good Acres Cemetery at 1190 Colville Road, Esquimalt, BC. The inspection took place on November 2, 2018.

Background

In 2005, the BC government promulgated Sewerage System Regulation BC Reg. 326/2004. Prior to this, Environmental Health Officers employed by the regional health authorities (in this area – the Vancouver Island Health Authority) would issue a permit that stipulated the basic requirements for building a particular onsite sewage system. The Environmental Health Officers would visit the site at least twice. The first visit would be to look at the soils and determine the main requirements for the system that would be put on the permit. A second site visit would occur during construction to ensure that the permit requirements were being met.

Since adoption of *Sewerage System Regulation* in 2005, only *authorized persons* are allowed to design, install, maintain and inspect onsite sewage systems. *Authorized persons* are either Professionals (generally Professional Engineers with appropriate training and experience) or Registered Onsite Wastewater Practitioners (ROWP). These *authorized persons* assume responsibility for ensuring that the repaired system will not cause or contribute to a health hazard.

Prior to 2005, the provincial regulation standard for sizing a septic tank was two days design flow. The design flow for a typical three-bedroom house is 300 lgal/day. Consequently, the standard septic tank size for a three-bedroom home for many years was a 600 lgal septic tank. When the standard was raised from 2 days to 3 days retention, the required septic tank size increased to 900 lgal for a standard three-bedroom home. (In the CRD a local policy stipulated that septic tanks should have 3 days retention time a few years before the regulations were changed). Consequently, almost all onsite sewage systems built prior to 2005 are now not in total compliance with the Standard Practice Manual (SPM).

Gravity systems are effectively designed to progressively fail. At virtually all times, they are being hydraulically overloaded. During the first few years of a gravity system only a small part of the field is being utilized (the laterals that have the lowest elevation of the pipe perforations in a perforated pipe and rock trench system). As the system fails the hydraulic capacity of the soil reduces so that it backs up a bit and the flow goes to the new area that is at a slightly higher elevation. Therefore, with gravity systems they generally all eventually fail – it is more a matter of what is the expected lifespan.

Additional occupants or changes in use including a home-based business (daycare, hair salon, brewery, etc.) or discharge of high-strength waste from certain hobbies (winemaking, husbandry, etc.) can increase the sewage flows and sewage strength to the system which will cause the dispersal field to mature faster. If you plan on changes to usage of the home or adding additional bedrooms or suites, you should consult with an ROWP or Professional Engineer to determine if your sewage system can handle the changes.

Observations

General

- The building contains bathrooms for 3 workers.
- Based on an average daily flow of 60 L/day/worker and a peaking factor of 1.5, the daily design flow for the onsite sewage system is 270 L/day or 59 Imp. Gal/day.
- There is a wellhead located in a manhole between the chapel and maintenance building.
- The wellhead has a 2" plastic overflow pipe which proceeds downslope towards the base of the slope.
- The overflow pipe was blocked by a rock near the base of the slope.

Septic Tank

- We located the septic tank with the inspection camera through a clean out in the workshop.
- The plumbing under the building appears to be clean.
- The septic tank is located against the eastern wall of the maintenance building.
- The septic tank is located approx. 26 m from the wellhead.
- The septic tank is approx. 4" – 6" below surface.
- There is a 11" x 9" concrete lid over the outlet of the septic tank.
- The interior dimensions of the septic tank are approx. 93" L x 43" W x 23" (operating depth).
- The concrete septic tank has a volume of approx. 330 Imp. Gal.
- The liquid level in the tank was approx. 17" from the bottom of the tank.
- The concrete baffle at the outlet of the septic tank appears to be in good condition.
- There was no effluent filter in the outlet of the septic tank.

Dispersal Field

- The dispersal lateral runs south along the slope east of the maintenance building.
- The dispersal lateral is made of clay tile pipe approx. 14" below surface.
- The lateral is full of roots from nearby trees.
- The inspection camera was blocked by roots approx. 5 feet from the building edge.
- The existing lateral is within approx. 17 m from the wellhead.
- There is approx. 6" of topsoil over an impermeable clay layer.

Conclusions:

- The daily design flow for this house is 59 Imp. Gal/day and would require a septic tank retention volume of approx. 178 Imp. Gal. to meet today's standards. Since the septic tank retention volume is 330 Imp. Gal., the septic tank volume meets today's standards.
- The septic tank appears to be leaking. The septic tank has not been pumped out in several years, but the liquid level in the tank is 4" below the invert of the outlet pipe. The septic tank should be replaced.
- The septic tank and dispersal lateral are within the 30-m horizontal separation prescribed by the BC Sewerage System Standard Practice Manual (26 m and 17 m, respectively). You may need to consult a

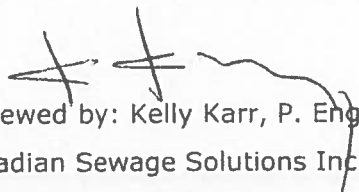
professional who is proficient in hydrogeology to justify the repair or replacement of the existing onsite sewage system within this 30-m setback from the wellhead.

- The dispersal lateral is full of roots, and there is insufficient vertical separation from a restrictive layer (clay). The dispersal field should be replaced to achieve sufficient vertical separation.
- Overall, the onsite sewage system is in poor condition and does not meet today's standards. The onsite sewage system should be replaced in order to meet performance standards.

NOTE: The information provided in the above sections helps an experienced inspector to provide an opinion as to the overall operating condition of the septic system on the date of the inspection. It should be noted that a septic system inspection is not a warranty nor a guarantee that the system inspected will function for any period of time in the future, as many factors that affect the operation of septic systems, such as weather, age and individual water use, are beyond our control. An inspection is NOT intended to be used as a guarantee or warranty, expressed or implied, regarding the adequacy, performance or condition of any inspected structure, item or system. An inspection is not intended to reflect the value of the premises, nor to make any representation as to the advisability or inadvisability of purchase or the suitability for use.

This inspection report and recommendations are true to the best knowledge of this date: November 6, 2018.

Stephen Coburn, EIT
Wastewater Systems Design Engineer


Reviewed by: Kelly Karr, P. Eng.
Canadian Sewage Solutions Inc.



Note: Canadian Sewage Solutions Inc. would be pleased to do the above repairs or maintenance. However, any inspector offering to do repairs or maintenance has a potential conflict of interest by offering to do repairs on a system that they have inspected.

Photo pages



Photo 1: Subject property

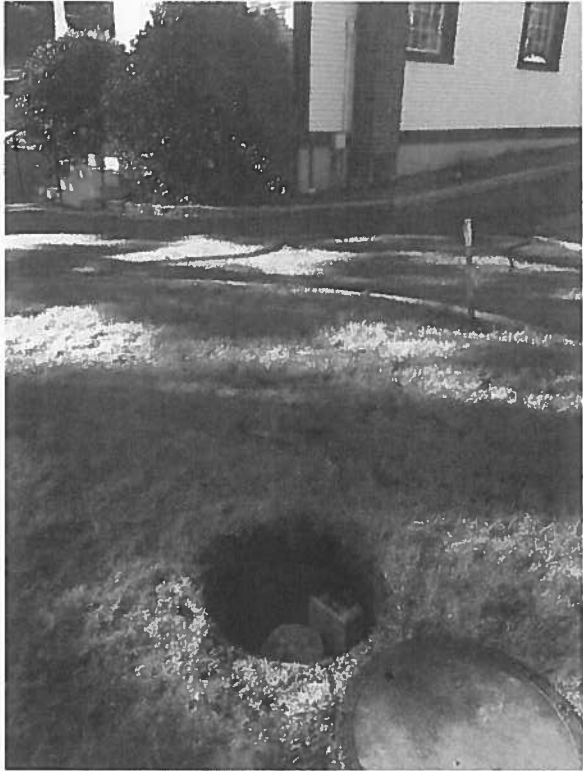


Photo 2: Wellhead location.

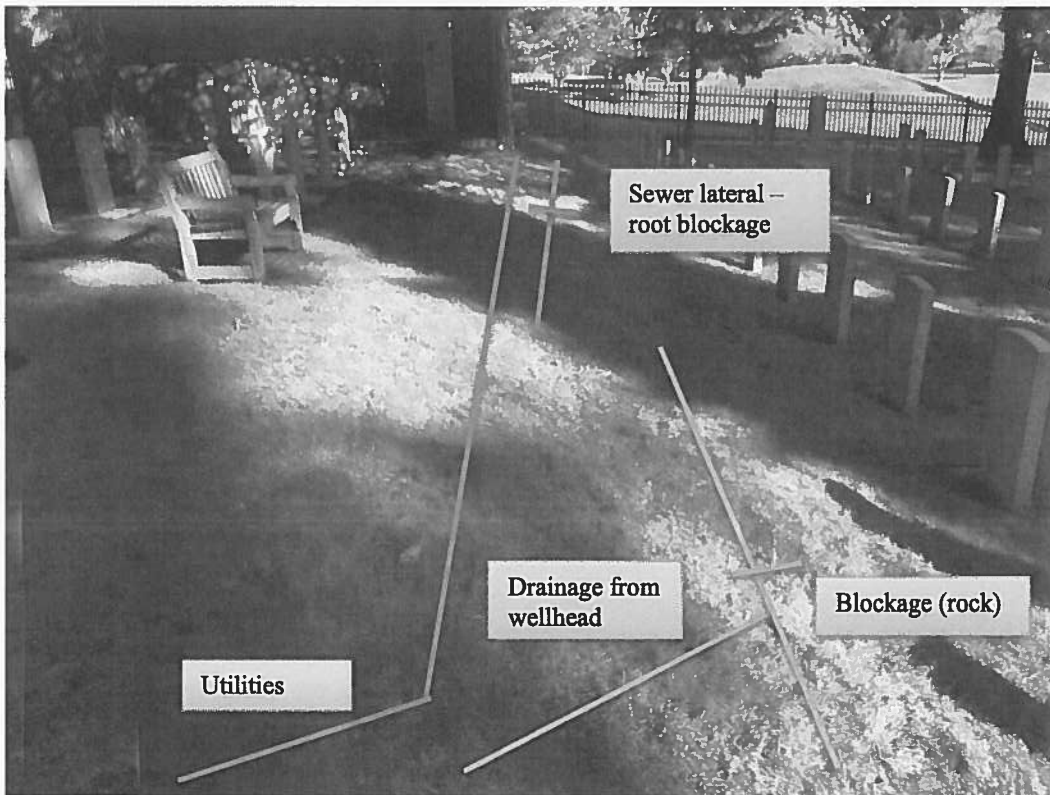


Photo 3: Dispersal field location.

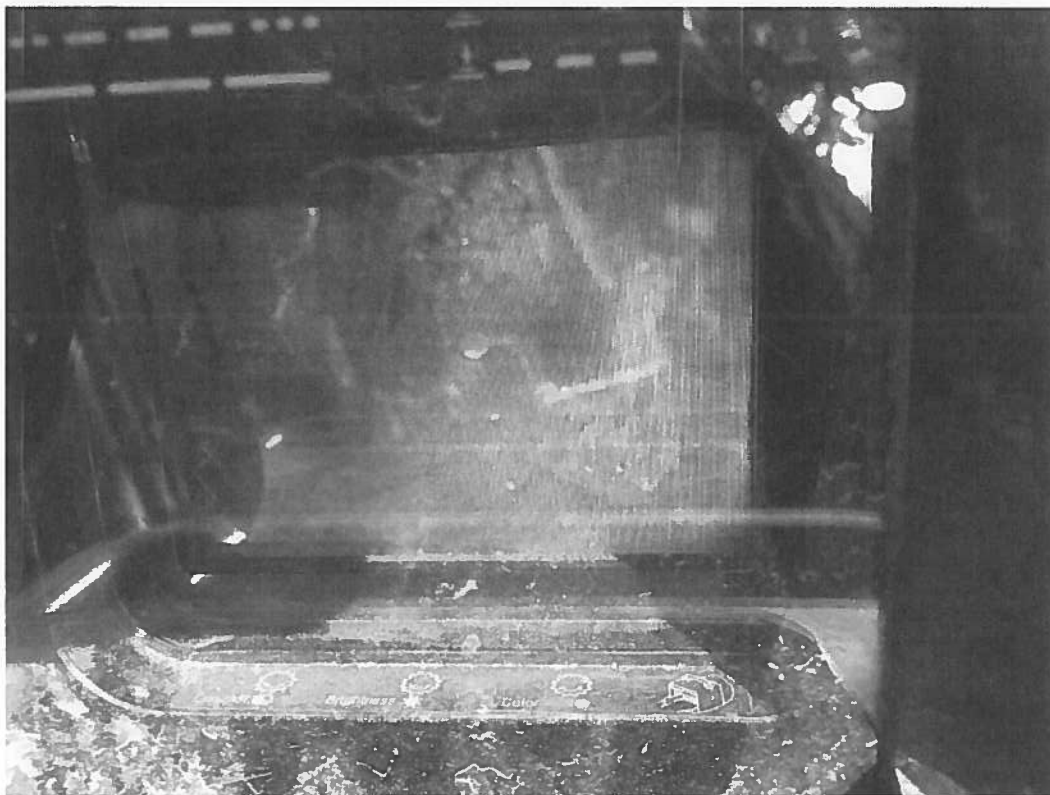


Photo 4: Rock in drain pipe from wellhead.

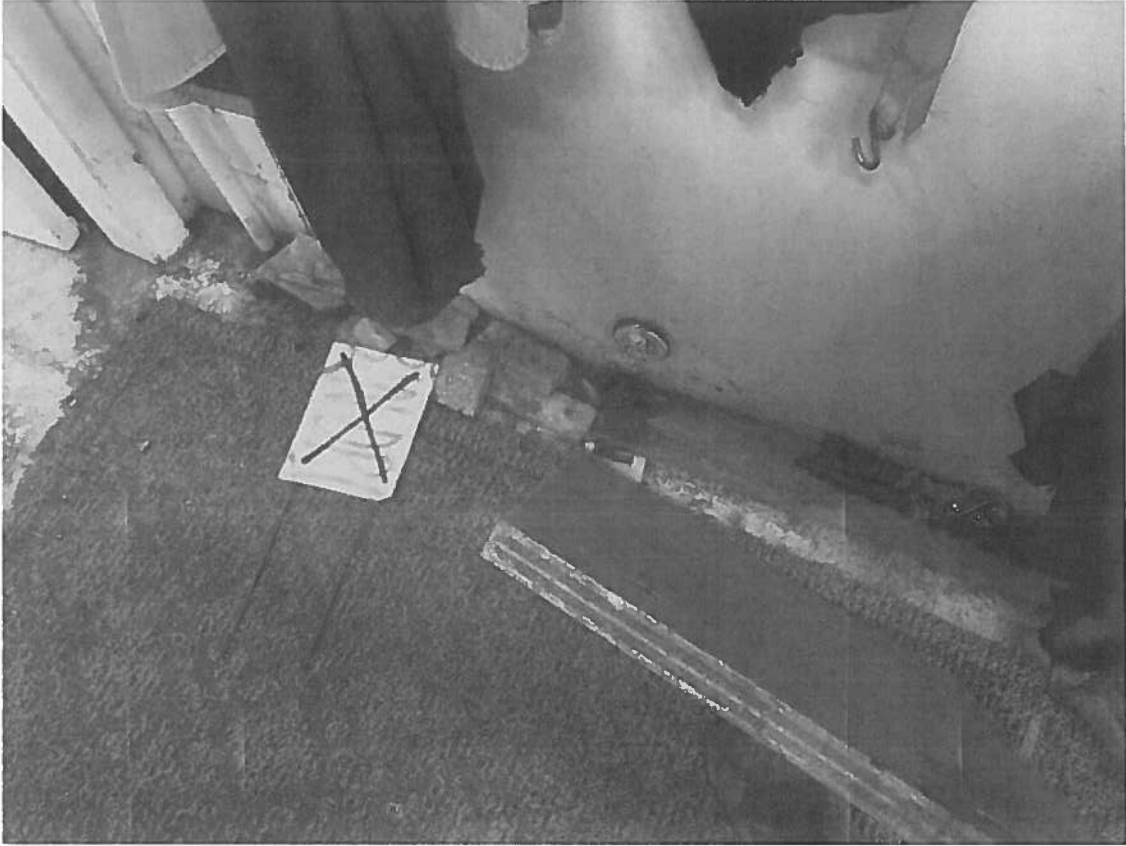


Photo 5: Cleanout access in workshop.

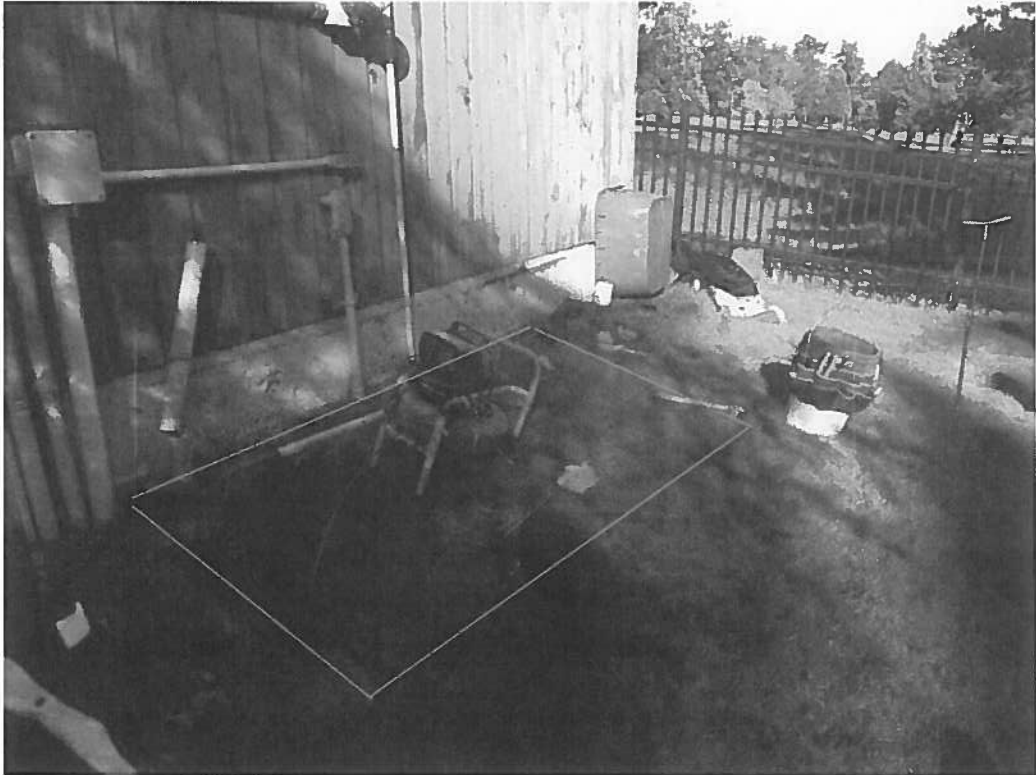


Photo 6: Septic tank location.



Photo 7: Liquid level approx. 4" below outlet pipe invert.

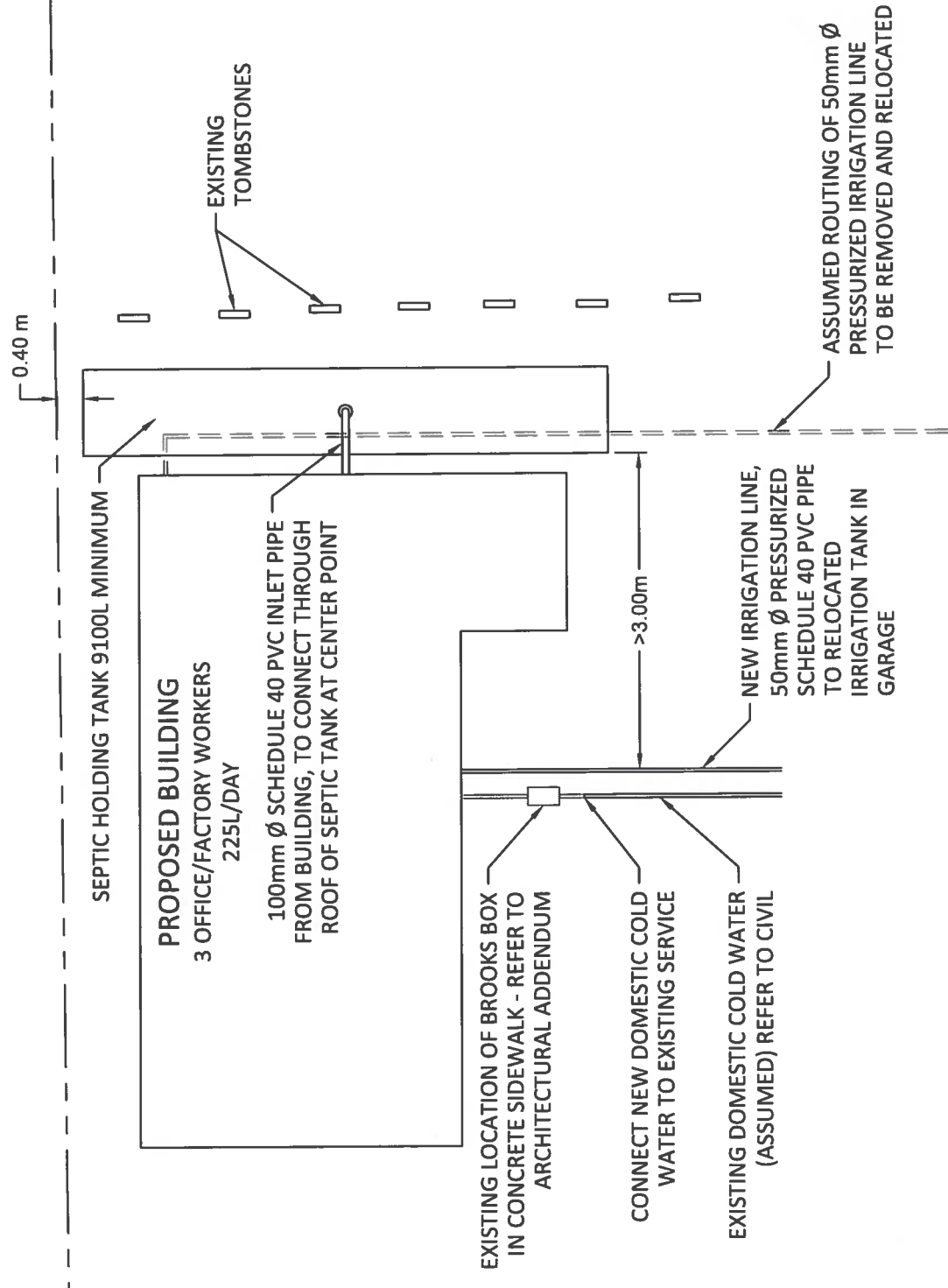
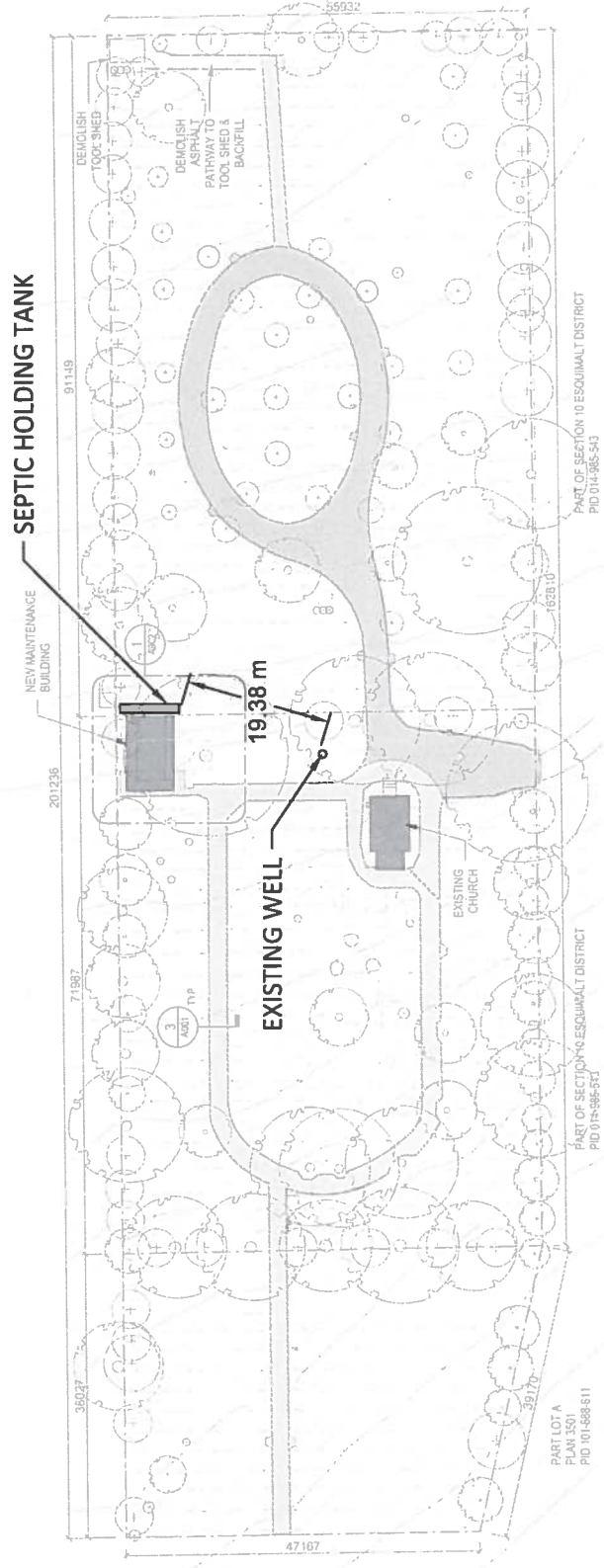


Photo 8: Roots at pipe blockage.



Photo 9: Clay tile pipe with root infiltration.

APPENDIX G



PROPERTY SITE PLAN
SCALE 1:1000

SEPTIC TANK PLAN
SCALE 1:100



Unit 15 20279 97th Avenue
Langley BC, V1M 4B9
Phone: (604) 882-8475
Fax: (604) 882-8476

Client: ISL Engineering & Land Services Ltd.

Location: 1190 Colville Road
Victoria, BC

FILE No.
41971-66

DATE
December 20, 2018

Septic Holding Tank
Site Plan

| | | | |
|-----------------|-------|----------------|--------|
| DRAWN: | ML | DWG No. | 1 of 2 |
| CHECKED: | RV | SCALE: | |
| SCALE: | NOTED | | |

| REV. | DATE | DESCRIPTION |
|------|---------------|----------------------|
| 1 | Dec. 20, 2018 | Issue for Submission |



APPENDIX H

Asbestos Building Materials Assessment

Chapel, Equipment Storage
Shed/Office, and Maintenance
Building at the Veteran's
Cemetery – 1190 Colville Road,
Esquimalt BC



Prepared for:
Public Services and Procurement
Canada
Environmental Services, Pacific
Region
401-1230 Government
Victoria BC V8W 3X4

Prepared by:
Stantec Consulting Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6
Tel: (604) 436-3014
Fax: (604) 436-3752

Project No.: 123220983

November 2, 2017

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Executive Summary

Stantec Consulting Ltd. (Stantec) was retained by Public Services and Procurement Canada (PSPC) to conduct an asbestos-containing materials (ACMs) assessment of the following structures (subject buildings) associated with the Veteran's Cemetery located at 1190 Colville Road in Esquimalt, British Columbia:

- Chapel
- Equipment storage shed and office
- Maintenance

The purpose of the assessment was to assess for the presence (or absence) and estimated extent of ACMs within the subject buildings that may require special management practices in accordance with the requirements of the Canada Labour Code, Part II (Canada Labour Code) and the current version of British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97), for continued operations and maintenance.

Based on Stantec's visual assessment and on the laboratory analyses performed on samples collected, ACMs were identified within the subject buildings.

A summary of our findings and recommendations is presented below. Recommendations pertaining to the handling, removal, transportation and disposal of identified ACMs are provided in Section 6.0 of this report.

It should be noted that this summary is subject to the same restrictions and limitations as presented in Section 4.0 (Assessment Limitations) and Section 7.0 (Closure). The information provided is to be read in conjunction with the remainder of this report.

ASBESTOS BUILDING MATERIALS ASSESSMENT

Summary of Findings

The following ACMs were identified through this assessment:

- Chapel
 - Grey exterior stucco applied at bases of walls
- Equipment storage shed and office
 - Black window pane caulking on window above washroom door
 - Light gray putty applied to electrical penetrations
 - Dark gray putty applied to electrical penetrations

These materials were observed to be in good condition.

The following building materials are potentially present but were not sampled, and are listed as presumed asbestos-containing materials (PACMs):

- Insulation in fire rated doors in the following locations:
 - Three doors in equipment storage shed and office
 - One door in maintenance shed

These materials were observed to be in good condition. These materials were not sampled to preserve their integrity. Sampling of these materials was not part of the scope of work as determined by Stantec's understanding of the project. As these materials are known to have been manufactured with asbestos, they should be presumed to be asbestos-containing unless proven otherwise by laboratory analysis.

ASBESTOS BUILDING MATERIALS ASSESSMENT

Introduction
November 2, 2017

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Public Services and Procurement Canada (PSPC) to conduct an asbestos-containing materials (ACMs) assessment of the following structures (subject buildings) associated with the Veteran's Cemetery located at 1190 Colville Road in Esquimalt, British Columbia:

- Chapel
- Equipment storage shed and office
- Maintenance

The purpose of the assessment was to assess for the presence (or absence) and estimated extent of ACMs within the subject buildings that may require special management practices in accordance with the requirements of the Canada Labour Code, Part II (Canada Labour Code) and the current version of British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97), for continued operations and maintenance.

Site work was completed within the subject buildings on September 25 and September 27, 2017.

2.0 BACKGROUND

The subject buildings consist of the following:

- Chapel
 - One story wood-framed structure built slab on concrete with wood exterior/plaster interior wall finishes, wood flooring and wood shingle roof
- Equipment storage shed and office
 - One story wood-framed structure built slab on concrete with wood interior/exterior walls and wood shingle roof
- Maintenance shed
 - Small one-story wood-framed outdoor shed built slab on concrete with wood exterior walls and wood shingle roof

Although the construction dates of the subject buildings are unknown they were reportedly constructed prior to 1990. These dates of construction would be consistent with those dates when ACMs were commonly used and/or may be present.

Stantec understands that the information pertaining to the identity, location and approximate extent of ACMs (if any) within the subject buildings is either not on-file or outdated. As such, and in accordance with the requirements of the Canada Labour Code and BC Reg. 296/97 pertaining to identifying hazards associated with ACMs in the workplace, the Client commissioned this assessment.

ASBESTOS BUILDING MATERIALS ASSESSMENT

Scope and Methodology
November 2, 2017

3.0 SCOPE AND METHODOLOGY

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, ACM means any material containing at least 0.5% asbestos, or vermiculite insulation with any asbestos.

Keith Irwin of Stantec conducted a visual assessment within the subject buildings on September 25 and September 27, 2017. 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. Where building materials were suspected but not confirmed to contain asbestos, samples were collected for analysis to confirm or deny the presence of asbestos. Based on analytical results, visually similar materials were referenced to specific analyzed samples to reduce the number of samples collected.

Multiple samples were collected from each "homogenous application" of an observed suspected ACM (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 Burnaby, British Columbia for analysis of asbestos content using Polarized Light Microscopy (PLM) with dispersion staining, in accordance with the US Environmental Protection Agency (EPA) 600/R-93/116 Method *Method for the Determination of Asbestos in Bulk Building Materials*. The number of samples to be collected for each homogenous application of a suspected ACM was based on the recommendations provided in the WorkSafeBC publication *Safe Work Practices for Handling Asbestos* (2017, further referred to as the Asbestos Guide),

ASBESTOS BUILDING MATERIALS ASSESSMENT

Assessment Limitations
November 2, 2017

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).

3.1.1 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 0.5% in one of the samples within a set that was collected to represent a "homogenous application" of that material (or in any concentration, for vermiculite). 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.

3.1.2 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.

4.0 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.

ASBESTOS BUILDING MATERIALS ASSESSMENT

Results

November 2, 2017

This report reflects the observations made within accessible and accessed areas of the subject buildings, and the results of analyses performed on the specific material sampled during the assessment. Analytical results reflect the sampled material at the specific sample locations.

This report has been prepared for the exclusive use of the PSPC for the purpose of assessing general conditions in the subject buildings. Any use that a third party makes this report, or reliance on, or decisions to be made on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Due to the limitations of sampling techniques, the asbestos content of some materials within the subject buildings could neither be confirmed nor denied. Suspected ACMs that were not sampled include, but are not limited to, the following:

- Concealed layers of roofing materials, if present, beneath those observed during the assessment
- 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

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.

5.0 RESULTS

Floor plans showing bulk sample locations and locations of identified ACMs (where practical) are provided in Appendix A.

Stantec identified and sampled various suspected ACMs. The samples collected were submitted to EMSL for analysis of asbestos content and nature.

ASBESTOS BUILDING MATERIALS ASSESSMENT

Results
November 2, 2017

A summary of the materials sampled as part of the current assessment, along with the sample locations and analytical results is presented in Table 1, below. A copy of the certificate of analysis provided by EMSL for the suspected ACM samples submitted as part of this assessment is attached in Appendix B.

**Table 1 Suspected ACM Sample Collection and Analysis Summary
Veteran’s Cemetery—1190 Colville Road, Esquimalt, BC**

| Sample Number | Material Description | Sample Location | Result (%/type asbestos) |
|---------------|--|----------------------------|--------------------------|
| Chapel | | | |
| CH-EWFC-01A | Exterior window frame caulking, cream (painted black), applied to seams of wood window frame | Exterior, north window | None Detected |
| CH-EWFC-01B | Exterior window frame caulking, cream (painted black), applied to seams of wood window frame | Exterior, north window | None Detected |
| CH-EWFC-01C | Exterior window frame caulking, cream (painted black), applied to seams of wood window frame | Exterior, south window | None Detected |
| CH-EWFC-02A | Exterior window frame caulking, cream, applied to seams | Exterior, west window | None Detected |
| CH-EWFC-02B | Exterior window frame caulking, cream, applied to seams of wood window frame | Exterior, west window | None Detected |
| CH-EWFC-02C | Exterior window frame caulking, cream, applied to seams | Exterior, west window | None Detected |
| CH-CC-01A | White caulking applied to chimney edge | Exterior, north | None Detected |
| CH-CC-01B | White caulking applied to chimney edge | Exterior, north | None Detected |
| CH-CC-01C | White caulking applied to chimney edge | Exterior, north | None Detected |
| CH-EPP-01A | Grey (painted white) electrical penetration putty | Exterior, north by chimney | None Detected |
| CH-EPP-01B | Grey (painted white) electrical penetration putty | Exterior, north by chimney | None Detected |
| CH-EPP-01C | Grey (painted white) electrical penetration putty | Exterior, north by chimney | None Detected |
| CH-CP-01 | Cement drainage pipe | Exterior, northwest corner | None Detected |

ASBESTOS BUILDING MATERIALS ASSESSMENT

Results
November 2, 2017

**Table 1 Suspected ACM Sample Collection and Analysis Summary
Veteran's Cemetery—1190 Colville Road, Esquimalt, BC**

| Sample Number | Material Description | Sample Location | Result (%/type asbestos) |
|--|---|----------------------------|-------------------------------------|
| Chapel (cont'd) | | | |
| CH-BM-01A | Chimney brick mortar | Exterior, north chimney | None Detected |
| CH-BM-01B | Chimney brick mortar | Exterior, north chimney | None Detected |
| CH-BM-01C | Chimney brick mortar | Exterior, north chimney | None Detected |
| CH-PL-01A | Plaster applied to walls and ceilings | Interior, east by entrance | None Detected |
| CH-PL-01B | Plaster applied to walls and ceilings | Interior, northeast | None Detected |
| CH-PL-01C | Plaster applied to walls and ceilings | Interior, south | None Detected |
| CH-PL-01D | Plaster applied to walls and ceilings | Interior, south | None Detected |
| CH-PL-01E | Plaster applied to walls and ceilings | Interior, northeast | None Detected |
| CH-ES-01A | Grey exterior stucco applied at base of walls | Exterior, north | 2% Chrysotile |
| CH-ES-01B | Grey exterior stucco applied at base of walls | Exterior, north | Positive Stop (Not Analyzed) |
| CH-ES-01C | Grey exterior stucco applied at base of walls | Exterior, south | Positive Stop (Not Analyzed) |
| Equipment Storage Shed and Office | | | |
| ES-FM-01A | Grey mastic applied to roof flashing seams | Roof | None Detected |
| ES-FM-01B | Grey mastic applied to roof flashing seams | Roof | None Detected |
| ES-FM-01C | Grey mastic applied to roof flashing seams | Roof | None Detected |
| ES-RM-01A | SBS roof membrane | Roof | None Detected |
| ES-RM-01B | SBS roof membrane | Roof | None Detected |
| ES-RM-01C | SBS roof membrane | Roof | None Detected |
| ES-WPC-01A | Black window pane caulking on window above washroom door | Washroom | 3.8% Chrysotile |
| ES-WPC-01B | Black window pane caulking on window above washroom door | Washroom | Positive Stop (Not Analyzed) |
| ES-WPC-01C | Black window pane caulking on window above washroom door | Washroom | Positive Stop (Not Analyzed) |
| ES-PS-01A | Brown penetration sealant on plastic vent | Exterior south | None Detected |
| ES-PS-01B | Brown penetration sealant on plastic vent | Exterior south | None Detected |
| ES-PS-01C | Brown penetration sealant on plastic vent | Exterior south | None Detected |

ASBESTOS BUILDING MATERIALS ASSESSMENT

Results
November 2, 2017

**Table 1 Suspected ACM Sample Collection and Analysis Summary
Veteran’s Cemetery—1190 Colville Road, Esquimalt, BC**

| Sample Number | Material Description | Sample Location | Result (%/type asbestos) |
|---|---|-----------------|------------------------------|
| Equipment Storage Shed and Office (cont'd) | | | |
| ES-EPP-01A | Light gray putty applied to electrical penetrations | Exterior south | 0.25% Chrysotile |
| ES-EPP-01B | Light gray putty applied to electrical penetrations | Exterior south | 1.1% Chrysotile |
| ES-EPP-01C | Light gray putty applied to electrical penetrations | Exterior south | Positive Stop (Not Analyzed) |
| ES-EPP-02A | Dark gray putty applied to electrical penetrations | Exterior south | 2.4% Chrysotile |
| ES-EPP-02B | Dark gray putty applied to electrical penetrations | Exterior south | Positive Stop (Not Analyzed) |
| ES-EPP-02C | Dark gray putty applied to electrical penetrations | Exterior south | Positive Stop (Not Analyzed) |
| Maintenance Shed | | | |
| MS-RS-01A | Black roof shingle with grey specks | Roof | <0.34% Chrysotile |
| MS-RS-01B | Black roof shingle with grey specks | Roof | None Detected |
| MS-RS-01C | Black roof shingle with grey specks | Roof | None Detected |
| MS-RF-01A | Roof felt underlay | Roof | None Detected |
| MS-RF-01B | Roof felt underlay | Roof | None Detected |
| MS-RF-01C | Roof felt underlay | Roof | None Detected |
| NOTE: Bold, highlighted text indicates confirmed ACM | | | |

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of the results of suspected ACM samples collected during this assessment, the materials presented in Table 2, below were identified as ACMs within the subject buildings.

ASBESTOS BUILDING MATERIALS ASSESSMENT

Results
November 2, 2017


**Table 2 Summary of Identified ACMs
Veteran’s Cemetery—1190 Colville Road, Esquimalt, BC**

| Identified ACM Description | | Photo |
|---|-------------------------------------|--|
| Chapel—grey exterior stucco applied at base | |  |
| Friability | Friable | |
| Condition | Good | |
| Total Quantity | Approximately 35 square metres | |
| Content | 2.0% Chrysotile | |
| Equipment Storage Shed and Office—black window pane caulking on window above washroom door | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 3 linear metres | |
| Content | 3.8% Chrysotile | |
| Equipment Storage Shed and Office—light gray putty applied to electrical penetrations | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 10 square centimetres | |
| Content | 0.25% to 1.1% Chrysotile | |

ASBESTOS BUILDING MATERIALS ASSESSMENT

Results
November 2, 2017

**Table 2 Summary of Identified ACMs
Veteran’s Cemetery—1190 Colville Road, Esquimalt, BC**

| Identified ACM Description | | Photo |
|---|------------------------------------|--|
| Equipment Storage Shed and Office—dark gray putty applied to electrical penetrations | |  |
| Friability | Non-friable | |
| Condition | Good | |
| Total Quantity | Approximately 5 square centimetres | |
| Content | 2.4% Chrysotile | |

5.1.1 Presumed Asbestos-containing Materials

The following building materials were observed to be present but not sampled, and are listed as presumed asbestos-containing materials (PACMs):

- Insulation in fire rated doors in the following locations:
 - Three doors in equipment storage shed and office
 - One door in maintenance shed

These materials were observed to be in good condition. These materials were not sampled to preserve their integrity. Sampling of these materials was not part of the scope of work as determined by Stantec’s understanding of the project. As these materials are known to have been manufactured with asbestos, they should be presumed to be asbestos-containing unless proven otherwise by laboratory analysis.

5.1.2 Materials Containing Less Than 0.5% Asbestos

Three samples of black (with grey specks) roof shingles were collected from the Maintenance Shed roof. The analytical results indicate that less than 0.34% chrysotile asbestos was detected in one sample, with no asbestos having been detected in the other two samples. The number of samples collected for this material would be adequate to appropriately characterize its asbestos content based on its extent and published standards for sampling of homogenous applications of suspected ACMs (e.g., the Asbestos Guide). Given the analytical results and the non-friable nature of this material, it would not be considered an ACM.

ASBESTOS BUILDING MATERIALS ASSESSMENT

Recommendations
November 2, 2017

5.1.3 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 attic spaces, floor cavities and masonry block or brick walls, which are typical areas where vermiculite is found. No vermiculite or locations that may potentially contain vermiculite (that could not otherwise be assessed) were observed.

6.0 RECOMMENDATIONS

Stantec recommends the following with regards to meeting the requirements of the Canada Labour Code and BC Reg. 296/97 as they pertain to managing asbestos in the workplace:

- Due to the confirmed presence of asbestos within the subject building, and in accordance with the requirements of the Canada Labour Code, the Asbestos Guide and BC Reg. 296/97, an asbestos exposure control plan (also known as an Asbestos Management Plan [AMP] or Asbestos Operations and Management Plan) must be developed and implemented for the subject buildings. The AMP would serve to compile the available data, results and reports regarding the presence, extent, handling, removal, and disposal of ACMs within the subject buildings. The AMP would also provide sections for information regarding future sampling and analysis of suspected ACMs, if required, asbestos-abatement projects, if undertaken, and other information regarding the management of asbestos within the subject buildings.
- Identified ACMs in good condition can be managed in place, upon development and implementation of an AMP.
- 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 ACMs should be handled in accordance with applicable guidelines and regulations.
- Prior to renovation and/or demolition activities that would disturb them, undertake testing of PACMs that may be impacted to determine their asbestos content. Confirmed ACMs should be handled accordingly.
- Suspected ACMs deemed visually similar to the ACMs identified in this report 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 at any time when excavation is required.
- Ensure asbestos containing waste is handled, stored, transported 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).
- This report should be added to the AMP and referred to as the current ACM record.

ASBESTOS BUILDING MATERIALS ASSESSMENT

Closure
November 2, 2017

7.0 CLOSURE

This report has been prepared by Stantec for the sole benefit of the Public Services and Procurement 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 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 date 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 cannot warrant against undiscovered environmental 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 A FLOOR PLANS



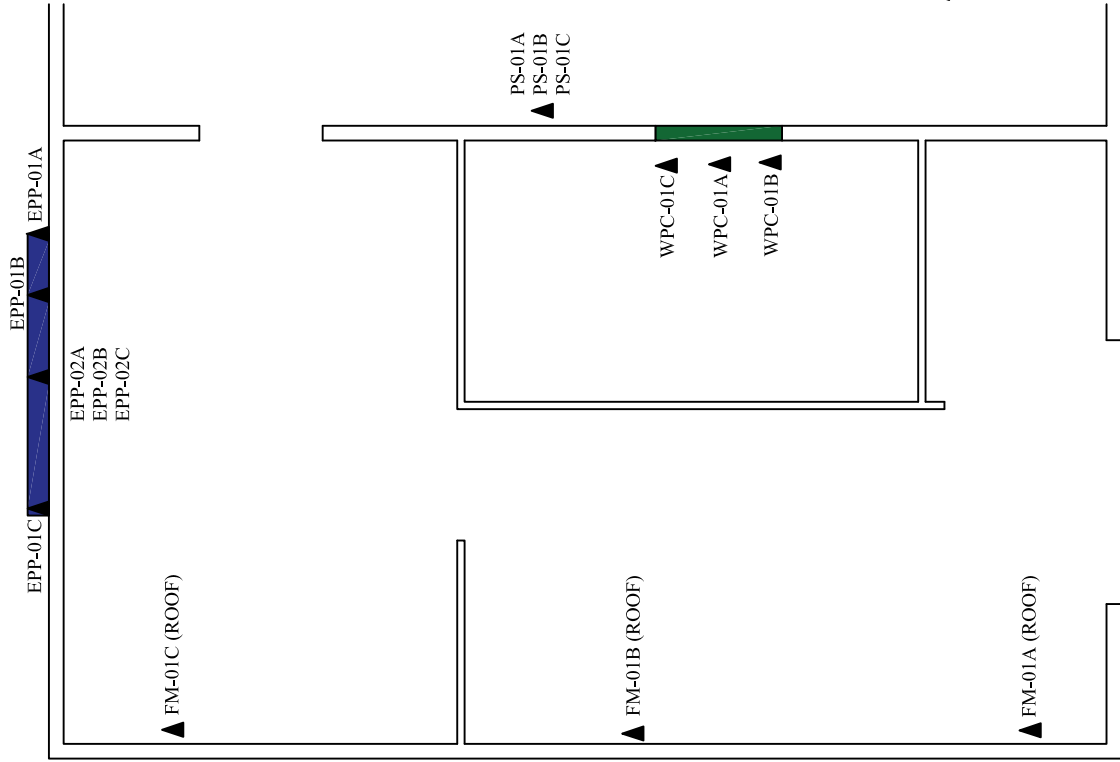
LEGEND
 ▲ ASBESTOS BULK SAMPLE
 ■ ACM EXTERIOR STUCCO APPLIED TO BASE OF WALLS

CHAPEL

1. THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

| | | |
|--|---------------------|------------------|
| Project No.: 123220983 | | Dwg. No.: |
| Scale: N.T.S. | | 1 |
| Date: 17/10/26 | | |
| Dwn. By: CD_DM | SL2017100510 | |
| App'd By: TW | | |
| FLOOR PLAN SHOWING ASBESTOS-CONTAINING MATERIALS (ACMS) AND BULK SAMPLE LOCATIONS VETERAN'S CEMETERY - 1190 COLVILLE ROAD, ESQUJIMALT BC PUBLIC SERVICES AND PROCUREMENT CANADA (PSPC) | | |
| Client: | | |



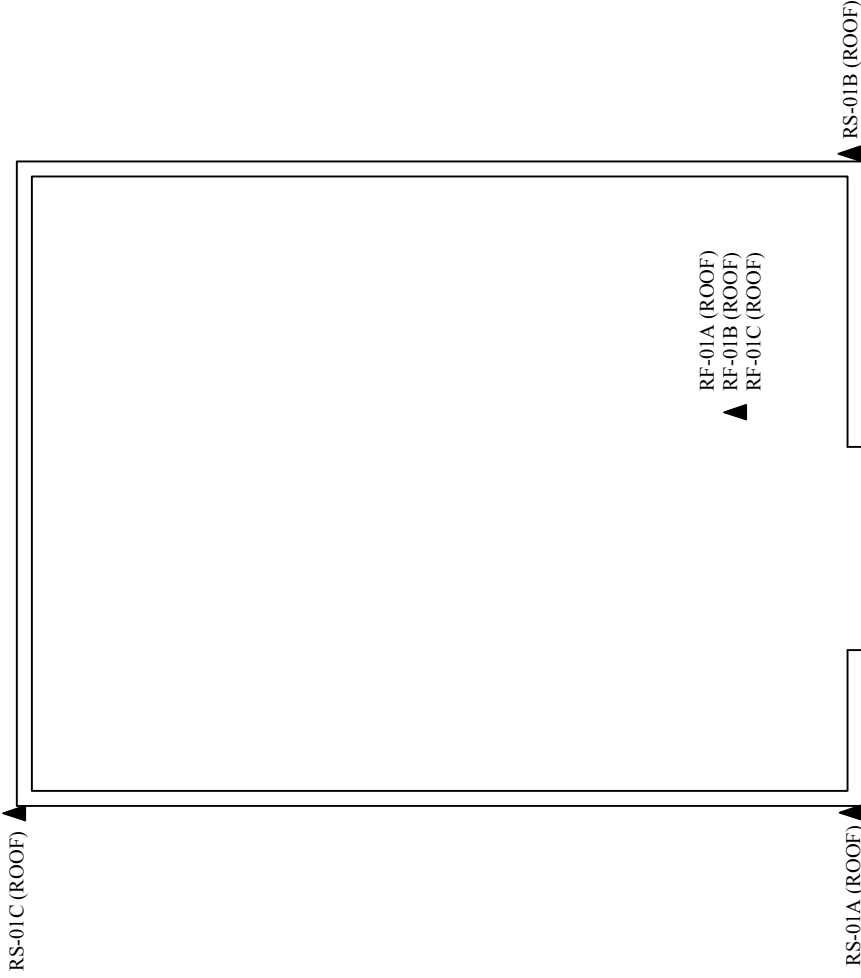


**EQUIPMENT STORAGE
SHED AND OFFICE**

- LEGEND**
- ▲ ASBESTOS BULK SAMPLE
 - ACM WINDOW PANE CAULKING
 - ACM LIGHT/DARK PUTTY APPLIED TO ELECTRICAL PENETRATIONS

1. THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

| | | | |
|--|---|----------------------------------|--|
| Project No.: 123220983 | | Dwg. No.: 2 | |
| Scale: N.T.S. | | | |
| Date: 17/10/26 | | | |
| Dwn. By: CD_DM | SL2017100511 | | |
| App'd By: TW | | | |
| FLOOR PLAN SHOWING ASBESTOS-CONTAINING MATERIALS (ACMS) AND BULK SAMPLE LOCATIONS | | | |
| VETERAN'S CEMETERY - 1190 COLVILLE ROAD, ESQUIMALT BC | | | |
| Client: | PUBLIC SERVICES AND PROCUREMENT CANADA (PSPC) | | |



MAINTENANCE SHED

LEGEND
 ▲ ASBESTOS
 ▲ BULK SAMPLE

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

FLOOR PLAN SHOWING ASBESTOS-CONTAINING MATERIALS (ACMS) AND BULK SAMPLE LOCATIONS

VETERAN'S CEMETERY - 1190 COLVILLE ROAD, ESQUIMALT BC
 PUBLIC SERVICES AND PROCUREMENT CANADA (PSPC)

| | | |
|--|-------------|--|
| Project No.: 123220983 | Dwg. No.: 3 | |
| Scale: N.T.S. | | |
| Date: 17/10/26 | | |
| Dwn. By: CD _{DM} SL2017100512 | | |
| App'd By: TW | | |

APPENDIX B
CERTIFICATE OF ANALYSIS—SUSPECTED
ACM SAMPLES



EMSL Canada Inc.

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EMSL Canada Order 691702392
 Customer ID: 55JACQ30L
 Customer PO: 123220983
 Project ID:

Attn: Keith Irwin
 Stantec Consulting, Ltd.
 500 - 4730 Kingsway
 Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 10/10/2017
Analyzed: 10/13/2017

Proj: 123220983

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: | CH-EWFC-01A | Lab Sample ID: | 691702392-0001 |
| Sample Description: | EXTERIOR WINDOW FRAME CAULKING, CREAM (PAINTED BLACK), APPLIED TO SEAMS OF WOOD WINDOW FRAME/EXTERIOR, NORTH WINDOW | | |
| TEST | Analyzed Date | Color | Non-Asbestos Fibrous Non-Fibrous Asbestos Comment |
| PLM Grav. Reduction | 10/12/2017 | Black | 0.0% 100% None Detected |
| Client Sample ID: | CH-EWFC-01B | Lab Sample ID: | 691702392-0002 |
| Sample Description: | EXTERIOR WINDOW FRAME CAULKING, CREAM (PAINTED BLACK), APPLIED TO SEAMS OF WOOD WINDOW FRAME/EXTERIOR, NORTH WINDOW | | |
| TEST | Analyzed Date | Color | Non-Asbestos Fibrous Non-Fibrous Asbestos Comment |
| PLM Grav. Reduction | 10/12/2017 | Black | 0.0% 100% None Detected |
| Client Sample ID: | CH-EWFC-01C | Lab Sample ID: | 691702392-0003 |
| Sample Description: | EXTERIOR WINDOW FRAME CAULKING, CREAM (PAINTED BLACK), APPLIED TO SEAMS OF WOOD WINDOW FRAME/EXTERIOR, NORTH WINDOW | | |
| TEST | Analyzed Date | Color | Non-Asbestos Fibrous Non-Fibrous Asbestos Comment |
| PLM | 10/13/2017 | Black | 0% 100% None Detected |
| Client Sample ID: | CH-EWFC-02A | Lab Sample ID: | 691702392-0004 |
| Sample Description: | EXTERIOR WINDOW FRAME CAULKING, CREAMM APPLIED TO SEAMS/EXTERIOR, WEST WINDOW | | |
| TEST | Analyzed Date | Color | Non-Asbestos Fibrous Non-Fibrous Asbestos Comment |
| PLM Grav. Reduction | 10/12/2017 | White | 0.0% 100% None Detected |
| Client Sample ID: | CH-EWFC-02B | Lab Sample ID: | 691702392-0005 |
| Sample Description: | EXTERIOR WINDOW FRAME CAULKING, CREAMM APPLIED TO SEAMS OF WOOD WINDOW FRAME/EXTERIOR, WEST WINDOW | | |
| TEST | Analyzed Date | Color | Non-Asbestos Fibrous Non-Fibrous Asbestos Comment |
| PLM Grav. Reduction | 10/12/2017 | White | 0.0% 100% None Detected |
| Client Sample ID: | CH-EWFC-02C | Lab Sample ID: | 691702392-0006 |
| Sample Description: | EXTERIOR WINDOW FRAME CAULKING, CREAMM APPLIED TO SEAMS/EXTERIOR, WEST WINDOW | | |
| TEST | Analyzed Date | Color | Non-Asbestos Fibrous Non-Fibrous Asbestos Comment |
| PLM Grav. Reduction | 10/13/2017 | White | 0.0% 100% None Detected |
| Client Sample ID: | CH-CC-01A | Lab Sample ID: | 691702392-0007 |
| Sample Description: | WHITE CAULKING APPLIED TO CHIMNEY EDGE/EXTERIOR, NORTH | | |
| TEST | Analyzed Date | Color | Non-Asbestos Fibrous Non-Fibrous Asbestos Comment |
| PLM Grav. Reduction | 10/12/2017 | White | 0.0% 100% None Detected |



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EMSL Canada Order 691702392
Customer ID: 55JACQ30L
Customer PO: 123220983
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: CH-CC-01B **Lab Sample ID:** 691702392-0008
Sample Description: WHITE CAULKING APPLIED TO CHIMNEY EDGE/EXTERIOR, NORTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | White | 0.0% | 100% | None Detected | |

Client Sample ID: CH-CC-01C **Lab Sample ID:** 691702392-0009
Sample Description: WHITE CAULKING APPLIED TO CHIMNEY EDGE/EXTERIOR, NORTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/13/2017 | White | 0.0% | 100% | None Detected | |

Client Sample ID: CH-EPP-01A **Lab Sample ID:** 691702392-0010
Sample Description: GREY (PAINTED WHITE) ELECTRICAL PENETRATION PUTTY/EXTERIOR, NORTH BY CHIMNEY

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Gray | 0.0% | 100% | None Detected | |

Client Sample ID: CH-EPP-01B **Lab Sample ID:** 691702392-0011
Sample Description: GREY (PAINTED WHITE) ELECTRICAL PENETRATION PUTTY/EXTERIOR, NORTH BY CHIMNEY

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Gray | 0.0% | 100% | None Detected | |

Client Sample ID: CH-EPP-01C **Lab Sample ID:** 691702392-0012
Sample Description: GREY (PAINTED WHITE) ELECTRICAL PENETRATION PUTTY/EXTERIOR, NORTH BY CHIMNEY

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Gray | 0.0% | 100% | None Detected | |

Client Sample ID: CH-CP-01 **Lab Sample ID:** 691702392-0013
Sample Description: CEMENT DRAINAGE PIPE/EXTERIOR, NORTHWEST CORNER

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | Gray | 0% | 100% | None Detected | |

Client Sample ID: CH-BM-01A **Lab Sample ID:** 691702392-0014
Sample Description: CHIMNEY BRICK MORTAR/EXTERIOR, NORTH CHIMNEY

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | Gray | 0% | 100% | None Detected | |

Client Sample ID: CH-BM-01B **Lab Sample ID:** 691702392-0015
Sample Description: CHIMNEY BRICK MORTAR/EXTERIOR, NORTH CHIMNEY

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | Gray | 0% | 100% | None Detected | |



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EMSL Canada Order 691702392
Customer ID: 55JACQ30L
Customer PO: 123220983
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: CH-BM-01C **Lab Sample ID:** 691702392-0016
Sample Description: CHIMNEY BRICK MORTAR/EXTERIOR, NORTH CHIMNEY

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | Gray | 0% | 100% | None Detected | |

Client Sample ID: CH-PL-01A **Lab Sample ID:** 691702392-0017
Sample Description: PLASTER APPLIED TO WALLS AND CEILINGS/INTERIOR, EAST BY ENTRANCE

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | Gray | 0% | 100% | None Detected | |

Client Sample ID: CH-PL-01B-Skim Coat **Lab Sample ID:** 691702392-0018
Sample Description: PLASTER APPLIED TO WALLS AND CEILINGS/INTERIOR, NORTHEAST

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | White | 0% | 100% | None Detected | |

Client Sample ID: CH-PL-01B-Rough Coat **Lab Sample ID:** 691702392-0018A
Sample Description: PLASTER APPLIED TO WALLS AND CEILINGS/INTERIOR, NORTHEAST

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | Gray | 0% | 100% | None Detected | |

Client Sample ID: CH-PL-01C **Lab Sample ID:** 691702392-0019
Sample Description: PLASTER APPLIED TO WALLS AND CEILINGS/INTERIOR, SOUTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | White | 0% | 100% | None Detected | |

Client Sample ID: CH-PL-01D **Lab Sample ID:** 691702392-0020
Sample Description: PLASTER APPLIED TO WALLS AND CEILINGS/INTERIOR, SOUTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | Gray | 0% | 100% | None Detected | |

Client Sample ID: CH-PL-01E **Lab Sample ID:** 691702392-0021
Sample Description: PLASTER APPLIED TO WALLS AND CEILINGS/INTERIOR, NORTHEAST

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | Gray | 0% | 100% | None Detected | |

Client Sample ID: CH-ES-01A **Lab Sample ID:** 691702392-0022
Sample Description: GREY EXTERIOR STUCCO APPLIED AT BASE/EXTERIOR, NORTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | Gray | 0% | 98% | 2% Chrysotile | |



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EMSL Canada Order 691702392
Customer ID: 55JACQ30L
Customer PO: 123220983
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: CH-ES-01B **Lab Sample ID:** 691702392-0023
Sample Description: GREY EXTERIOR STUCCO APPLIED AT BASE/EXTERIOR, NORTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|----------|------------------------------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | | | | | Positive Stop (Not Analyzed) |

Client Sample ID: CH-ES-01C **Lab Sample ID:** 691702392-0024
Sample Description: GREY EXTERIOR STUCCO APPLIED AT BASE/EXTERIOR, SOUTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|------|---------------|-------|--------------|-------------|----------|------------------------------|
| | | | Fibrous | Non-Fibrous | | |
| PLM | 10/13/2017 | | | | | Positive Stop (Not Analyzed) |

Client Sample ID: ES-FM-01A **Lab Sample ID:** 691702392-0025
Sample Description: GREY MASTIC APPLIED TO ROOF FLASHING SEAMS/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Brown | 0.0% | 100% | None Detected | |

Client Sample ID: ES-FM-01B **Lab Sample ID:** 691702392-0026
Sample Description: GREY MASTIC APPLIED TO ROOF FLASHING SEAMS/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Brown | 0.0% | 100% | None Detected | |

Client Sample ID: ES-FM-01C **Lab Sample ID:** 691702392-0027
Sample Description: GREY MASTIC APPLIED TO ROOF FLASHING SEAMS/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/13/2017 | Brown | 0.0% | 100% | None Detected | |

Client Sample ID: ES-RM-01A **Lab Sample ID:** 691702392-0028
Sample Description: SBS ROOF MEMBRANE/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Black | 0.0% | 100% | None Detected | |

Client Sample ID: ES-RM-01B **Lab Sample ID:** 691702392-0029
Sample Description: SBS ROOF MEMBRANE/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Black | 0.0% | 100% | None Detected | |

Client Sample ID: ES-RM-01C **Lab Sample ID:** 691702392-0030
Sample Description: SBS ROOF MEMBRANE/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/13/2017 | Black | 0.0% | 100% | None Detected | |



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Customer ID: 55JACQ30L
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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: | ES-WPC-01A | | | | Lab Sample ID: | 691702392-0031 |
| Sample Description: | BLACK WINDOW PANE CAULKING ON WINDOW ABOVE WASHROOM DOOR/WASHROOM | | | | | |
| | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
| TEST | Date | Color | Fibrous | Non-Fibrous | Asbestos | Comment |
| PLM Grav. Reduction | 10/12/2017 | Black | 0.0% | 96.2% | 3.8% Chrysotile | |

| | | | | | | |
|----------------------------|---|--------------|---------------------|--------------------|------------------------------|----------------|
| Client Sample ID: | ES-WPC-01B | | | | Lab Sample ID: | 691702392-0032 |
| Sample Description: | BLACK WINDOW PANE CAULKING ON WINDOW ABOVE WASHROOM DOOR/WASHROOM | | | | | |
| | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
| TEST | Date | Color | Fibrous | Non-Fibrous | Asbestos | Comment |
| PLM Grav. Reduction | 10/12/2017 | | | | Positive Stop (Not Analyzed) | |

| | | | | | | |
|----------------------------|---|--------------|---------------------|--------------------|------------------------------|----------------|
| Client Sample ID: | ES-WPC-01C | | | | Lab Sample ID: | 691702392-0033 |
| Sample Description: | BLACK WINDOW PANE CAULKING ON WINDOW ABOVE WASHROOM DOOR/WASHROOM | | | | | |
| | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
| TEST | Date | Color | Fibrous | Non-Fibrous | Asbestos | Comment |
| PLM Grav. Reduction | 10/12/2017 | | | | Positive Stop (Not Analyzed) | |

| | | | | | | |
|----------------------------|--|--------------|---------------------|--------------------|-----------------------|----------------|
| Client Sample ID: | ES-PS-01A | | | | Lab Sample ID: | 691702392-0034 |
| Sample Description: | BROWN PENETRATION SEALANT ON PLASTIC VENT/EXTERIOR SOUTH | | | | | |
| | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
| TEST | Date | Color | Fibrous | Non-Fibrous | Asbestos | Comment |
| PLM Grav. Reduction | 10/12/2017 | Gray | 0.0% | 100% | None Detected | |

| | | | | | | |
|----------------------------|--|--------------|---------------------|--------------------|-----------------------|----------------|
| Client Sample ID: | ES-PS-01B | | | | Lab Sample ID: | 691702392-0035 |
| Sample Description: | BROWN PENETRATION SEALANT ON PLASTIC VENT/EXTERIOR SOUTH | | | | | |
| | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
| TEST | Date | Color | Fibrous | Non-Fibrous | Asbestos | Comment |
| PLM Grav. Reduction | 10/12/2017 | Gray | 0.0% | 100% | None Detected | |

| | | | | | | |
|----------------------------|--|--------------|---------------------|--------------------|-----------------------|----------------|
| Client Sample ID: | ES-PS-01C | | | | Lab Sample ID: | 691702392-0036 |
| Sample Description: | BROWN PENETRATION SEALANT ON PLASTIC VENT/EXTERIOR SOUTH | | | | | |
| | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
| TEST | Date | Color | Fibrous | Non-Fibrous | Asbestos | Comment |
| PLM Grav. Reduction | 10/13/2017 | Gray | 0.0% | 100% | None Detected | |

| | | | | | | |
|----------------------------|--|--------------|---------------------|--------------------|-----------------------|----------------|
| Client Sample ID: | ES-EPP-01A | | | | Lab Sample ID: | 691702392-0037 |
| Sample Description: | LIGHT GRAY PUTTY APPLIED TO ELECTRICAL PENETRATIONS/EXTERIOR SOUTH | | | | | |
| | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
| TEST | Date | Color | Fibrous | Non-Fibrous | Asbestos | Comment |
| PLM Grav. Reduction | 10/12/2017 | Gray | 0.0% | 99.7% | 0.25% Chrysotile | |

| | | | | | | |
|----------------------------|--|--------------|---------------------|--------------------|-----------------------|----------------|
| Client Sample ID: | ES-EPP-01B | | | | Lab Sample ID: | 691702392-0038 |
| Sample Description: | LIGHT GRAY PUTTY APPLIED TO ELECTRICAL PENETRATIONS/EXTERIOR SOUTH | | | | | |
| | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
| TEST | Date | Color | Fibrous | Non-Fibrous | Asbestos | Comment |
| PLM Grav. Reduction | 10/12/2017 | Gray | 0.0% | 98.9% | 1.1% Chrysotile | |



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EMSL Canada Order 691702392
 Customer ID: 55JACQ30L
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 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: ES-EPP-01C **Lab Sample ID:** 691702392-0039
Sample Description: LIGHT GRAY PUTTY APPLIED TO ELECTRICAL PENETRATIONS/EXTERIOR SOUTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|----------|------------------------------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | | | | | Positive Stop (Not Analyzed) |

Client Sample ID: ES-EPP-02A **Lab Sample ID:** 691702392-0040
Sample Description: DARK GRAY PUTTY APPLIED TO ELECTRICAL PENETRATIONS/EXTERIOR SOUTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|-----------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Black | 0.0% | 97.6% | 2.4% Chrysotile | |

Client Sample ID: ES-EPP-02B **Lab Sample ID:** 691702392-0041
Sample Description: DARK GRAY PUTTY APPLIED TO ELECTRICAL PENETRATIONS/EXTERIOR SOUTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|----------|------------------------------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | | | | | Positive Stop (Not Analyzed) |

Client Sample ID: ES-EPP-02C **Lab Sample ID:** 691702392-0042
Sample Description: DARK GRAY PUTTY APPLIED TO ELECTRICAL PENETRATIONS/EXTERIOR SOUTH

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|----------|------------------------------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | | | | | Positive Stop (Not Analyzed) |

Client Sample ID: MS-RS-01A **Lab Sample ID:** 691702392-0043
Sample Description: BLACK ROOF SHINGLE WITH GREY SPECKS/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|-------------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Black | 1.7% | 98.3% | <0.34% Chrysotile | |

Client Sample ID: MS-RS-01B **Lab Sample ID:** 691702392-0044
Sample Description: BLACK ROOF SHINGLE WITH GREY SPECKS/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Black | 3.6% | 96.4% | None Detected | |

Client Sample ID: MS-RS-01C **Lab Sample ID:** 691702392-0045
Sample Description: BLACK ROOF SHINGLE WITH GREY SPECKS/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/13/2017 | Black | 0.0% | 100% | None Detected | |

Client Sample ID: MS-RF-01A **Lab Sample ID:** 691702392-0046
Sample Description: ROOF FELT UNDERLAY/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Black | 0.0% | 100% | None Detected | |



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EMSL Canada Order 691702392
Customer ID: 55JACQ30L
Customer PO: 123220983
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: MS-RF-01B **Lab Sample ID:** 691702392-0047
Sample Description: ROOF FELT UNDERLAY/ROOF

| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/12/2017 | Black | 0.0% | 100% | None Detected | |

Client Sample ID: MS-RF-01C **Lab Sample ID:** 691702392-0048
Sample Description: ROOF FELT UNDERLAY/ROOF

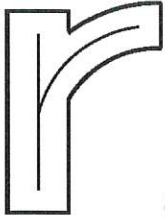
| TEST | Analyzed Date | Color | Non-Asbestos | | Asbestos | Comment |
|---------------------|---------------|-------|--------------|-------------|---------------|---------|
| | | | Fibrous | Non-Fibrous | | |
| PLM Grav. Reduction | 10/13/2017 | Black | 0.0% | 100% | None Detected | |

Analyst(s):
Kathleen Cruz PLM Grav. Reduction (23)
Nicole Yeo PLM (12)
PLM Grav. Reduction (7)

Reviewed and approved by: 
Nicole Yeo, Laboratory Manager
or Other Approved Signatory

None Detected = <0.1%. 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.

APPENDIX I



RYZUK GEOTECHNICAL
ENGINEERING & MATERIALS TESTING

28 Crease Avenue
Victoria, B.C.
V8Z 1S3
Tel: 250-475-3131
Fax: 250-475-3611
mail@ryzuk.com

Geotechnical Field Review

Project No: 8-4070-7
Project: God's Acre - Veteran Cemetery - Improvements - 1190 Colville Road - Esquimalt, BC
Client: CWMM Consulting Engineers Ltd.
Contact: Patrick Lam
Email / Fax No: patlam@cwmm.com
Date: December 21, 2018

Copy to:
Carlos Rincon CarlosR@thinkratio.com
Craig Stantos CSantos@cwmm.com

Copy to:

Asphalt Coring Program

As requested, we have completed a coring program to determine asphalt thickness of the existing pathways. Our observations are summarized below. All our work has been undertaken in accordance with, and is subject to, the previously provided Terms of Engagement.

Requested coring hole locations were provided by ISL Engineering and Land Services Ltd. (ISL). Based on these locations, coring depths were limited to 0.3 metres below ground surface (m BGS) by a Government Canada representative for each coring hole except CH18-03 and CH18-05. It is understood that the observed asphalt thickness will be used by ISL to support the new pathway design. Asphalt thicknesses observed are summarized in Table 1. Coring hole locations are shown on the attached Core Hole Location Plan (8-4070-7-1).

Table 1 - Asphalt Thickness

| Coring Hole ID | Asphalt Depth (mm) | Comments |
|----------------|--------------------|-----------------------------------|
| CH18-01 | 47 | |
| CH18-02 | 45 | |
| CH18-03 | 50 | |
| CH18-04 | 53 | |
| CH18-05 | 25 | Possibly two lifts |
| CH18-06 | 42 | |
| CH18-07 | 20, 15, 10 | Three lifts (bottom, middle, top) |
| CH18-08 | 25, 20, 20 | Three lifts (bottom, middle, top) |

We trust the preceding is suitable for your purposes at present. If you have any questions with respect to the above, or require anything further, please contact the undersigned.

Kind regards,
Ryzuk Geotechnical

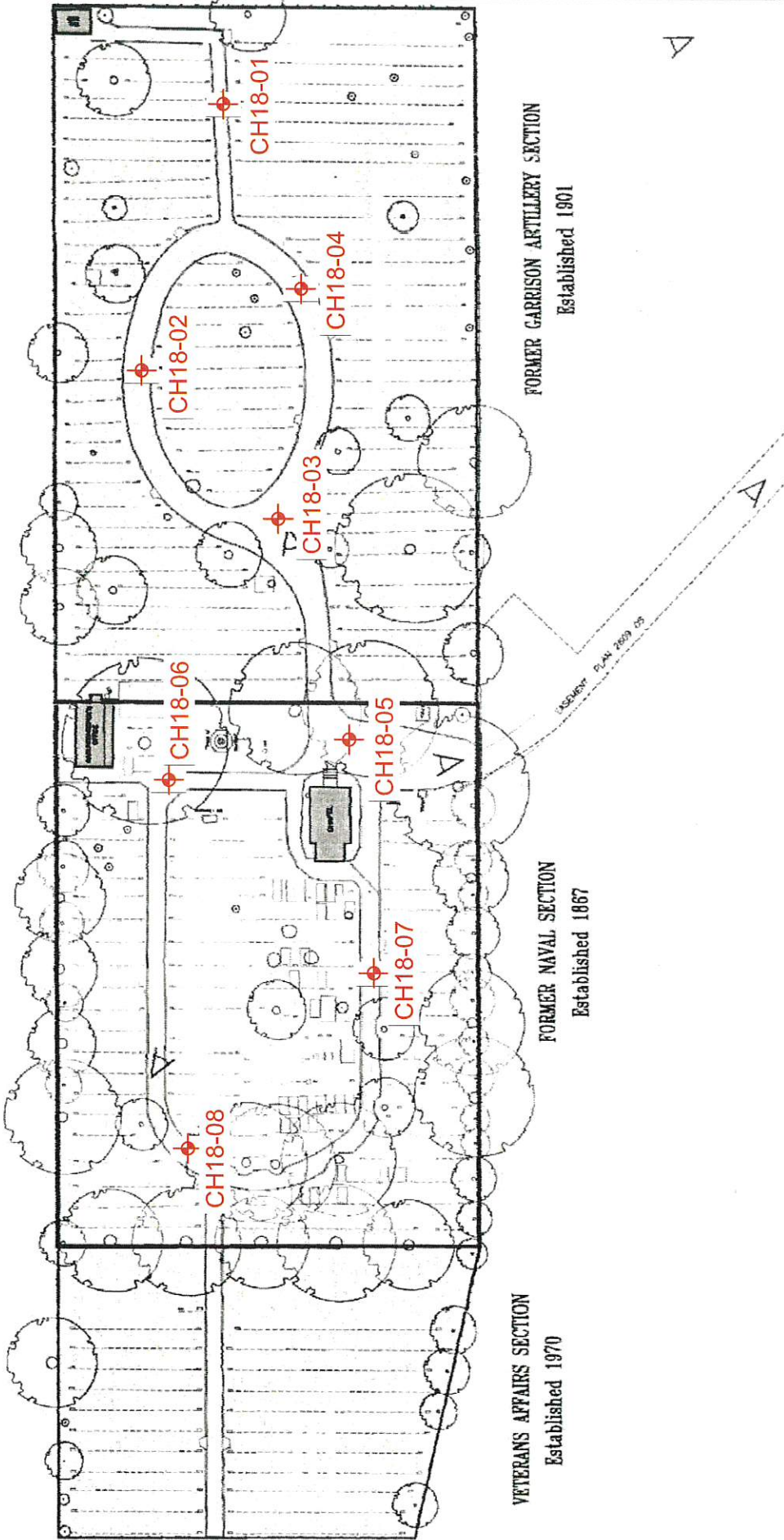
Richard Moser, P.Eng.
Project Engineer



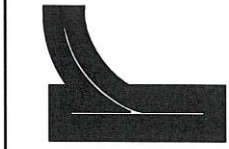
Bruce Dagg, P.Eng.
Senior Geotechnical Engineer

GORGE VALE GOLF COURSE
Established 1927

THE HEART OF THE HISTORIC CEMETERY



Notes:
Base drawing provided by Veteran Affairs Canada



CWMM Consulting Engineers Ltd.
CORING HOLE LOCATION PLAN
God's Acre - Veteran's Cemetery
1190 Colville
Victoria, B.C.
Engineering & Materials Testing

| | |
|-------------|----------------|
| DRAWN | RTM |
| DATE | December, 2018 |
| APPROVED | |
| SCALE | 30:1 |
| DRAWING NO. | 8-4070-7-1 |

