



Travaux publics et
Services gouvernementaux
Canada

Public Works and
Government Services
Canada

**CANADA BORDER SERVICES AGENCY COLLEGE (CBSA)
KENNEL EXPANSION AND CONSTRUCTION OF A NEW TRAINING
HANGAR**

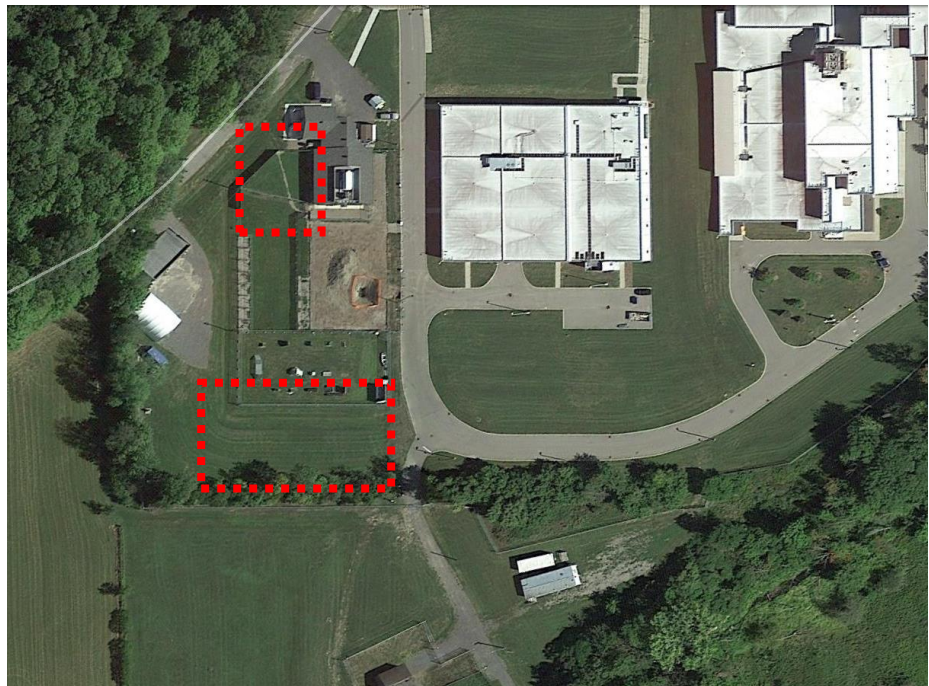
Public Services and Procurement Canada (PSPC)

Place Bonaventure - Portail Sud-Ouest
800, de La Gauchetière street west
Office 7300
Montreal, Quebec
H5A 1L6
Client N° : R.100341.001
BBBL N°: P18-116

VOLUME 2

GENERAL REQUIREMENTS / ARCHITECTURAL SPECIFICATIONS

ISSUED FOR TENDER | JUNE 30, 2020



***CE DOCUMENT NE DOIT PAS ÊTRE UTILISÉ
À DES FINS DE CONSTRUCTION**

**CANADA BORDER SERVICE AGENCY
COLLEGE (CBSA)**

**Kennel Extension and Construction of a
New Training Hangar**

Project No.: R.100341.001

**TECHNICAL SPECIFICATIONS
For Tender**

Civil / Structural / Mechanical / Electrical

Prepared for:

CBSA

Prepared by:

Étienne Paquet-Morin, Eng.

Civil

Éric Michaud, Eng.

Structural

Aboubakeur Bensikhelifa, Eng.

Commissioning

Michel Hallis-Springuel, Eng.

Mechanical

Pier-Luc Desrosiers, Jr. Eng.

Fire Protection

Alain Higgins, Eng.

Automatic Regulation

Mohamed Balarh, Eng., MBA

Electrical

Verified by:

Philippe Reid, Eng.

Fire Protection

June 30, 2020

O/Ref.: 157102560-300-GN-S-0004-0

CANADA BORDER SERVICE AGENCY COLLEGE (CBSA)

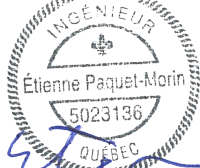
Kennel Extension and Construction of a New Training Hangar

TECHNICAL SPECIFICATIONS

Civil / Structural / Mechanical / Electrical

SIGN-OFF SHEET

Prepared by:



2020-06-29

Étienne Paquet-Morin, Eng.
Civil

Prepared by:



2020-06-26

Éric Michaud, Eng.
Structural

Prepared by:



2020-06-26

Aboubakeur Bensikhelifa, Eng.
Commissioning

Prepared by:

A handwritten signature in blue ink, likely belonging to Pier-Luc Desrosiers, Jr. Eng.

Pier-Luc Desrosiers, Jr Eng.
Fire Protection

Prepared by:



2020-06-26

Michel Hallis-Springuel, Eng.
Mechanical

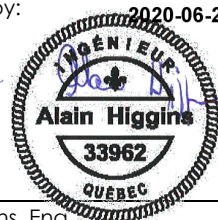
Verified by:



2020-06-29

Philippe Reid, Eng.
Fire Protection

Prepared by:



2020-06-26

Alain Higgins, Eng.
Automatic Regulation

Prepared by:



Mohamed Balarh, Eng., MBA
Electrical

RECORD OF REVISIONS AND ISSUES

Revision No.	Date	Description of the modification and/or of the issue
0	2020-06-30	For Tender "This document shall not be used for Construction"

TABLE OF CONTENTS

June 30, 2020

Page i

SPECIFICATIONS:

DIVISION	SECTION		NUMBER OF PAGES
DIVISION 01	01 91 13	General Commissioning (CX) Requirements	19
	01 91 13.13	Commissioning Plan	39
DIVISION 02	02 41 13	Selective Site Demolition	5
DIVISION 03	03 10 00	Concrete Forming and Accessories	12
	03 20 00	Concrete Reinforcement	8
	03 30 00	Cast-in-Place Concrete	14
	03 35 00	Finishing of Concrete Slabs	5
DIVISION 05	05 12 23	Structural Steel for Building	12
	05 21 00	Steel Joist Framing	5
	05 31 00	Steel Decking	5
DIVISION 06	06 10 53	Miscellaneous Rough Carpentry	8
	06 17 53	Shop-Fabricated Wood Trusses	6
DIVISION 07	07 84 00	Fire-Stopping	6
DIVISION 10	10 44 16.19	Portable Extinguishers	5
DIVISION 21	21 13 13	Wet Pipe Sprinkler Systems	10
	21 13 16	Dry Pipe Sprinkler Systems	8
DIVISION 22	22 05 00	Common Work Results for Plumbing	6
	22 05 15	Plumbing - Specialties and Accessories	12
	22 10 10	Plumbing Pumps	4
	22 11 16	Domestic Water Piping	11
	22 13 16.13	Drainage Waste and Vent Piping - Cast Iron and Copper	5
	22 13 16.16	Sanitary Waste and Vent Piping - Plastic	3
	22 33 00	Domestic Water Heaters	3
	22 42 13	Commercial Water Closets, Urinal, and Bidets	5
	22 42 16	Commercial Lavatories, Sinks, and Water Fountains	4
	22 42 19	Commercial Bathtubs and Showers	3
DIVISION 23	23 01 05	Operation and Maintenance of HVAC Systems During Construction	1
	23 05 00	Common Work Results for HVAC	5
	23 05 15	Common installation requirements for HVAC pipework	4

DIVISION	SECTION	NUMBER OF PAGES
	23 05 17 Pipe Welding	4
	23 05 19.13 Thermometers and Pressure Gauges - Piping Systems	4
	23 05 29 Hangers and Supports for HVAC Piping and Equipment	9
	23 05 48 Vibration and Seismic Controls for HVAC	8
	23 05 48.16 Seismic Restraint Systems (SRS) - Type 2 Buildings	8
	23 05 53 Identification for HVAC Piping and Equipment	6
	Appendix: "Normes pour plaques signalétiques"	2
	23 05 93 Testing, Adjusting and Balancing for HVAC	6
	23 05 94 Pressure Testing of Duct Air Systems	3
	23 07 13 Duct Insulation	6
	23 07 19 HVAC Piping Insulation	8
	23 08 13 Performance Verification HVAC Systems	2
	23 23 00 Refrigerant Piping and Wall Air Conditioner	7
	23 31 13.01 Metal Ducts - Low Pressure to 500 Pa	7
	23 32 48 Acoustical Air Plenums	3
	23 33 00 Air Duct Accessories	4
	23 33 14 Dampers - Balancing	3
	23 33 15 Dampers - Operating	3
	23 33 16 Dampers - Fire and Smoke	5
	23 33 46 Flexible Ducts	2
	23 33 53 Duct Liners	4
	23 34 23.13 Packaged Roof and Wall Exhausters	4
	23 36 00 Air Terminal Units	3
	23 37 13 Diffusers, Registers and Grilles	4
	23 40 00 HVAC Cleaning Devices	4
	23 55 13 Duct Heaters	3
	23 72 00 Air-to-Air Energy Recovery Equipment	6
	23 73 00.16 Air-Handling Units - Packaged	10
	23 84 13 Humidifiers	6
DIVISION 25	25 01 01 EMCS: General Requirements	7
	25 05 60 EMCS: Field Installation	8
	25 30 01 EMCS: Building Controllers	10
	25 30 02 EMCS: Field Control Devices	10

DIVISION	SECTION		NUMBER OF PAGES
	25 90 01	EMCS: Site Requirements, Applications, and Systems Sequences of Operation	7
	25 99 05	EMCS: Requirements Relative to Programming and Dynamic Screens	6
DIVISION 26	26 05 00	Common Work Results for Electrical	11
	26 05 20	Wire and Box Connectors (0-1,000 V)	3
	26 05 21	Wires and Cables (0-1,000 V)	6
	26 05 28	Grounding - Secondary	5
	26 05 29	Hangers and Supports for Electrical Systems	4
	26 05 30	Seismic Restraint Systems (SRS)	5
	26 05 31	Splitters, Junction, Pull Boxes and Cabinets	3
	26 05 32	Outlet Boxes, Conduit Boxes and Fittings	4
	26 05 34	Conduits, Conduit Fastenings and Conduit Fittings	6
	26 05 36	Cable Trays for Electrical Systems	3
	26 05 43.01	Installation of Cables in Trenches and in Conduits	3
	26 09 23.02	Lighting Control Devices - Photoelectric	2
	26 09 24	Lighting Control Devices - Low Voltage	9
	26 12 16.01	Dry Type Transformers up to 600 V - Primary	3
	26 24 16.01	Panelboards Breaker Type	5
	26 27 26	Wiring Devices	5
	26 28 13.01	Fuses - Low Voltage	2
	26 28 16.02	Moulded Case Circuit Breakers	4
	26 28 20	Ground Fault Circuit Interrupters - Class A	3
	26 28 23	Disconnect Switchers - Fused and Non-Fused	3
	26 29 03	Control Devices	4
	26 29 10	Motor Starters to 600 V	4
	26 43 13	Surge Protective Devices	3
	26 50 00	Lighting	4
	26 52 13.16	Exit Signs	3
DIVISION 27	27 05 26	Grounding and Bonding for Communications Systems	3
	27 05 28	Pathways for Communication Systems	3
DIVISION 28	28 31 00.01	Multiplex Fire Alarm System	23

DIVISION	SECTION	NUMBER OF PAGES
DIVISION 31	31 00 00.01 Earthwork - Short Form	3
	31 05 16 Aggregates for Earthwork	4
	31 11 00 Clearance and Uprooting	5
	31 23 33.01 Excavating, Trenching, and Backfilling	23
DIVISION 32	32 11 16.01 Granular Sub-Base	4
	32 12 16.01 Asphalt Paving - Sort Form	3
	32 16 00 Curbs, Gutters and Sidewalks	4
	32 31 13 Chain Link Fences and Gates	11
	32 91 19.13 Topsoil, Placement and Grading	4
	32 92 19.16 Hydroseeding	7
	32 92 23 Sodding	6
DIVISION 33	33 05 16 Maintenance Manholes	6
	33 14 16 Site Water Utility Distribution Piping	10
	33 31 11 Public Sanitary Sewerage Gravity Piping	7
	33 41 00 Storm Utility Drainage Piping	7
	33 65 73 Concrete Encased Duct Banks and Manholes	6
	33 65 76 Direct Buried Underground Cable Ducts	3
APPENDIX 1	Étude géotechnique (Journaux Assoc – No. L-15-1847)	55
APPENDIX 2	Mémoire technique (Journaux Assoc – No. L-20-2253)	32
APPENDIX 3	Étude géotechnique et caractérisation environnementale sommaire des sols (Englobe – No. 025-P-0019200-0-01-001-GE-R-0001-00)	243

DRAWINGS:

Civil	C01	Existing Conditions and Demolition
	C02	Proposed Arrangements
	C03	Details
	C04	Details
Structural	S100	Frontispiece Sheet
	S101	General Notes - French
	S102	General Notes - English
	S103	Graphical Legend and Design Criteria

	S110	Typical Details - Concrete
	S111	Typical Details - Concrete
	S112	Typical Details - CMU
	S113	Typical Details - Steel
	S114	Typical Details - Wood
	S120	Hangar - Plan View - Foundations
	S121	Hangar - Plan View - Base Plates and Columns
	S122	Hangar - Plan View - Ground Floor
	S123	Hangar - Plan View - Canopies and Mezzanine
	S124	Hangar - Plan View - Roof
	S125	Hangar - Enlarged Pilasters Details
	S130	Hangar - Elevations
	S131	Hangar - Elevations
	S140	Hangar - Sections and Details - Concrete
	S141	Hangar - Sections and Details - Concrete
	S145	Hangar - Sections and Details - Steel
	S150	Hangar - Schedules
	S220	Kennel - Plan View - Foundations
	DS221	Kennel - Plan View - Ground Floor - Demolition
	S221	Kennel - Plan View - Ground Floor
	S222	Kennel - Plan View - Roof
	S240	Kennel - Sections and Details - Concrete
	S241	Kennel - Sections and Details - Wood
Mechanical	M01	Mechanical Legend and Drawing List
	M02	Mechanical Plumbing Details and Schedules
	M03	Mechanical Ventilation Details and Schedules
	M04	Mechanical Plumbing Diagrams
	M05	Mechanical Plumbing - Drainage Kennel - Ground Floor
	M06	Mechanical Plumbing - Domestic Water Kennel - Ground Floor
	M07	Mechanical Plumbing and Ventilation Kennel - Roof
	M08	Mechanical Plumbing - Drainage Hangar - Ground Floor
	M09	Mechanical Plumbing - Domestic Water Hangar - Ground Floor
	M10	Mechanical Plumbing and Ventilation Hangar - Roof
	M11	Mechanical Fire Protection Kennel - Ground Floor
	M12	Mechanical Fire protection Hangar - Ground Floor

	M13	Mechanical Ventilation Kennel - Ground Floor
	M14	Mechanical Ventilation Hangar - Ground Floor
	M15	Mechanical Automatic Regulation Diagrams
Electrical	E01	Legend and Plan List
	E02	Partial Plan Site - Existing Underground Networks
	E03	Partial Plan Site - Planned-Underground Networks
	E04	Kennel and hangar - Service connections
	E05	Kennel - Lighting
	E06	Kennel - Services
	E07	Kennel - Auxiliary Services and Fire Alarm
	E08	Kennel - Roof Services
	E09	Kennel - Distribution Single Line Diagram and Panels
	E10	Hangar - Lighting
	E11	Hangar - Services
	E12	Hangar - Auxiliary Services and Fire Alarm
	E13	Hangar - Roof Services
	E14	Hangar - Distribution Single Line Diagram
	E15	Hangar - Panels
	E16	Details
	E17	Telecom Infrastructure -Details
	E18	Grounding Busbars Diagram
	E19	Lighting Control Diagram

END OF SECTION

DIVISION 01

Part 1 General**1.1 RELATED DOCUMENTS**

- .1 Section 21 13 16 - Dry Pipe Sprinkler Systems.
- .2 Section 22 05 15 - Plumbing - Specialties and Accessories.
- .3 Section 22 10 10 - Plumbing Pumps.
- .4 Section 22 11 16 - Domestic Water Piping.
- .5 Section 22 13 16.13 - Drainage Waste and Vent Piping - Cast Iron and Copper.
- .6 Section 22 13 16.16 - Sanitary Waste and Vent Piping - Plastic.
- .7 Section 22 33 00 - Domestic Water Heaters.
- .8 Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- .9 Section 23 05 53 - Identification for HVAC Piping and Equipment.
- .10 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .11 Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .12 Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.
- .13 Section 23 33 16 - Dampers - Fire and Smoke.
- .14 Section 23 36 00 - Air Terminal Units.
- .15 Section 23 55 13 - Duct Heaters.
- .16 Section 23 73 00.16 - Air Handling Units - Packaged.
- .17 Section 23 84 13 - Humidifiers.
- .18 Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.
- .19 Section 26 05 28 - Grounding - Secondary.
- .20 Section 26 09 24 - Lighting Control Devices - Low Voltage.
- .21 Section 26 12 16.01 - Dry Type Transformers up to 600 V - Primary.
- .22 Section 26 24 16.01 - Panelboards Breaker Type.

- .23 Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .24 Section 26 29 10 - Motor Starters to 600 V.
- .25 Section 26 50 00 - Lighting.
- .26 Section 28 31 00.01 - Multiplex Fire Alarm System.

1.2 CODES AND STANDARDS

- .1 ACG Commissioning Guideline.
- .2 ASHRAE Guideline 0-2005.
- .3 ASHRAE Guideline 1.1-2007.
- .4 Building Commissioning Association (BCxA) Standard.
- .5 Commissioning Guide for New Buildings ("CanmetÉnergie/Ressources naturelles Canada").
- .6 CSA-Z320-11 - Building Commissioning Standard.

1.3 OBJECTIVES

- .1 Commissioning (Cx) is a quality process designed to ensure that all building systems achieve their intended objectives. This methodology starts in the design phase and continues in the construction and acceptance phases, with verification of system performance, validation, and optimization of operating sequences. The main objectives of Cx are as follows:
 - .1 Ensure that equipment, systems, and integrated systems operate in accordance with the requirements of Contract Documents, Design Criteria, and Owner's Requirements;
 - .2 Complete project according to schedule;
 - .3 Verify and document the performance of systems and equipment;
 - .4 Ensure that appropriate documentation has been incorporated into the O&M Manual;
 - .5 Train O&M personnel;
 - .6 Optimize equipment life cycle costs and improve energy performance of systems;
 - .7 Reduce costs of operation and maintenance.

1.4 ACRONYMS

- .1 A/E: Architect/Design Engineers.
- .2 BAS: Building Automation System.
- .3 BOD: Basis of design.
- .4 CS: Contractors and Subcontractor.

- .5 CxA: Commissioning Agent.
- .6 Cx: Commissioning.
- .7 CxRC: Commissioning Representative for the Contractor.
- .8 CxRO: Commissioning Representative for the Owner.
- .9 OPR: Owner's Project Requirements.
- .10 TAB: Testing, Adjusting and Balancing.

1.5 DEFINITION

- .1 The Cx Authority: Person appointed by the Departmental Representative to lead the process of CX and submit a final report to the Departmental Representative on performance of the systems and the whole process.
- .2 Cx Team: The team members are Cx Authority, the project manager, the representative of the Departmental Representative, the Architect, the design Engineer, the General Contractor, the equipment suppliers and the Subcontractors.
- .3 Commissioning Plan: An evolutive document that defines the activities of the Cx project, the schedule, the documentation requirements, and the roles and responsibilities of team members.
- .4 Cx Calendar: General Contractor shall coordinate with the Cx Authority to establish a protocol and a timetable for Cx systems and equipment, which will be updated with progress.
- .5 Deficiencies and Non-compliances Register: It is an official and evolutive directory of the deficiencies and anomalies (with solution when required) that the Cx Authority or other member of the Cx team will have observed during the process.
- .6 Cx Form: Document containing the performance data collected during the static tests (dynamic) carried out on equipment and systems.
- .7 Installation Control Form: Forms provided by the manufacturer or the engineer, which include checklist for proper installation of equipment.
- .8 Cx Coordinator of the Contractor: Person at the service of the Contractor, responsible for coordinating the activities of the commissioning.
- .9 Cx Coordinator of the Owner: Person at the service of the Owner, responsible for coordinating the activities and for supporting the Cx Activities.

Part 2 CX Steps**2.1 CX PROCESS**

- .1 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx;
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures;
 - .3 Sets out deliverables relating to O&M, process and administration of Cx;
 - .4 Describes process of verification of how works meet design requirements;
 - .5 Produces a complete functional system prior to issuance of the certificate of occupancy;
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx;
 - .2 Commissioned systems;
 - .3 Construction checklists;
 - .4 The overview of the Cx activities during the pre-design, design, construction, occupation, and operation phases;
 - .5 Cx schedule;
 - .6 Process and methodology for successful Cx;
 - .7 The expected objectives and results of the Cx;
 - .8 The list of team members, their responsibilities and expected deliverables;
 - .9 The training documents;
 - .10 Requirements of O&M Manuals.
- .2 Refinement of Cx Plan: During construction phase, revise, refine and update Cx Plan to include:
 - .1 Changes resulting from modifications;
 - .2 Approved design and construction changes;
 - .3 Results of previous steps.
- .3 Overview of the Process:
 - .1 Develop the Owner's Project Requirements (OPR), and ensure they are included in the basis of design (BOD);
 - .2 Develop a Cx plan and presenting it to the Cx team at the starting meeting;
 - .3 Coordinate with Contractors to establish a methodology for functional tests of equipment;
 - .4 Develop a record of anomalies and deficiencies;
 - .5 Oversee staff training;
 - .6 Reviewing operation and maintenance manuals;
 - .7 Optimize and validate the sequences of operation and solve the identified problems.

2.2 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

2.3 COMPOSITION AND RESPONSIBILITIES OF CX TEAM

- .1 Cx Authority (Stantec):
 - .1 Organize and lead the Cx team;
 - .2 Develop a Cx plan and include it in the construction document as well as updating it regularly;
 - .3 Organize and conduct Cx meetings, and draw up the minutes;
 - .4 Provide the Construction Checklists;
 - .5 Perform site inspections, check functional performance and attend tests;
 - .6 Oversee the process of training staff;
 - .7 Review operation and maintenance manuals;
 - .8 Maintain up to date the list of the validity dates of the guarantees;
 - .9 Approve or oversee the Cx balancing reports and sequences of control in collaboration with the Commissioning Representative for the Owner (CxRO);
 - .10 Prepare a final Cx report summarizing undertaken works and the results of all tests;
 - .11 Issuing a Cx acceptance report to validate the certificate of provisional acceptance.
- .2 Engineers and Architects:
 - .1 Assist to Cx meetings;
 - .2 Verify installations compliance;
 - .3 Attend selectively to installation Cx;
 - .4 Make lists of deficiencies relating to the installation and testing;
 - .5 Provide appropriate training sessions on the concept and the objectives of different systems;
 - .6 Verify Cx reports;
 - .7 Help resolve any problem related to the design, equipment, installation, or operation.
- .3 Contractors, Sub-contractors, and Commissioning Representative for the Contractor (CxRC):
 - .1 Assist to Cx meetings;
 - .2 Consolidate Cx steps in the construction schedule;
 - .3 Perform tests and functional tests on equipment and systems;
 - .4 Fill the Construction Checklists;
 - .5 Complete and provide to the Cx Authority the Cx schedule;
 - .6 Submit the different required reports;

- .7 Coordinate and convene manufacturer representatives at the different steps of the Cx and to the meetings when requested;
- .8 Produce operation and maintenance manuals;
- .9 Coordinate and validate training program, plan and provide training sessions required for installed equipment as recommended by the Cx Authority;
- .10 Correct deficiencies;
- .11 Issue the appropriate warranties;
- .12 Proceed with seasonal adjustments;
- .13 Visit site prior to the end of warranties (10 months after provisional acceptance, to correct problems during occupancy period).
- .4 Departmental Representative, Users and Operation and Maintenance Members:
 - .1 Attend Cx meetings;
 - .2 Participate to training sessions;
 - .3 Facilitate the coordination work between the Cx Authority and the General Contractor;
 - .4 Raise any issues found during the Cx;
 - .5 Follow the process and work with the Cx Authority.

2.4 MANUFACTURERS' INVOLVEMENT

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation contractor/subcontractor.
 - .1 Equipment and systems, except as indicated otherwise.
 - .2 Equipment Manufacturer: Equipment specified to be installed and started by manufacturer:
 - .1 To include performance verification.
 - .3 Factory Testing: Manufacturer to:
 - .1 Coordinate time and location of testing;
 - .2 Provide testing documentation for approval by Cx Authority;
 - .3 Arrange for Cx Authority to witness tests;
 - .4 Obtain written approval of test results and documentation from Cx Authority before delivery to site.
 - .4 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems, and review with Cx Authority:
 - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer;
 - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

- .5 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty;
 - .2 Verify with manufacturer that testing as specified will not void warranties;
 - .3 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of concerned equipment and systems;
 - .2 Ability to interpret test results concisely, logically, and accurately.
- .6 Specialized Companies: Required participation in the case of equipment and systems supplied and installed by a specialist company.

2.5 SCOPE OF COMMISSIONING (SYSTEMS AND EQUIPMENT TO VERIFY)

- .1 Cx of mechanical systems and associated equipment:
 - .1 Plumbing systems:
 - .1 Domestic CWS and HWS;
 - .2 Sanitary waste systems;
 - .3 Storm water systems;
 - .2 HVAC and exhaust systems:
 - .1 HVAC ducts, sheaths, and systems;
 - .2 Exhaust systems;
 - .3 Heat recovery systems (heat exchanger);
 - .4 Condenser/compressor groups.
 - .3 Fire and life safety systems:
 - .1 Wet pipe sprinkler systems;
 - .2 Fire extinguishers.
 - .4 Noise and vibration control systems for mechanical systems.
 - .5 Seismic restraint and control measures.
 - .6 IAQ environmental control systems.
 - .7 Building management system (BMS).
- .2 Cx of electrical systems and equipment:
 - .1 High voltage:
 - .1 High voltage switch gear and transformation equipment;
 - .2 High voltage distribution systems.
 - .2 Low voltage below 750 V:
 - .1 Low voltage equipment;
 - .2 Low voltage distribution systems.

- .3 Lighting systems:
 - .1 Lighting equipment;
 - .2 Distribution systems;
 - .3 Emergency lighting systems, including battery packs;
 - .4 Fire exit emergency signage.
- .4 Fire alarm systems, equipment:
 - .1 Detection system;
 - .2 Signalling system.
- .5 Other systems and equipment:
 - .1 Intrusion and access security and safety systems.

2.6 INSTRUMENTS

- .1 Each report must indicate what tools were used for measures in the report:
 - .1 Balancing devices;
 - .2 Thermometers and manometers;
 - .3 Air quality devices;
 - .4 Multimeters;
 - .5 Luxmeter.
- .2 The Operation and Maintenance Manual must include the list of instruments used, including: Serial number, the current certificate of calibration, calibration date, date of expiration of the calibration, and the accuracy of the calibration.
- .3 Upon request, submit the instruments and equipment for the examination and approval by the Cx Authority.

2.7 COMMISSIONING DELIVERABLES OF CX PROCESS

- .1 Static verification of installation and components.
- .2 Quality and performance control by using functional tests on systems and equipment.
- .3 Training program.
- .4 Operation and Maintenance Manual.
- .5 Final Cx Reports.

2.8 COMMISSIONING MEETINGS

- .1 Convene Cx meetings.
- .2 Purpose: To explain process, resolve issues, monitor progress, identify deficiencies, relating to Cx.

- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage, CxA must call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Addressing delays and potential problems;
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter, Contractor must call Cx meetings with his Subcontractors, to be held until project completion and as required, during Cx and functional testing periods.
- .6 Meetings will be chaired by Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturers' representative are present at Cx meetings when they are convened or as requested by CxA.

2.9 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of Authority Having Jurisdiction, arrange for authority to witness procedures to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of Authority Having Jurisdiction.
- .3 Include certificates of approval, acceptance and compliance with the Operation and Maintenance Manual, and provide copies upon request to Departmental Representative.

2.10 AERAULIC AND HYDRAULIC BALANCING

- .1 Perform aeraulic and hydraulic balancing, as specified in the relevant Sections. Validate the balancing method with the Cx Authority or the Departmental Representative. Produce reports within 10 days after a series of interventions. Reports must indicate the observed anomalies.

2.11 CX CONTROL

- .1 Perform Cx control, as required in the relevant Sections.
- .2 Submit graphic trends (30 days) for the main control loop.
- .3 Produce reports and verifications as Cx forms.

2.12 START-UP OF INTEGRATED EQUIPMENT

- .1 Realize start-up of equipment requiring prior completion of the various disciplines. These devices can be started when:
 - .1 Installation is complete;
 - .2 Power supply is checked;
 - .3 Water network balancing is completed;
 - .4 Auxiliary services are completed.
- .2 Obtain collaboration of manufacturers to confirm compliance of the installation before the Cx equipment.
- .3 Fill in the Cx forms of equipment, submitted by the Cx Authority or manufacturers, if they include all required information.
- .4 Cx reports shall specify conditions under which the start-up was made. These conditions include:
 - .1 External ambient conditions;
 - .2 Supply voltage;
 - .3 Pressure and supply temperature of auxiliary services;
 - .4 Any special condition that may influences the performance.
- .5 Integrated systems include the following:
 - .1 Systems related to indoor air quality;
 - .2 Automatic regulation systems for rooms;
 - .3 Fire alarm systems;
 - .4 Fire pumps and controllers;
 - .5 Emergency lighting systems.

2.13 CONSTRUCTION CHECKLISTS (STATIC VERIFICATION FORMS)

- .1 These control forms of the installation must include the following:
 - .1 Installation instructions provided by the manufacturer and controls recommended by the manufacturer;
 - .2 Specific procedures established in technical relevant Section;
 - .3 Procedures considered as good practice in installation and construction of mechanical/electrical, and deemed necessary to a proper and effective operation of the equipment and systems.
- .2 The control forms for the installation, provided by the manufacturer, are also acceptable. If the Cx Authority deems them necessary, lists of additional data will be required in case of projects with special conditions.
- .3 Use control forms to verify the installation of equipment and systems involved. Confirm on the document the verifications carried out, indicate anomalies and deficiencies identified and corrective measures implemented.

- .4 Provide to the Cx Authority the control forms which have been duly signed by the subcontractor concerned or the representative of the manufacturer, once the process is completed, to confirm that the audits and inspections were actually performed. These forms will be required at the time of Cx and will be joined in the operation and maintenance manual at the project completion.
- .5 The control forms that are used in the Cx must be strictly complied with at the time of equipment and systems Cx.

2.14 FUNCTIONAL TESTINGS (DYNAMICS)

- .1 Before testing begins, ensure:
 - .1 That the Construction Checklist forms are available and filled;
 - .2 That the installation of components, equipment, systems, and related subsystems is completed;
 - .3 That the requirements and test procedures are well understood by all interveners;
 - .4 That the design criteria, the design intention and particular characteristics are well understood;
 - .5 That complete Cx documentation is up to date and available;
 - .6 That the Cx calendar is up to date;
 - .7 That all systems are completely cleaned;
 - .8 That the required tests in the different sections were made and reports were submitted;
 - .9 That the TAB operations of equipment and systems are completed and that relevant reports have been submitted to Departmental Representative, for consideration and approval;
 - .10 That the provisions related to records are taken.
- .2 Length of Testing:
 - .1 All equipment and systems specified in Cx plan must be subjected to functional tests for a continuous period of 30 days. During this period, the Contractor shall correct the deficiencies and make necessary adjustments to optimize the systems and obtain the specified performance. The modifications must be recorded and documented;
 - .2 During the testing period, conduct periodic audits and produce reports every three (3) days to confirm the sequence of tests.
- .3 The Cx forms are documents on which are recorded the results of audits, functional tests (dynamic) and adjustments that have been carried out on equipment and systems concerned to ensure they work efficiently and effectively, alone or in interaction with others, as required by work.
- .4 The Cx forms also include documents on which the Contractor has recorded the readings and the data measured during functional testing and in the control process of the performance of equipment and systems concerned.

2.15 TESTS RECORDING

- .1 Before testing starts, the Contractor shall take required dispositions and set up recording equipment required to produce reports that assess test compliance.
- .2 When possible, the permanent monitoring equipment can be used if the equipment were calibrated following the procedures and using instruments with calibration certificates that have been submitted.
- .3 Equipment must be able to record the required measures every 15 or 30 minutes throughout the duration of the tests, or more frequently if required for the test validation, when requested by Departmental Representative or Cx Authority.
- .4 The required measures must allow to certify:
 - .1 The stability of the equipment and measured values;
 - .2 The proper functioning of equipment with required efficiencies under different loads, including operation at full load and at minimum conditions;
 - .3 The start-up sequence of equipment.
- .5 If testing and measurement does not confirm the operation under conditions considered representative, the Cx Authority may require additional specific tests. At least one additional test will be asked for verification of networks in heating or cooling mode, depending on whether the official 30-day trials have been carried out in summer or winter.
- .6 The General Contractor shall assume the responsibilities and inspection costs, including disassembly and reassembly after approval, testing and adjustment of equipment and systems, as well as the provision of test equipment.

2.16 TOLERANCES - PERFORMANCE VERIFICATION

- .1 Application Tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within $\pm 10\%$ of specified values.
- .2 Instrument Accuracy Tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within $\pm 2\%$ of recorded values.

2.17 COMMISSIONING SCHEDULE

- .1 The General Contractor, in collaboration with the Cx Authority, prepare a detailed Cx schedule, which must include the following:
 - .1 Cx meeting program;

- .2 Sequence of testing of equipment and systems, interrelation between the various tests, test duration, and periods of training;
- .3 Expected date of installation control of each equipment and system;
- .4 Expected date for the Cx of each equipment and system;
- .5 Expected date for the transmission of Operation and Maintenance Manuals;
- .6 Expected date for training of operating staff;
- .7 Expected date for the delivery of Cx final report;
- .8 Expected date of seasonal tests if applicable;
- .9 Expected date of seasonal finetuning (30 hours);
- .10 Expected date of contractors visit prior to end of warranties.
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project, and hand-over.
- .3 After approval, incorporate Cx Schedule into Construction Schedule.
- .4 The Cx team must monitor the progress of the Cx with respect to schedule and update as needed.

2.18 STANDARDS AND PROCEDURES FOR CX OF MECHANICAL INSTALLATIONS

- .1 Network Risers and Fire Protection Valves.
 - .1 Provide temporary fire cabinets.
 - .1 Install equipment to provide fire protection during construction; this equipment must only be commissioned once the building is closed.
 - .2 Perform installed system testing according to NFPA 14.
- .2 Wet Automatic Sprinkler Systems.
 - .1 Perform tests of installed systems in accordance with NFPA 13.
- .3 Integrated Fire Protection Systems.
 - .1 Upon testing different systems completed, test the integrated systems to ensure that the different components work together as designed.
 - .2 Once the fire alarm connections and the Cx regulatory pressure pumps are completed, test the flow sprinklers.
- .4 HVAC Systems.
 - .1 Prior to conceal HVAC systems, test and certify the air ducts, pipes, and ducts to conceal in accordance with the indicated Standards.
 - .2 Perform the initial audit checklists HVAC systems, subjecting them to a trial run in standalone mode and conduct inspections prior to the Cx.
 - .3 Do not proceed with the Cx of the HVAC systems until the construction dust generating is completed and the concerned areas have been dusted.
 - .4 Turn on HVAC systems to replace the temporary heating source, after obtaining the written approval of the Departmental Representative.

- .5 Operate HVAC systems to allow the holding TAB operations and ensure they are fully compliant with the contract documents, once installed fire damper, caulking and sealing envelope completed, bulkheads and interior doors installed, and return air plenums in place.
- .6 Equipment and systems subject to specified Standards and Codes or approval of competent authority:
 - .1 Perform Cx of these systems and equipment in compliance with Codes, Standards, and considered authorities.
 - .2 Where tests are subject to regulatory requirements and appropriate MES procedures exist, ensure that these tests are actually performed in accordance with these requirements (e.g. Codes). For purposes of quality assurance, these tests must be performed in the presence of the Departmental Representative and the Cx Agent.
- .5 Energy Management and Control System (EMCS).
 - .1 The system test performance and point to point must be performed by the Contractor under the supervision of the Departmental Representative or Cx Authority, and then checked through the control system.
 - .2 Demonstrate the operation of all systems in all operating conditions, before the trial period of 30 days, in the presence of the Departmental Representative and Cx Authority. This demonstration must include simulated trials in opposite seasons. Conduct an audit of programming and operating sequences of ECMS after TAB operations completed during the probationary period prescribed for 30 days. Data gathered during these tests must be registered to control panels or ECMS central.

2.19 STANDARDS AND PROCEDURES FOR THE CX OF THE ELECTRICAL INSTALLATIONS

- .1 Facilities to be commissioned as required by applicable Codes.
 - .1 When the tests are subject to regulatory requirements and appropriate Cx procedures, ensure that these tests are actually carried out in accordance with these requirements (eg. Codes).
 - .2 For quality assurance purposes, conduct these tests in the presence of the Professional.
- .2 Low Voltage Systems.
 - .1 These systems include low voltage lighting systems.
- .3 Lighting Security Systems.
 - .1 Verify the operation of these systems by cutting the normal supply.
 - .2 Then verify if the area illuminated by the devices is appropriate.
- .4 Fire Alarm Systems.
 - .1 Make functional tests after considering all other aspects of the safety of persons and property.
 - .2 Testing shall be reviewed fully in accordance with the requirements of ULC.

2.20 CORRECTION OF DEFICIENCIES

- .1 The Cx Authority must give Cx lists of deficiencies in accordance with specific conditions.
- .2 If equipment, systems, components, and control/regulation devices have been incorrectly installed or have anomalies during the Cx, correct anomalies, repeat equipment and components verification of the non operating system, including related systems therefore, if the Departmental Representative and the Cx Authority ask for them to ensure that the system works as it should.
- .3 The Contractor shall assume all costs associated with corrections, inspections and additional tests to determine the acceptability and performance of these elements. These costs will be deducted from payments or will be retain.

2.21 VERIFICATION OF RESULTS

- .1 Labor:
 - .1 Provide labor and instrumentation to verify up to 30% of reported results, unless specified otherwise in other Sections of specs. Number and location are decided by the Cx Authority.
- .2 Conduct tests repeated during verification under same conditions as original tests, using same test equipment and instrumentation.
- .3 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .4 Perform additional commissioning until results are acceptable to Departmental Representative and Cx Authority.

2.22 REPEAT VERIFICATIONS

- .1 Assume costs incurred by Departmental Representative and Cx Authority for third and subsequent verifications where:
 - .1 Verification of reported results fails to receive Departmental Representative's and Cx Agent's approval;
 - .2 Repetition of second verification fails again to receive approval;
 - .3 Departmental Representative and Cx Authority deems Contractor's request for second verification was premature.

2.23 TEST RESULTS

- .1 If start-up, testing, and/or PV produce unacceptable results according to Departmental Representative or Cx Authority, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide labor, equipment, and materials for re-commissioning.

2.24 SEASONAL TESTING

- .1 If requested by the Cx Authority, additional seasonal testing recommended may be performed so that verification of performance is close to real conditions.

2.25 EXTRAPOLATION OF RESULTS

- .1 Where Cx of equipment or systems weather, occupancy, or seasonal-sensitive cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

2.26 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during Cx process, Cx Agent to provide updated Cx form for affected item.

2.27 DEPARTMENTAL REPRESENTATIVE'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

2.28 ACTIVITIES DURING WARRANTY PERIOD

- .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
 - .1 Fine tuning of HVAC systems;
 - .2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings;
 - .3 **Fine-tuning: 15 hours** for fine tuning with Cx Agent have to be allowed by Control Contractor.

2.29 TRAINING SCHEDULE

- .1 Following training sessions are mandatory:
 - .1 Mechanical (General) (2 hr.);
 - .2 Section 23 73 00.16 - Air Handling Units - Packaged (3 hr.);
 - .3 Section 23 84 13 - Humidifiers (1 hr.);
 - .4 Section 25 90 01 - EMCS: Site Requirements, Applications, and Systems Sequences of Operation (12 hr.);
 - .5 Electrical (General) (2 hr.);
 - .6 Section 28 31 00.01 - Multiplex Fire Alarm System (2 hr.).
- .2 Each training responsible must provide:
 - .1 Training program;

- .2 List of persons attending training;
 - .3 Training location;
 - .4 Objectives;
 - .5 Subjects (description, time, techniques used, etc.);
 - .6 Training duration for each subject;
 - .7 Training methods.
- .3 Coordinate trainings to be given according to the requirements of the different sections with the initial training, given by the Departmental Representative.
- .4 The training by the Departmental Representative must include the following:
- .1 Review of facility and occupancy profile;
 - .2 Functional requirements;
 - .3 System philosophy, limitations of systems and emergency procedures;
 - .4 Verification of operation and maintenance documents;
 - .5 Review of all systems using simplified diagrams for the cooling water systems, water condensers or heat exhausts, heating systems, gas supply, fuel and air, and exhaust system.
- .5 The training by the Contractor must include the following:
- .1 Review of system layout, equipment, components and controls;
 - .2 Equipment and system start-up, operation, monitoring, servicing, maintenance, and shutdown procedures;
 - .3 System operating sequences, including step-by-step directions for starting up, shutdown, operation of valves, dampers, switches, adjustment of control settings and emergency procedures;
 - .4 Maintenance and servicing;
 - .5 Troubleshooting diagnosis;
 - .6 Interaction among systems during integrated operation.
- .6 Deliver training during regular working hours in 3-hour training sessions.
- .7 Training to be completed prior to acceptance of facility of building.
- .8 Visual recordings of trainings can be requested by the Departmental Representative.

2.30 OPERATION AND MAINTENANCE MANUAL

- .1 Operating and maintenance manuals must be checked by the Cx Authority before final inspection by the Departmental Representative who retains the final copies.
- .2 Operation and maintenance manuals must include the following:
 - .1 A summary;
 - .2 The list of the Contractors and emergency information;

- .3 Command and regulation network diagrams of each network, including ambient circuit;
 - .4 A description of each system or each installation and its control device;
 - .5 A description of the operation of each system or each installation, under various loads, with program of setpoint and indication of seasonal variations modifications;
 - .6 Instructions on the operation of each system or each facility and each component;
 - .7 A description of measures to be taken in case of equipment failure;
 - .8 A color code;
 - .9 Instructions for maintenance, repair, operation and how to identify defects in each piece of equipment;
 - .10 The information on the periodicity of tasks to be done, as well as tools, parts and time needed for all these tasks;
 - .11 The performance data provided by the equipment manufacturer stating the points of use of equipment, once the Cx is completed;
 - .12 The Cx forms for all equipment and systems;
 - .13 Any other specific performance data specified elsewhere in the contract documents;
 - .14 TAB reports for each system;
 - .15 The name, address and phone number of the manufacturer or supplier and the Contractor who performed the installation;
 - .16 The shop drawings approved;
 - .17 The "As-built" drawings;
 - .18 The description of the exact operation, step by step, of each system installed;
 - .19 The description of the procedure, step-by-step, for the start up and stopping, in order to have a safe and reliable operation;
 - .20 A list of the different parts of the equipment that could be replaced on a regular basis, giving the replacement interval;
 - .21 The list of spare parts and the names, address and telephone numbers of suppliers of all equipment, engines and accessories supplied and installed, with reference to the appropriate section.
 - .22 The final Cx report.
- .3 Approval:
- .1 For approval, submit to the Cx Authority and to the Departmental Representative, the copy of the operation and maintenance manual draft. Unless otherwise directed by the Cx Authority and the Departmental Representative, the forms must not be submitted individually.
 - .2 Make the necessary changes in the operation and maintenance manual and resubmit as directed by the Cx Authority and the Departmental Representative.
 - .3 Provide a final copy of the operation and maintenance manual to the Cx Authority and three (3) final copies to the Departmental Representative.

- .4 Additional information:
 - .1 Prepare additional information forms and attach them to the operation and maintenance manual when the demonstrations or the instruction execution described above demonstrate that such records are necessary.
- .5 The operation and maintenance manual must be presented in a ring binder and must respect the order of the sections in the specifications.

END OF SECTION

**CANADA BORDER SERVICE
AGENCY COLLEGE (CBSA)**

**Kennel Extension and Construction of
a New Training Hangar**

Project No.: R.100341.001

**Commissioning Plan
Version 3**



Prepared for:

CBSA

Prepared by:

**Aboubakeur Bensikhelifa, P.Eng., CBCP
LEED AP BD+C | Commissioning Agent**

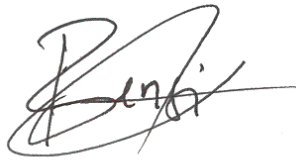
June 30, 2020

O/Ref.: 157102560-300-GN-S-0005-0

Sign-off Sheet

This document was prepared by Stantec Consulting Ltd. ("Stantec") for the account of CBSA (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by:



2020-06-29

Aboubakeur Bensikhelifa, P.Eng., CBCP, LEED BD+C
Commissioning Agent
OIQ Membership: 140616

RECORD OF REVISIONS AND ISSUES		
Revision No.	Date	Description of the modification and/or the issue
0	2020-06-26	Version 3
0	2020-05-01	Version 2
0	2020-03-31	Version 1



PROJECT NO.: 157102560300-GN-S-0005-0

Table of Contents

1.0	INTRODUCTION	1.1
2.0	OVERVIEW OF THE PROCESS	2.1
2.1	DESIGN PHASE	2.1
2.2	CONSTRUCTION PHASE.....	2.1
2.3	OPERATION PHASE	2.1
3.0	ACTIVITIES AND OBJECTIVES OF THE COMMISSIONING PROCESS	3.1
4.0	COMMISSIONING TEAM.....	4.1
5.0	ROLES AND RESPONSIBILITIES	5.1
6.0	COMMISSIONING PROCESS	6.1
6.1	DESIGN PHASE	6.1
6.1.1	Owner's Project Requirements and Basic of Design.....	6.1
6.1.2	Commissioning Plan	6.1
6.1.3	Training Requirements	6.1
6.1.4	Specifications of the Commissioning in Bid Documents	6.1
6.1.5	Design and Drawings Review.....	6.2
6.2	CONSTRUCTION PHASE.....	6.2
6.2.1	Review of Shop Drawings	6.2
6.2.2	Site Observation.....	6.2
6.2.3	Commissioning Schedule	6.2
6.2.4	Construction Checklists Forms (Static Verification)	6.3
6.2.5	Functional Testing Procedure (Dynamic Verification)	6.3
6.2.6	Integrated Automation	6.4
6.2.7	Commissioning Meetings	6.4
6.2.8	Operation and Maintenance Manuals.....	6.4
6.2.9	Commissioning Final Report	6.4

LIST OF APPENDICES

- APPENDIX 1 Commissioning Systems
- APPENDIX 2 Commissioning Forms
- APPENDIX 3 Commissioning Schedule
- APPENDIX 4 Training



1.0 INTRODUCTION

The commissioning (hereafter Cx) of a new installation is an intensive process of quality assurance which starts with the design, which continues during the construction and operation phases.

This process guarantees that the new building operates according to the initial expectations, that it meets the Owner's requirements, that the electromechanical installations is operating according to the design criterion, and that the building maintenance staff is able to operate and to look after the various equipment and systems.

This Cx Plan is an evolutionary document that will define the Cx Activities of this project, the Cx Schedule, the documentation requirements, as well as the roles and responsibilities of the Commissioning Team.

Among other things, this plan will include:

- A description of the Cx Process used in this project;
- The Cx Team;
- The details of the Cx Activities.

Additional details concerning the Cx Process can be found in Section 01 91 13 (General Commissioning (Cx) Requirements) found in the specification of works.



2.0 OVERVIEW OF THE PROCESS

2.1 DESIGN PHASE

Here is a brief description of the Cx Process during the Design Phase:

- Definition of the Cx Objectives;
- Definition of the Owner's project requirements, which will be used as guidelines for the design, the construction, and the operation of the future building;
- Development of a preliminary Cx Plan, as well as updates;
- Incorporation of Cx Requirements into Construction Specification;
- Review of the design to ensure that it reflects the Owner's project requirement.

2.2 CONSTRUCTION PHASE

Here is a brief description of the Cx Process during the Construction Phase:

- Organization of Cx Coordination Meetings;
- Establishment of a Cx Schedule;
- Hold a review of workshop drawings (operation access);
- Verification of installation of systems and equipment;
- Verification of operation and performance of electromechanical systems;
- Verification and optimization of the functioning sequences;
- Training updates, as well as revision of Operation and Maintenance (O&M) Manuals;
- Submission of a final Cx Report (final version of the Cx Plan).

2.3 OPERATION PHASE

Here is a brief description of the Cx Process during the Operation Phase:

- Seasonal tests to verify the operation of the systems under various conditions;
- Carry out recordings and tendency analysis to supervise the operation parameters.



3.0 ACTIVITIES AND OBJECTIVES OF THE COMMISSIONING PROCESS

During the Construction Phase, the fixed objectives are as follows:

- Ensure that all Cx Team Members understand their roles;
- Establish a Cx Schedule for the Construction Phase;
- Carry out the global verification of the installation;
- Document system performance;
- Do the training follow-up as well as verification of O&M Manuals.



4.0 COMMISSIONING TEAM

TEAM MEMBER	COMPANY	RESOURCE PERSON/ TELEPHONE/ E-MAIL
Cx Authority		
Owner (Technical Services)		
Cx Owner's Representative		
General Contractor		
Electrical Contractor		
Balancing Contractor		
Control Contractor		
Ventilation Contractor		
Plumbing Contractor		
Fire Alarm Contractor		
Consultant		
Architects and Engineers		



5.0 ROLES AND RESPONSIBILITIES

ACTIVITIES	Cx A	OR	A/E	GCS
DESIGN PHASE				
Definition of Requirements Related to Operation and Maintenance of Equipment	P	P	P	
Review of Basic Design	P	P	P	
Organization and Management of the Cx Team	R	P	P	
Incorporation of Cx Specifications into Construction Bid Documents	R	P	R	
CONSTRUCTION AND OPERATION PHASES				
Follow the Cx Plan and Provide Help to Solve the Deficiencies Registered	R	P	P	P
Organization of Cx Meetings	R			
Attend Cx Meetings	P	P	P	R
Submit Workshop Drawings of Systems and Equipment	R		P	
Hold a Review of a Workshop Drawings	P		R	
Develop Testing Procedures	R		P	P
Hold a Review of the Cx Plan	R			
Develop and Hold a Record of Deficiencies and Anomalies	R		P	
Follow the Cx Plan and Help Resolve the Deficiencies	R	P	P	P
Verify Compliance of the Installations and Solve the Deficiencies	P	P	R	P
Elaboration of a Cx Schedule and Submission to the Cx Authority for Approval	P	P	P	R
Fill the Construction Checklist Forms	P			R
Perform the Performance Tests	P	P	P	R
Submission of Various Reports and Production of O&M Manuals				R
Training Sessions			P	R
Reports Verification	P	P	R	
Follow-up of Training and Verification of Operation Manuals	P	P	P	R
Warranty Review	P			P
Preparation of a Cx Final Report Summarizing the Work Done so far	R			

P: Participant

R: Responsible



6.0 COMMISSIONING PROCESS

This section details Cx Activities.

6.1 DESIGN PHASE

During this phase, we must ensure that the Owner's requirements are reflected in the basic of design and we have to ensure to obtain the required documentation as well. Needs related to the O&M must also be taken into consideration.

6.1.1 Owner's Project Requirements and Basic of Design

Documentation of the basic of design must include the following items:

- Energy performance;
- Codes and Standards applied to the project;
- Characteristics of the building envelope;
- Calculation of heat loads;
- Vibration and sound level;
- Design parameters (temperature and humidity);
- Equipment dimensioning;
- Indoor air quality;
- Lighting;
- Fire alarm zoning;
- Emergency supply systems.

6.1.2 Commissioning Plan

Elaborate a Cx Plan which will be used as guidelines during the entire project. This Cx Plan must include all required information and must be updated on a regular basis. The final version of the document will be used for the Cx Execution.

6.1.3 Training Requirements

The Cx Authority, in collaboration with Owner and A/E, will evaluate the needs for training, as well as its strictness, and will provide this information to the people responsible of the staff training.

Also include the training into the Cx Schedule and submit it, for approval, as well as the course outline to the Cx Authority.

The training sheets are provided in Appendix 4.

6.1.4 Specifications of the Commissioning in Bid Documents

The Cx must be incorporated into bid documents to enable tenderers to evaluate the actual needs. Moreover, tests procedures as well as responsibilities must be duly developed in the "Commissioning" section of bid documents.



6.1.5 Design and Drawings Review

A general overview of design and drawings at 40%, 95%, and 100% stages is necessary, and must include the following items:

- Make sure PWGSC Standards are met in the Design Phase;
- Verify O&M requirements;
- Ensure that tools required for the balancing of the installation are available;
- Verify needs for training.

6.2 CONSTRUCTION PHASE

The Cx Activities during the Construction Phase must be carried out starting from the lowest to the highest level of complexity of systems and subsystems. In general, tests must be done in the following order:

- Static verification (e.g. verification of components and tightness test);
- Equipment start-up (dynamic verifications);
- Verification stage-by-stage of control;
- Balancing;
- Interaction between the systems and performance verification.

Refer to Appendix 2 for the Construction Checklist Forms.

6.2.1 Review of Shop Drawings

The Cx Authority must carry out a selective review of workshop drawings as per Cx Requirements. This verification must include the following items:

- Ensure the equipment correspond to specifications;
- Verification of information availability;
- This review does not replace the one carried out by Design Engineers.

6.2.2 Site Observation

The Cx Authority schedules periodic visits in order to supervise the system and equipment installations, those will be coordinated with the Contractors and the Owner.

The Cx Authority will develop and update the register of the deficiencies and anomalies. This register will include pictures and actions foreseen to correct these deficiencies.

Also, the Cx Authority selectively attends site meetings to be kept informed of job progress.

6.2.3 Commissioning Schedule

The General Contractor must provide, for approval, a Cx Schedule for each equipment and system. This schedule must be updated as the project progresses. Refer to Appendix 3 for the Cx Schedule.



6.2.4 Construction Checklists Forms (Static Verification)

These verifications will allow ensuring that all equipment and systems are connected and operational, prior to conduct performance testing (examples of controlled point: Oil level, fan belt tension, labels affixed, alignment, calibration probes, etc.).

No sampling strategy is used. In general, the Contractors will complete the forms for all equipment and systems before beginning the performance tests (see Appendix 2 for the Construction Checklist Forms).

6.2.5 Functional Testing Procedure (Dynamic Verification)

The functional test will serve to verify the complete operation of the systems or the equipment (rather than just components). The test procedure will include the evaluation of different modes (low load, high load, heating, cooling, unoccupied, the interaction with the fire alarm, and emergency operation, if applicable) as well as the full review of the control sequences.

The TAB of hydraulic and ventilation systems must be completed, and results approved to make the performance testing.

After each test, reports or test results will be provided to the Owner, findings and recommendations will be annotated.

These tests will be using the Energy Monitoring and Control System (EMCS).

Here are the prerequisites for these tests:

- All features of BSA are programmed, graphics completed, as well as fine tuning of the loops (PID);
- All plumbing pipes flushed;
- Water treatment systems functional;
- TAB air and water completed and approved;
- Deficiencies corrected.

The Contractor, under the supervision of the Cx Authority, must carry out required tests and verifications (static and dynamic) on systems and equipment in order to evaluate their performance. Results must be documented in the Cx Sheets by the Cx Authority.

Verifications on less critical electrical components, such as switches, sockets, lighting, and other similar equipment, will be done with samplings between 10% and 30% (to be defined during Cx meetings).



6.2.6 Integrated Automation

Seasonal Adjustments: The Integrated Automation Contractor must foresee a 40-hour period to perform the seasonal adjustments. These hours will only be used on call and upon instructions of the Commissioning Agent.

The Integrated Automation Contractor must provide and install for the Commissioning Agent all software and access required to allow remote access to the Building Management System, including licenses.

6.2.7 Commissioning Meetings

Periodic meetings must be organized with the Cx Team to explain the process, to obtain the information concerning the progress of the Cx, and to solve possible problems observed. Minutes of meetings will be issued by the Cx Authority.

6.2.8 Operation and Maintenance Manuals

The documentation related to Operation and Maintenance Manuals must be gathered and submitted to the Cx Authority for approval. O&M Manuals must include the following:

- Summary;
- List of Contractors and any critical information;
- Verified workshop drawings;
- Equipment data sheets;
- Preventative maintenance sheets;
- "As-built" drawings;
- Warranties;
- Workshop test and in-situ test certificates of equipment or specified systems;
- Reports of tests and networks cleaning;
- Balancing report.

6.2.9 Commissioning Final Report

The Cx Authority will provide a Cx final report which will include the following items:

- Construction Checklists;
- Various tests results;
- Training program and O&M Manuals;
- Outstanding questions;
- Recommissioning Plan.



APPENDIX 1

Commissioning Systems



Commissioned Systems

FORM	SYSTEM AND EQUIPMENT	PRESENCE REQUIRED AT COMMISSIONING	DOCUMENTS TO SUBMIT	CX DATE
HVAC Systems				
1	Dry Pipe Sprinkler Systems	General Contractor, Cx Agent, Subcontractors	Cx Report	
2	Backflow Preventer	General Contractor, Cx Agent, Subcontractors	Cx Report, refer to Section 22 05 15.	
3	Pumps	General Contractor, Cx Agent, Subcontractors	Installation Checklist	
4	Domestic Water Piping	General Contractor, Cx Agent, Subcontractors	Cx Report	
5	Domestic Water Heaters	General Contractor, Cx Agent, Subcontractors	Installation Checklist	
6	Drainage Waste and Vent Piping - Cast Iron and Copper	General Contractor, Cx Agent, Subcontractors	Cx Report, refer to Sections 22 13 16.13/22 13 16.16.	
7	Vibration and Seismic Controls for HVAC	General Contractor, Cx Agent, Subcontractors	Cx Report	
8	Testing, Adjusting and Balancing for HVAC	General Contractor, Cx Agent, Subcontractors	Cx Report	
9	Pressure Testing of Ducted Air Systems	General Contractor, Cx Agent, Subcontractors	Cx Report according to SMACNA (refer to Section 23 05 94 - Part 3).	
10	Duct Heater	General Contractor, Cx Agent, Subcontractors	Cx Report	
11	AHU	General Contractor, Cx Agent, Subcontractors	Cx Report, Installation Checklist	
12	Humidifier	General Contractor, Cx Agent, Subcontractors	Cx Report, Installation Checklist	

FORM	SYSTEM AND EQUIPMENT	PRESENCE REQUIRED AT COMMISSIONING	DOCUMENTS TO SUBMIT	CX DATE
13	Sequences of Operation	General Contractor, Cx Agent, Subcontractors	Installation Checklist	
Electrical and Physical Security				
14	Grounding – Secondary	General Contractor, Cx Agent, Subcontractors	Cx Report	
15	Lighting Control	General Contractor, Cx Agent, Subcontractors	Cx Report	
16	Panelboards Breaker Type	General Contractor, Cx Agent, Subcontractors	Installation Checklist	
17	Transformer	General Contractor, Cx Agent, Subcontractors	Installation Checklist, Cx Report according to Section 26 12 16.01	
18	Starter 600 V	General Contractor, Cx Agent, Subcontractors	Installation Checklist	
19	Lighting	General Contractor, Cx Agent, Subcontractors	Installation Checklist	
20	Multiplex Fire Alarm System	General Contractor, Cx Agent, Subcontractors	Cx Report	

APPENDIX 2

Commissioning Forms



PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 3	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

PUMP (PLUMBING)

IDENTIFICATION	Equipment Tag:	Serial No.:
	Type:	Location:
	Make:	Contractor:
	Model No.:	Manufacturer:
	Dimensions:	
	System:	
	Sector:	
Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Pneumatic Communication/Integration: <input type="checkbox"/> Internal <input type="checkbox"/> Electric <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> External <input type="checkbox"/> Digital <input type="checkbox"/> N/A		

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

PERFORMANCE	Operation Data	Design	Reading
	Water Flow:		
	Inlet Pressure:		
	Outlet Pressure:		
	Head:		
	Amperage:		
	Voltage:		

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 5	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

Water Heater

IDENTIFICATION	Equipment Tag:	Serial No.:
	Type:	Location:
	Make:	Contractor:
	Model No.:	Manufacturer:
	Dimensions:	
	System:	
	Sector:	

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

PERFORMANCE	Operation Data	Design	Reading
	Burner Model:		
	Heat Capacity:		
	Tank Volume :		
	Tension:		
	Thermostat Setting:		
	Safety:		

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:



PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 11	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 3	
APPENDIX 2 - COMMISSIONING FORM			

AIR HANDLING UNIT

IDENTIFICATION	Equipment Tag:	Serial No.:
	Location:	
	Model No.:	Contractor:
	Type:	Manufacturer:
	Description of System:	
	Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Pneumatic <input type="checkbox"/> Internal <input type="checkbox"/> Electric <input type="checkbox"/> External <input type="checkbox"/> Digital	
	Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A	

<input type="checkbox"/> Manufacturer Checklist	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
---	--	--

INSTALLATION CHECKLIST			
Item	Yes	No	Comments
Cabinet and general installation			
Permanent labels affixed/Filters installed, and replacement type and efficiency permanently affixed to housing/construction filters removed			
Exhaust fan and motor aligned/ Exhaust fan belt tension & condition good/ Exhaust fan protective shrouds for belts in place and secure			
Exhaust fan and motor lube lines installed and lubed			
Fan rotation correct (If VFD, check rotation in bypass and VFD Inverter mode)			
Fan has no unusual noise or vibration			

*Attach the contractor installation checklist.

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 11	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 3	
APPENDIX 2 - COMMISSIONING FORM			

AIR HANDLING UNIT

PERFORMANCE	Fan	Design	Reading
	Flow:		
	Total Static Pressure:		
	RPM:		
	Motor	Design	Reading
	Capacity:		
	Voltage:		
	Amperage:		

Heating Coil

PERFORMANCE	Operation Data	Design	Reading
	Fluid Flow:		
	Air Flow:		
	Air Pressure Loss:		
	Fluid Pressure Loss:		In: Out:
FLUID	Operation Data	Design	Reading
	Temperature in:		
	Temperature out:		
	Capacity:		
AIR	Operation Data	Design	Reading
	Temperature in:		
	Temperature out:		
	Capacity:		

Cooling Coil

PERFORMANCE	Operation Data	Design	Reading
	Fluid Flow:		
	Air Flow:		
	Air Pressure Loss:		
	Fluid Pressure Loss:		In: Out:

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 11	No.:
	Kennel Extension and Construction of a New Training Hangar	3 of 3	
APPENDIX 2 - COMMISSIONING FORM			

AIR HANDLING UNIT

FLUID	Operation Data	Design	Reading
	Temperature in:		
	Temperature out:		
	Capacity:		
AIR	Operation Data	Design	Reading
	Temperature in:		
	Temperature out:		
	Capacity:		

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 12	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

HUMIDIFIER

IDENTIFICATION	Equipment Tag:	Serial No.
	Type:	Location:
	Make:	Contractor:
	Model No.:	Manufacturer:
	Dimensions:	
	Sector:	
	Accessories: <div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> High limit humidity detector <input type="checkbox"/> Flow switch <input type="checkbox"/> Internal control <input type="checkbox"/> External control </div> <div> <input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital </div> <div> Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A </div> </div>	

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

PERFORMANCE	Operation Data	Design	Reading
	Air flow:		
	Temperature in/out:		
	Humidity in/out:		
	Capacity:		

*attach the contractor installation check list.

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 13	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

SEQUENCE OF OPERATIONS

IDENTIFICATION	Name of System:		
	Description of System:		
	<table> <tr> <td> Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Internal <input type="checkbox"/> External </td> <td> <input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital </td> <td> Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A </td> </tr> </table>	Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Internal <input type="checkbox"/> External	<input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital
Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Internal <input type="checkbox"/> External	<input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital	Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A	

SEQUENCE OF OPERATION	VERIFIED	COMMENTS
All sensors and actuators are calibrated, correctly positioned and working properly.		
Configuration of occupation schedule and pre-start-up mode or night set back temperature.		
Minimum position for fresh air damper.		
Modulation of valves and dampers		
Pressure, temperature and humidity control loops		
Supply and mixed air control loops		
Hardware protections (freeze, high pressure, proof of flow, high temperature, high humidity)		
Static pressure set point (also see bypass and variable frequency drives)		
Positioning of systems when stopped		
Variable frequency drives (minimum speed, acceleration ramps, deceleration) and bypass circuit		
Pressure, temperature, and CO ₂ alarms		
Functionality of terminal boxes		
Heating and cooling loops		
Special systems (recovery, energy measurement, gas detection)		

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 16	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 3	
APPENDIX 2 - COMMISSIONING FORM			

PANELBOARDS BREAKER TYPE

IDENTIFICATION	Equipment Tag:		Drawing No.:	
	Brand:		Location:	
	Model Number:		Manufacturer:	
	Voltage:	NEMA:	Bars: <input type="checkbox"/> Cu <input type="checkbox"/> Al	
	Amp. horizontal:	Amp. vertical:	Amp. bar MALT:	
	Omnibus (kA):	Supply:	Connected to:	

INSPECTION	DESCRIPTION	YES	NO	NC	COMMENTS
	Nameplate readable				
	All enclosures clearly identified				
	Primary connection tight				
	Phase identification of the bus bars				
	Right grounding				
	Facility starters drawer checked				
	Adequate clearance in front of the CCM				
	Clean equipment / no scratch or damage				
	Good ventilation				

TESTS	TESTS			COMMENTS
	Electric Strength Test (MΩ):		Ph ABC/T:	
	Phase A-B:	Phase B-C:	Phase C-A:	
	Voltage test:			
	V _{AN} :	V _{BN} :	V _{CN} :	
	V _{AB} :	V _{BC} :	V _{CA} :	
	Balancing Charge Test:			
	I _A :	I _B :	I _C :	
	Note: The equipment must be isolated from any power source			

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 16	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 3	
APPENDIX 2 - COMMISSIONING FORM			

PANELBOARDS BREAKER TYPE

ASSOCIATED CHECKLISTS					
Grounding	<input type="checkbox"/>	Lighting	<input type="checkbox"/>	Low Voltage Transformer	<input type="checkbox"/>
Low Voltage MCC	<input type="checkbox"/>	Low Voltage Switchgear	<input type="checkbox"/>	Unit Substation	<input type="checkbox"/>
Unit Substation Transformer	<input type="checkbox"/>	Other	<input type="checkbox"/>	Other	<input type="checkbox"/>
Comments:					

REQUESTED DOCUMENTATION SUBMITTED	REC'D	COMMENTS
Manufacturer's Cut Sheets	<input type="checkbox"/>	
Installation and Start-up Manual and Plan	<input type="checkbox"/>	
O&M Manuals	<input type="checkbox"/>	
Sequences and Control Strategies	<input type="checkbox"/>	
Warranty Certificate	<input type="checkbox"/>	
Comments:		

DISTRIBUTION PANEL ENCLOSURE/CABINTRY			
CHECK IF ACCEPTABLE; PROVIDE COMMENT IF UNACCEPTABLE		NA	COMMENT
Equipment installed per manufacturer's instructions and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment installed agrees with shop drawings and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
Verify mounting, location and clearances are per drawings and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
Inspect for physical, electrical and mechanical condition of equipment and cabinet - no damage evident	<input type="checkbox"/>	<input type="checkbox"/>	
Inspect panels and doors for proper fit and alignment	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels permanently affixed	<input type="checkbox"/>	<input type="checkbox"/>	
Panel is clean and clear of dust or dirt	<input type="checkbox"/>	<input type="checkbox"/>	
Verify the application of manufacturer recommended torque values applied to bolted connections	<input type="checkbox"/>	<input type="checkbox"/>	
Verify correct circuit breaker sizes and types per the specifications and manufacturer's drawings	<input type="checkbox"/>	<input type="checkbox"/>	
Inspect insulators, barriers, and shields for damage or contamination	<input type="checkbox"/>	<input type="checkbox"/>	
Verify that ground bus is properly bonded to enclosure, enclosure is grounded and resistance to ground meets grounding specifications.	<input type="checkbox"/>	<input type="checkbox"/>	

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 16	No.:
	Kennel Extension and Construction of a New Training Hangar	3 of 3	
APPENDIX 2 - COMMISSIONING FORM			

PANELBOARDS BREAKER TYPE

DISTRIBUTION PANEL ENCLOSURE/CABINETRY			
CHECK IF ACCEPTABLE; PROVIDE COMMENT IF UNACCEPTABLE	NA	COMMENT	
Neutral bus isolated from cabinet	<input type="checkbox"/>	<input type="checkbox"/>	
Megger test of bus – phase to phase and phase to ground. Test voltage per manufacturer's recommendations.	<input type="checkbox"/>	<input type="checkbox"/>	
CIRCUIT BREAKERS 208/120 VAC PANELS			
Installed per manufacturer's instructions, plans and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
No physical damage	<input type="checkbox"/>	<input type="checkbox"/>	
Verify voltage and current rating of circuit breaker are per plans and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
Verify breakers are mounted securely and operates smoothly	<input type="checkbox"/>	<input type="checkbox"/>	
Verify wire is properly installed and suitable size for breaker	<input type="checkbox"/>	<input type="checkbox"/>	
Check cell fit and element alignment	<input type="checkbox"/>	<input type="checkbox"/>	
Check racking mechanism	<input type="checkbox"/>	<input type="checkbox"/>	

OPERATIONAL CHECKS			
CHECK IF ACCEPTABLE; PROVIDE COMMENT IF UNACCEPTABLE	NA	COMMENT	
Specified sequences of operation and operating schedules have been provided with all variations documented	<input type="checkbox"/>	<input type="checkbox"/>	
Specified point-to-point checks have been completed and documentation record submitted for this system	<input type="checkbox"/>	<input type="checkbox"/>	

MEMORANDUM (Deficiencies, repair work, sound, and maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 17	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 2	
APPENDIX 2 - COMMISSIONING FORM			

TRANSFORMER

IDENTIFICATION	Equipment No.:		Drawing No.:	
	Make:		Location:	
	Model:		Supplier's Address:	
	Serial No.:		Factory Test Report Included: <input type="checkbox"/> Yes <input type="checkbox"/> No	
	ANN Capacity (kVA):	AFN Capacity (kVA):	Winding:	<input type="checkbox"/> Cu <input type="checkbox"/> Al
	High Voltage:	BIL HV (kV):	Connection:	<input type="checkbox"/> Δ <input type="checkbox"/> Y
	Low Voltage:	BIL LV (kV):	Connection:	<input type="checkbox"/> Δ <input type="checkbox"/> Y
	Phase:	Frequency:	Impedance:	
	Isolation:	Temperature Rise:	Isolation Class:	
	Primary Power Socket:	Exhaust Hood:	Noise (dB):	

INSPECTION	Description	Yes	No	N/A	Comments / Observations
	Legible nameplate, complying with workshop drawings				
	Good primaries and secondaries connections				
	Good grounding connection				
	Good connection of branch loader				
	Branch line properly adjusted				
	Isolators in good condition (Without cracks or mess)				
	Proper clearance surrounding equipment				
	Tools removed, doors, and covers replaced				
	Proper ventilation				
	Noise level measured (dB)				
	Remark: Equipment to be isolated from any supply source				

Name of Technician:	Date:
Approved by: (Person in charge of Cx)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 17	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 2	
APPENDIX 2 - COMMISSIONING FORM			

TRANSFORMER

PERFORMANCE VERIFICATION			
Measured Data	Specified	Installed	Verified
Primary Amperage			
Secondary Amperage			
Primary Tension			
Secondary Tension			
Resistance to Earth (Primary)			
Resistance to Earth (Secondary)			
Primary Line Voltage			
Secondary Line Voltage			
Primary Resistance			
Secondary Resistance			
Primary Connection			
Secondary Connexion			
Ambient Room Temperature			
Core Temperature			
Coil Temperature			
Primary Power Socket Setting			
Secondary Power Socket Setting			

MEMORANDUM (Deficiencies, repair work, sound, maintenance, etc.)	STATUS
	<input type="checkbox"/> Compliant
	<input type="checkbox"/> To verify
	<input type="checkbox"/> To be completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-compliant

Name of Technician:	Date:
Approved by: (Person in charge of Cx)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 18	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 2	
APPENDIX 2 - COMMISSIONING FORM			

STARTER

IDENTIFICATION	Identification:		Drawing No.:	
	Brand:		Location:	
	Catalogue No.:		Motor Reference:	
	Type: <input type="checkbox"/> Manual <input type="checkbox"/> Full Voltage <input type="checkbox"/> Wye-Delta <input type="checkbox"/> Autotransformer <input type="checkbox"/> Other:			
	Action: <input type="checkbox"/> 1 way <input type="checkbox"/> 2- way		Mounting: <input type="checkbox"/> Separated <input type="checkbox"/> In a MCC:	
	NEMA Rating:		NEMA Housing:	
	Voltage:		Phase/Poles: /	Command Voltage:
	Switch: <input type="checkbox"/> Yes <input type="checkbox"/> No		Fuse Type:	Dimensions:
	Moulded Case Breaker: <input type="checkbox"/> Yes <input type="checkbox"/> No		Type:	Trip:
	Overload Relay: <input type="checkbox"/> Yes <input type="checkbox"/> No		Type:	Adjustment:

INSPECTION ET ESSAIS	Description	Yes	No	N/A	Comments/Observations
	Clear labelling:				
	Adequate clearance for disconnect:				
	Functional LED lights:				
	Functional Start/Stop push buttons:				
	Functional relays:				
	Functional overload:				
	Reset push button:				
	Functional overheat relay:				
	Correct control sequence:				
Functional security interlock:					

MEASURE	Measure				Comments/Observations
	V _{A-B} :	V	I _A :	A	
	V _{B-C} :	V	I _B :	A	
	V _{C-A} :	V	I _C :	A	

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 18	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 2	
APPENDIX 2 - COMMISSIONING FORM			

STARTER

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 19	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 2	
APPENDIX 2 - COMMISSIONING FORM			

LIGHTING

IDENTIF.	Block:		Level:		Sector:	
	Panel with Relay:		Brand:		Model:	
	Drawing No.:					

TESTS	VERIFICATION OF LIGHTNING AND LIGHTNING CONTROL	Y	N	N/A	Nos.
	Devices installed per manufacturer's instructions and specifications				
	All the lamps work correctly (no burned lamps, no blinking, etc.)				
	The level of illumination is adequate				
	The illumination is uniform (no black spots, etc.)				
	The commands by switches work				
	The commands by motion detectors work correctly				
	The commands by gradation work correctly				
	The illumination is normal at every level of gradation since the minimum until 100%				
	The panel with relay works correctly				

DEFECTS/DISCREPANCIES	No.	Room	Item	Description of the Defect/Comments
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 19	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 2	
APPENDIX 2 - COMMISSIONING FORM			

LIGHTING

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

APPENDIX 3

Commissioning Schedule



PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 3	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

PUMP (PLUMBING)

IDENTIFICATION	Equipment Tag:	Serial No.:
	Type:	Location:
	Make:	Contractor:
	Model No.:	Manufacturer:
	Dimensions:	
	System:	
	Sector:	
Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Pneumatic Communication/Integration: <input type="checkbox"/> Internal <input type="checkbox"/> Electric <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> External <input type="checkbox"/> Digital <input type="checkbox"/> N/A		

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

PERFORMANCE	Operation Data	Design	Reading
	Water Flow:		
	Inlet Pressure:		
	Outlet Pressure:		
	Head:		
	Amperage:		
	Voltage:		

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 5	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

Water Heater

IDENTIFICATION	Equipment Tag:	Serial No.:
	Type:	Location:
	Make:	Contractor:
	Model No.:	Manufacturer:
	Dimensions:	
	System:	
	Sector:	

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

PERFORMANCE	Operation Data	Design	Reading
	Burner Model:		
	Heat Capacity:		
	Tank Volume :		
	Tension:		
	Thermostat Setting:		
	Safety:		

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:



PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 11	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 3	
APPENDIX 2 - COMMISSIONING FORM			

AIR HANDLING UNIT

IDENTIFICATION	Equipment Tag:	Serial No.:
	Location:	
	Model No.:	Contractor:
	Type:	Manufacturer:
	Description of System:	
	Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Pneumatic <input type="checkbox"/> Internal <input type="checkbox"/> Electric <input type="checkbox"/> External <input type="checkbox"/> Digital	
	Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A	

<input type="checkbox"/> Manufacturer Checklist	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals	
INSTALLATION CHECKLIST			
Item	Yes	No	Comments
Cabinet and general installation			
Permanent labels affixed/Filters installed, and replacement type and efficiency permanently affixed to housing/construction filters removed			
Exhaust fan and motor aligned/ Exhaust fan belt tension & condition good/ Exhaust fan protective shrouds for belts in place and secure			
Exhaust fan and motor lube lines installed and lubed			
Fan rotation correct (If VFD, check rotation in bypass and VFD Inverter mode)			
Fan has no unusual noise or vibration			

*Attach the contractor installation checklist.

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 11	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 3	
APPENDIX 2 - COMMISSIONING FORM			

AIR HANDLING UNIT

PERFORMANCE	Fan	Design	Reading
	Flow:		
	Total Static Pressure:		
	RPM:		
	Motor	Design	Reading
	Capacity:		
	Voltage:		
	Amperage:		

Heating Coil

PERFORMANCE	Operation Data	Design	Reading	
	Fluid Flow:			
	Air Flow:			
	Air Pressure Loss:			
	Fluid Pressure Loss:		In:	Out:
FLUID	Operation Data	Design	Reading	
	Temperature in:			
	Temperature out:			
	Capacity:			
AIR	Operation Data	Design	Reading	
	Temperature in:			
	Temperature out:			
	Capacity:			

Cooling Coil

PERFORMANCE	Operation Data	Design	Reading	
	Fluid Flow:			
	Air Flow:			
	Air Pressure Loss:			
	Fluid Pressure Loss:		In:	Out:

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 11	No.:
	Kennel Extension and Construction of a New Training Hangar	3 of 3	
APPENDIX 2 - COMMISSIONING FORM			

AIR HANDLING UNIT

FLUID	Operation Data	Design	Reading
	Temperature in:		
	Temperature out:		
	Capacity:		
AIR	Operation Data	Design	Reading
	Temperature in:		
	Temperature out:		
	Capacity:		

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 12	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

HUMIDIFIER

IDENTIFICATION	Equipment Tag:	Serial No.
	Type:	Location:
	Make:	Contractor:
	Model No.:	Manufacturer:
	Dimensions:	
	Sector:	
	Accessories: <div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> High limit humidity detector <input type="checkbox"/> Flow switch <input type="checkbox"/> Internal control <input type="checkbox"/> External control </div> <div> <input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital </div> <div> Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A </div> </div>	

<input type="checkbox"/> Manufacturer Check List	<input type="checkbox"/> Performance Sheets Included	<input type="checkbox"/> Operation and Maintenance Manuals
--	--	--

PERFORMANCE	Operation Data	Design	Reading
	Air flow:		
	Temperature in/out:		
	Humidity in/out:		
	Capacity:		

*attach the contractor installation check list.

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 13	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 1	
APPENDIX 2 - COMMISSIONING FORM			

SEQUENCE OF OPERATIONS

IDENTIFICATION	Name of System:		
	Description of System:		
	<table> <tr> <td> Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Internal <input type="checkbox"/> External </td> <td> <input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital </td> <td> Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A </td> </tr> </table>	Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Internal <input type="checkbox"/> External	<input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital
Controls: <input type="checkbox"/> N/A <input type="checkbox"/> Internal <input type="checkbox"/> External	<input type="checkbox"/> Pneumatic <input type="checkbox"/> Electric <input type="checkbox"/> Digital	Communication/Integration: <input type="checkbox"/> Coordination with BAS <input type="checkbox"/> N/A	

SEQUENCE OF OPERATION	VERIFIED	COMMENTS
All sensors and actuators are calibrated, correctly positioned and working properly.		
Configuration of occupation schedule and pre-start-up mode or night set back temperature.		
Minimum position for fresh air damper.		
Modulation of valves and dampers		
Pressure, temperature and humidity control loops		
Supply and mixed air control loops		
Hardware protections (freeze, high pressure, proof of flow, high temperature, high humidity)		
Static pressure set point (also see bypass and variable frequency drives)		
Positioning of systems when stopped		
Variable frequency drives (minimum speed, acceleration ramps, deceleration) and bypass circuit		
Pressure, temperature, and CO ₂ alarms		
Functionality of terminal boxes		
Heating and cooling loops		
Special systems (recovery, energy measurement, gas detection)		

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 16	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 3	
APPENDIX 2 - COMMISSIONING FORM			

PANELBOARDS BREAKER TYPE

IDENTIFICATION	Equipment Tag:		Drawing No.:	
	Brand:		Location:	
	Model Number:		Manufacturer:	
	Voltage:	NEMA:	Bars: <input type="checkbox"/> Cu <input type="checkbox"/> Al	
	Amp. horizontal:	Amp. vertical:	Amp. bar MALT:	
	Omnibus (kA):	Supply:	Connected to:	

INSPECTION	DESCRIPTION	YES	NO	NC	COMMENTS
	Nameplate readable				
	All enclosures clearly identified				
	Primary connection tight				
	Phase identification of the bus bars				
	Right grounding				
	Facility starters drawer checked				
	Adequate clearance in front of the CCM				
	Clean equipment / no scratch or damage				
	Good ventilation				

TESTS	TESTS			COMMENTS
	Electric Strength Test (MΩ):		Ph ABC/T:	
	Phase A-B:	Phase B-C:	Phase C-A:	
	Voltage test:			
	V _{AN} :	V _{BN} :	V _{CN} :	
	V _{AB} :	V _{BC} :	V _{CA} :	
	Balancing Charge Test:			
	I _A :	I _B :	I _C :	
	Note: The equipment must be isolated from any power source			

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 16	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 3	
APPENDIX 2 - COMMISSIONING FORM			

PANELBOARDS BREAKER TYPE

ASSOCIATED CHECKLISTS					
Grounding	<input type="checkbox"/>	Lighting	<input type="checkbox"/>	Low Voltage Transformer	<input type="checkbox"/>
Low Voltage MCC	<input type="checkbox"/>	Low Voltage Switchgear	<input type="checkbox"/>	Unit Substation	<input type="checkbox"/>
Unit Substation Transformer	<input type="checkbox"/>	Other	<input type="checkbox"/>	Other	<input type="checkbox"/>
Comments:					

REQUESTED DOCUMENTATION SUBMITTED	REC'D	COMMENTS
Manufacturer's Cut Sheets	<input type="checkbox"/>	
Installation and Start-up Manual and Plan	<input type="checkbox"/>	
O&M Manuals	<input type="checkbox"/>	
Sequences and Control Strategies	<input type="checkbox"/>	
Warranty Certificate	<input type="checkbox"/>	
Comments:		

DISTRIBUTION PANEL ENCLOSURE/CABINTRY			
CHECK IF ACCEPTABLE; PROVIDE COMMENT IF UNACCEPTABLE		NA	COMMENT
Equipment installed per manufacturer's instructions and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment installed agrees with shop drawings and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
Verify mounting, location and clearances are per drawings and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
Inspect for physical, electrical and mechanical condition of equipment and cabinet - no damage evident	<input type="checkbox"/>	<input type="checkbox"/>	
Inspect panels and doors for proper fit and alignment	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels permanently affixed	<input type="checkbox"/>	<input type="checkbox"/>	
Panel is clean and clear of dust or dirt	<input type="checkbox"/>	<input type="checkbox"/>	
Verify the application of manufacturer recommended torque values applied to bolted connections	<input type="checkbox"/>	<input type="checkbox"/>	
Verify correct circuit breaker sizes and types per the specifications and manufacturer's drawings	<input type="checkbox"/>	<input type="checkbox"/>	
Inspect insulators, barriers, and shields for damage or contamination	<input type="checkbox"/>	<input type="checkbox"/>	
Verify that ground bus is properly bonded to enclosure, enclosure is grounded and resistance to ground meets grounding specifications.	<input type="checkbox"/>	<input type="checkbox"/>	

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 16	No.:
	Kennel Extension and Construction of a New Training Hangar	3 of 3	
APPENDIX 2 - COMMISSIONING FORM			

PANELBOARDS BREAKER TYPE

DISTRIBUTION PANEL ENCLOSURE/CABINETRY			
CHECK IF ACCEPTABLE; PROVIDE COMMENT IF UNACCEPTABLE	NA	COMMENT	
Neutral bus isolated from cabinet	<input type="checkbox"/>	<input type="checkbox"/>	
Megger test of bus – phase to phase and phase to ground. Test voltage per manufacturer's recommendations.	<input type="checkbox"/>	<input type="checkbox"/>	
CIRCUIT BREAKERS 208/120 VAC PANELS			
Installed per manufacturer's instructions, plans and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
No physical damage	<input type="checkbox"/>	<input type="checkbox"/>	
Verify voltage and current rating of circuit breaker are per plans and specifications	<input type="checkbox"/>	<input type="checkbox"/>	
Verify breakers are mounted securely and operates smoothly	<input type="checkbox"/>	<input type="checkbox"/>	
Verify wire is properly installed and suitable size for breaker	<input type="checkbox"/>	<input type="checkbox"/>	
Check cell fit and element alignment	<input type="checkbox"/>	<input type="checkbox"/>	
Check racking mechanism	<input type="checkbox"/>	<input type="checkbox"/>	

OPERATIONAL CHECKS			
CHECK IF ACCEPTABLE; PROVIDE COMMENT IF UNACCEPTABLE	NA	COMMENT	
Specified sequences of operation and operating schedules have been provided with all variations documented	<input type="checkbox"/>	<input type="checkbox"/>	
Specified point-to-point checks have been completed and documentation record submitted for this system	<input type="checkbox"/>	<input type="checkbox"/>	

MEMORANDUM (Deficiencies, repair work, sound, and maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 17	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 2	
APPENDIX 2 - COMMISSIONING FORM			

TRANSFORMER

IDENTIFICATION	Equipment No.:		Drawing No.:	
	Make:		Location:	
	Model:		Supplier's Address:	
	Serial No.:		Factory Test Report Included: <input type="checkbox"/> Yes <input type="checkbox"/> No	
	ANN Capacity (kVA):	AFN Capacity (kVA):	Winding:	<input type="checkbox"/> Cu <input type="checkbox"/> Al
	High Voltage:	BIL HV (kV):	Connection:	<input type="checkbox"/> Δ <input type="checkbox"/> Y
	Low Voltage:	BIL LV (kV):	Connection:	<input type="checkbox"/> Δ <input type="checkbox"/> Y
	Phase:	Frequency:	Impedance:	
	Isolation:	Temperature Rise:	Isolation Class:	
	Primary Power Socket:	Exhaust Hood:	Noise (dB):	

INSPECTION	Description	Yes	No	N/A	Comments / Observations
	Legible nameplate, complying with workshop drawings				
	Good primaries and secondaries connections				
	Good grounding connection				
	Good connection of branch loader				
	Branch line properly adjusted				
	Isolators in good condition (Without cracks or mess)				
	Proper clearance surrounding equipment				
	Tools removed, doors, and covers replaced				
	Proper ventilation				
	Noise level measured (dB)				
	Remark: Equipment to be isolated from any supply source				

Name of Technician:	Date:
Approved by: (Person in charge of Cx)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 17	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 2	
APPENDIX 2 - COMMISSIONING FORM			

TRANSFORMER

PERFORMANCE VERIFICATION			
Measured Data	Specified	Installed	Verified
Primary Amperage			
Secondary Amperage			
Primary Tension			
Secondary Tension			
Resistance to Earth (Primary)			
Resistance to Earth (Secondary)			
Primary Line Voltage			
Secondary Line Voltage			
Primary Resistance			
Secondary Resistance			
Primary Connection			
Secondary Connexion			
Ambient Room Temperature			
Core Temperature			
Coil Temperature			
Primary Power Socket Setting			
Secondary Power Socket Setting			

MEMORANDUM (Deficiencies, repair work, sound, maintenance, etc.)	STATUS
	<input type="checkbox"/> Compliant
	<input type="checkbox"/> To verify
	<input type="checkbox"/> To be completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-compliant

Name of Technician:	Date:
Approved by: (Person in charge of Cx)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 18	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 2	
APPENDIX 2 - COMMISSIONING FORM			

STARTER

IDENTIFICATION	Identification:		Drawing No.:	
	Brand:		Location:	
	Catalogue No.:		Motor Reference:	
	Type: <input type="checkbox"/> Manual <input type="checkbox"/> Full Voltage <input type="checkbox"/> Wye-Delta <input type="checkbox"/> Autotransformer <input type="checkbox"/> Other:			
	Action: <input type="checkbox"/> 1 way <input type="checkbox"/> 2- way		Mounting: <input type="checkbox"/> Separated <input type="checkbox"/> In a MCC:	
	NEMA Rating:		NEMA Housing:	
	Voltage:		Phase/Poles: /	Command Voltage:
	Switch: <input type="checkbox"/> Yes <input type="checkbox"/> No		Fuse Type:	Dimensions:
	Moulded Case Breaker: <input type="checkbox"/> Yes <input type="checkbox"/> No		Type:	Trip:
	Overload Relay: <input type="checkbox"/> Yes <input type="checkbox"/> No		Type:	Adjustment:

INSPECTION ET ESSAIS	Description	Yes	No	N/A	Comments/Observations
	Clear labelling:				
	Adequate clearance for disconnect:				
	Functional LED lights:				
	Functional Start/Stop push buttons:				
	Functional relays:				
	Functional overload:				
	Reset push button:				
	Functional overheat relay:				
	Correct control sequence:				
Functional security interlock:					

MEASURE	Measure				Comments/Observations
	V _{A-B} :	V	I _A :	A	
	V _{B-C} :	V	I _B :	A	
	V _{C-A} :	V	I _C :	A	

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 18	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 2	
APPENDIX 2 - COMMISSIONING FORM			

STARTER

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 19	No.:
	Kennel Extension and Construction of a New Training Hangar	1 of 2	
APPENDIX 2 - COMMISSIONING FORM			

LIGHTING

IDENTIF.	Block:		Level:		Sector:	
	Panel with Relay:		Brand:		Model:	
	Drawing No.:					

TESTS	VERIFICATION OF LIGHTNING AND LIGHTNING CONTROL	Y	N	N/A	Nos.
	Devices installed per manufacturer's instructions and specifications				
	All the lamps work correctly (no burned lamps, no blinking, etc.)				
	The level of illumination is adequate				
	The illumination is uniform (no black spots, etc.)				
	The commands by switches work				
	The commands by motion detectors work correctly				
	The commands by gradation work correctly				
	The illumination is normal at every level of gradation since the minimum until 100%				
	The panel with relay works correctly				

DEFECTS/DISCREPANCIES	No.	Room	Item	Description of the Defect/Comments
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

PROJECT: 157102560 (R.100341.001)	Canada Border Service Agency College (CBSA)	Form: 19	No.:
	Kennel Extension and Construction of a New Training Hangar	2 of 2	
APPENDIX 2 - COMMISSIONING FORM			

LIGHTING

MEMORANDUM (Deficiencies, repair work, sound, maintenance)	STATUS
	<input type="checkbox"/> Compliance
	<input type="checkbox"/> Requires Additional Checking
	<input type="checkbox"/> To be Completed
	<input type="checkbox"/> Out of Service
	<input type="checkbox"/> Non-Compliance

Name of Technician:	Date:
Approved by: (Commissioning Authority)	Date:

APPENDIX 4

Training



TRAINING PROGRAM

(To be completed by the Commissioning Authority)

Equipment/System	Spec Section	Total Hours (if spec'd)	Trainee Level (List No. of each) ⁵	Trainers' Company	Trainer	Planned Training Date(s)
Mechanical/HVAC/Electrical						
Controls						
HVAC						
Sprinkler						
Plumbing						
Security						
Lighting and Fire Alarm System						
Recommissioning¹						
Architect²						
Mechanical Designer³						
Electrical Designer⁴						

¹**Recommissioning:** The Commissioning Agent will provide instruction on the use of blank functional test forms for periodic recommissioning of equipment and systems, as per the specification.

²**Architect:** The Architect will provide a general overview of the facility, its use, special features, tenant and public considerations, etc.

³**Mechanical Design Engineer:** The Mechanical Designer will provide an overview of the major systems and equipments in the facility, including for each system: the design intent, why the system was chosen, an overview of its operation, and interactions with other systems, any special areas to be aware of, issues regarding future expansion and remodeling, etc.

⁴**Electrical Design Engineer:** The Electrical Designer will provide an overview of the major electrical systems and equipment in the facility, particularly the lighting control systems, fire alarm, security and emergency power, focusing on the design intent, why the system was chosen, an overview of its operation, and interactions with other systems, any special areas to be aware of, issues regarding future expansion and remodeling, etc.

⁵**General Scope Codes:** (Refer to the specifications and to the specific equipment Training Agenda for additional details.)

A Provide an **overview** of the purpose and operation of this equipment, including required interactions of trainees with the equipment.

B At an **intermediate level**, provide technical information regarding the purpose, operation and maintenance of this equipment, expecting that serious malfunctions will be addressed by factory reps.

C At a **very technical level**, provide information regarding the purpose, operation, troubleshooting, and maintenance of this equipment, expecting that almost all operation, service, and repair will be provided by the trainees.

PROJECT No. R.100341.001
Canada Border Service Agency College (CBSA)
Kennel Extension and Construction of a New Training Hangar

TRAINING AND ORIENTATION AGENDA

Project: _____ Date: _____

Equipment/System: _____ Spec Section: _____

Section 1. Audience and General Scope *Owner and Commissioning Authority fill out this section and transmit entire form to responsible contractors. Attach training specification section.*

Intended Audience Type (enter number of staff): ____ Facility Manager ____ Facility Engineer
 ____ Facility Technician, ____ Project Manager, ____ Tenant, Other: _____

General objectives and scope of training: (Check all that apply)

- ____ A. Provide an overview of the purpose and operation of this equipment, including required interactions of trainees with the equipment.
- ____ B. Provide technical information regarding the purpose, operation and maintenance of this equipment at an intermediate level, expecting that serious malfunctions will be addressed by factory reps.
- ____ C. Provide technical information regarding the purpose, operation, troubleshooting, and maintenance of this equipment at a very detailed level, expecting that almost all operation, service and repair will be provided by the trainees.

Section 2. Instructors *(Commissioning agent fills in Company. Trainer fills out the balance, prior to training.)*

ID	<u>Trainer</u>	<u>Company</u>	<u>Position/Qualifications</u>
1)	_____	_____	_____
2)	_____	_____	_____
3)	_____	_____	_____

Section 3. Agenda *The responsible contractors have their trainers fill out this section and submit to Owner and Commissioning Agent for review and approval prior to conducting training.*

Location: _____ Date: _____

Agenda of General Subjects Covered

(√ when completed)

	<u>Duration</u> (min.)	<u>Instructor</u> (ID)	<u>Completed</u> (√)
____ General purpose of this system or equipment (Design intent)	_____	_____	_____
____ Review of control drawings and schematics (Have copies for attendees)	_____	_____	_____
____ Start-up, loading, normal operation, unloading, shutdown, unoccupied operation, seasonal changeover, etc., as applicable	_____	_____	_____
____ Integral controls (Packaged): Programming, troubleshooting, alarms, manual operation	_____	_____	_____
____ Building automation controls (BAS): Programming, troubleshooting, alarms, manual operation, interface with integral controls	_____	_____	_____
____ Interactions with other systems, operation during power outage and fire	_____	_____	_____



PROJECT No. R.100341.001
Canada Border Service Agency College (CBSA)
Kennel Extension and Construction of a New Training Hangar

___ Relevant health and safety issues and concerns and special safety features	_____	_____	_____
___ Energy conserving operation and strategies	_____	_____	_____
___ Any special issues to maintain warranty	_____	_____	_____
___ Common troubleshooting issues and methods, control system warnings and error messages, including using the control system for diagnostics	_____	_____	_____
___ Special requirements of tenants for this equipment's function	_____	_____	_____
___ Service, maintenance, and preventative maintenance (sources, spare parts inventory, special tools, etc.)	_____	_____	_____
___ Question and answer period	_____	_____	_____

<u>Other subjects covered, specific to the equipment:</u>	<u>Duration</u>	<u>Instructor</u>	<u>Completed</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
Total duration of training (hrs) ----->	<div></div>	_____	_____

Section 4. Approvals and Use (Once the Agenda has been filled out by the Trainer, the Owner and Commissioning Agent review, make edits, sign and return to Contractor who provides to the Trainer for use during training. Copies of Agenda shall be provided to trainees.)

Section 5. Comments Concerning the Training (To be fill out by trainee)

.....

.....

.....

.....

.....

.....

.....

This *plan* has been approved by the following individuals, subject to the additions and clarifications noted in the left columns marked "add." (This is not an approval of training completion.)

Owner's Representative

Date

Commissioning Authority

Date

**Canada Border Service Agency College (CBSA)
Kennel Extension and Construction of a New Training Hangar**

PARTICIPANT SIGN-IN SHEET

Equipment or System: _____

Signature	Total Hours Specified	Total Hours Received	Date	Instructor's Signature	CxA Initials
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Supplied Notes (Y/N) : _____

Training Final Approval :

Owner

Date

Commissioning Agent

Date

DIVISION 02

June 30, 2020

Part 1 General**1.1 SUMMARY**

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

1.2 RELATED REQUIREMENTS

- .1 Section 02 41 13.13 - Paving Removal
- .2 Section 02 42 00 - Removal and Salvage of Construction Materials
- .3 Section 31 23 33.01 - Excavating, Trenching and Backfilling

1.3 REFERENCE STANDARDS

- .1 Ministère de l'Environnement et de la Lutte contre les changements climatiques du Québec (MELCC)
 - .1 Environment Quality Act

1.4 DEFINITIONS

- .1 Selective Demolition: Sequencing demolition activities to allow separation and sorting of selected site materials.
- .2 Hazardous Substances: dangerous substances, dangerous goods, hazardous commodities and hazardous products, including but not limited to: asbestos PCB's, CFC's, HCFC's poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or well being or environment if handled improperly.
- .3 Draft Construction Waste Management Plan (Draft CWM Plan): Detailed inventory of materials in building indicating estimated quantities of reuse, recycling and landfill, prepared in accordance with Section 01 74 19- Construction Waste Management and Disposal and as follows:
 - .1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.
- .4 Waste Management Coordinator (WMC): contractor 's representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .5 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19- Waste Management and Disposal.
- .6 Construction Waste Management Report (CWM Report): Written report identifying actual materials that formed CWM Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19- Management and Disposal.

June 30, 2020

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordinate with Representative for the material ownership including the following:
 - .1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Representative's property, demolished materials shall become Contractor 's property and shall be removed from Project site.
 - .2 Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Representative that may be encountered during demolition remain Representative's property:
 - .1 Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Representative.
 - .2 Coordinate with Representative 's historical adviser, who will establish special procedures for removal and salvage operations.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Not applicable.

1.7 QUALITY ASSURANCE

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

1.8 SITE CONDITIONS

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

June 30, 2020

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

1.9 EXISTING CONDITIONS

- .1 Hazardous Materials: A geotechnical study and environmental soil characterisation has been performed on the site. Contractor must refer to the study to know the soil nature and its environmental characterisation.
 - .1 Hazardous materials will be as defined in the Hazardous Materials Act.
- .2 If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Representative. Hazardous materials will be removed by Representative under a separate contract or as a change to the Work.
- .3 Site elements that will be demolished are based on their condition on date that tender is accepted.

Part 2 Products

2.1 EQUIPMENT

- .1 Equipment and Heavy Machinery:
 - .1 Machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

June 30, 2020

Part 3 Execution**3.1 EXAMINATION**

- .1 Survey existing conditions and correlate with requirements indicated to determine extent of selective site demolition required.
- .2 Representative does not guaranty that existing conditions are the same as those indicated in Project Record Documents.
- .3 Inventory and record the condition of items being removed and salvaged.
- .4 When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to Representative.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.

3.3 REMOVAL AND DEMOLITION OPERATIONS

- .1 Remove items as indicated.
- .2 Disruption of items designated to remain in place is not permitted.
- .3 Removal of pavements, curbs and gutters:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Representative.
 - .2 Protect adjacent joints and load transfer devices.
 - .3 Protect underlying and adjacent granular materials.
- .4 Excavate at least 300 mm below pipe invert, when removing pipes under existing or future pavement area.
- .5 Remove designated trees during demolition.
 - .1 Obtain written approval of Representative prior to removal of trees not designated.
- .6 Stockpile topsoil for final grading and landscaping:
 - .1 Provide erosion control and seeding if not immediately used.

June 30, 2020

- .2 Soil Volumes that is not required for final grading or not acceptable as backfill material must be loaded and disposed off-site, in accordance with the requirements of the MELCC.
- .7 Disposal of Material:
 - .1 Dispose of materials not designated for salvage or reuse on site at authorized facilities approved by MELCC.
- .8 Backfill: Backfill in areas as indicated and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.4 REMOVAL FROM SITE

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

3.5 RESTORATION

- .1 Restore areas and existing works outside areas of demolition to conditions that existed prior to beginning of Work.
- .2 Use soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Remove debris, trim surfaces and leave work site clean, upon completion of Work
 - .3 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

DIVISION 03

Part 1 General**1.1 DESCRIPTION**

- .1 Work covered by this Section includes the provision of all materials, equipment supplies and services, labour and transportation to fully carry out the following:
 - .1 Design, construct, provide, assemble, dismantle and maintain all formwork, scaffolding, and falsework required for the construction of all structures specified or shown on the drawings;
 - .2 Install sleeves, anchor bolts, anchoring components, anchor plates, embedded components, grooves, sockets, angle irons, accessory parts, drains and all parts embedded in concrete shown on the plans of all disciplines or described in the invitation to tender document.

1.2 RELATED REQUIREMENTS

- .1 03 20 00 – Concrete reinforcement
- .2 03 30 00 – Cast-in-place concrete
- .3 31 23 33.01 – Excavating, trenching and backfilling

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM D1751-04 (R2013), Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types);
 - .2 ASTM D2240-05, Standard Test Method for Rubber Property-Durometer Hardness;
 - .3 ASTM D412-06a, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- .2 Canadian Standards Association (CSA):
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction / Methods of Test and Standard Practices for Concrete;
 - .2 CAN/CSA-G40.21-13, Construction Steel;
 - .3 CAN/CSA-S16-14, Design of Steel Structures;
 - .4 CSA-O86-14, Engineering Design in Wood;

- .5 CSA O121-08 (R2013), Douglas Fir Plywood;
- .6 CSA O151-09 (R2014), Canadian Softwood Plywood;
- .7 CSA O153-13, Poplar Plywood;
- .8 CAN/CSA-O325-16, Construction Sheathing;
- .9 CAN/CSA 437.0-93 (R2011), Standards on OSB and Waferboard;
- .10 CSA S269.1-16, Falsework for Construction Purposes;
- .11 CAN/CSA-S269.3-M92 (R2003), Concrete Formwork.
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction;
 - .2 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.
- .4 Publications du Québec:
 - .1 S-2.1; Loi sur la santé et la sécurité du travail;
 - .2 S-2.1, r.4; Code de sécurité pour les travaux de construction.
- .5 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S701-17, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.4 CONTRACTOR'S RESPONSIBILITIES

- .1 Assume responsibility of concrete formwork and falsework. The Departmental Representative's review of the formwork and falsework shall not release the Contractor from his responsibility regarding the provision of structures that fully comply with the drawings and specifications.
- .2 The Contractor shall be aware of all laws and regulations that apply to the design and construction of formwork and falsework and shall comply with these requirements. Comply with regulations including the Quebec Safety Code, S-2.1, r.4, regarding shoring of concrete formwork.
- .3 Before using the formwork and falsework, give the Departmental Representative a signed statement written by an Engineer who is a member in good standing of the Ordre des ingénieurs du Québec, and which bears the Engineer's seal.

The statement should certify that the formwork and falsework comply with the signed and sealed drawings, and that they may be used for their intended purposes.

1.5 ARCHITECTURAL CONCRETE

- .1 The Contractor shall take into account the fact that a significant part of the formwork is for concrete that will remain visible and must be considered architectural concrete.
- .2 The concrete used to build the following components shall be considered architectural concrete.

COMPONENTS	DESCRIPTION
▪ Apparent walls	All surfaces of these components above the ground floor level or the finish terrain.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in formwork liners and coatings and include product characteristics, performance criteria, physical size, finish, and limitations.
- .2 Produce shop drawings of formwork and falsework, which describe all the necessary components required to perform the work in compliance with the drawings and specifications:
 - .1 Have an engineer who is a member in good standing of the "Ordre des ingénieurs du Québec" sign these shop drawings and affix his seal;
 - .2 Before performing concrete formwork or falsework, submit these drawings to the Departmental Representative for review and comments. All drawings will be in the form of electronic copy;
 - .3 The shop drawings shall indicate, show or include the construction method and work schedule, procedures relating to shoring, the removal of forms, and the reinstallation of supports, the materials, the specific architectural characteristics of visible surface finishes, the location of joints, fasteners, ties and interior coatings, and the location of embedded falsework components. Comply with CSA S269.1 Falsework Drawing Requirements. Comply with CAN/CSA-S269.3 formwork drawing requirements;
 - .4 Shop drawings shall indicate, show, or include formwork data such as the allowable speed and temperature at which concrete may be placed into the forms;
 - .5 In addition to the details requested in 1.6.4., indicate on the shop drawings, at each location where the falsework is connected or leaning on an existing structure or a structure under construction, or already completed, the intensity and direction of maximum loads exerted on the load-bearing structure, taking into account construction site loads;

- .6 Specify the order in which the temporary concrete formwork and falsework are to be assembled and dismantled, according to the Departmental Representative's directives.

1.7 FORMWORK AND FALSEWORK DESIGN

- .1 Design the falsework according to trade practices making sure not to exert abnormal stress on the structure under construction.
- .2 Take construction sequences into account when designing the falsework. Describe on the shop drawings or in an explanatory note how and in what order to use the formworks, the position of specified construction joints and the falsework and formwork reuse principle. Submit the explanatory note and the relevant shop drawings to the Departmental Representative for review.
- .3 For vertical components, vertical construction joints shall be a maximum of 20 m apart. Submit the location of construction joints to the Departmental Representative.
- .4 The Contractor is entirely responsible for engineering, locating and building the formworks.
- .5 The formworks are engineered to sustain the loads and lateral pressures described in Section 102 of the American publication "Recommended Practice for Concrete Formwork" (ACI 347). Wind loads are those recommended by the latest edition of the National Building Code.
- .6 Engineering considerations and the allowable loads shall comply with Section 103 of the above-mentioned U.S. publication.
- .7 Every aspect of construction shall always comply with various government Standards (municipal, provincial, and federal Standards) that govern the Contractor's duties regarding worker safety on construction worksites.

1.8 CERTIFICATION OF COMPLIANCE

- .1 When requested by the CNESST, the anchor bolts must be prepared by an Engineer in good standing of the Ordre des ingénieurs du Québec hired by the Contractor.

1.9 QUALITY ASSURANCE

- .1 Retain a professional engineer registered or licensed in Quebec, Canada, with experience in formwork and falsework design of comparable complexity and scope, to perform following services as part of Work of this Section:
 - .1 Design of formwork and falsework;
 - .2 Review, stamp, and sign fabrication and erection Shop Drawings, design calculations and amendments;
 - .3 Conduct on-site inspections and prepare and submit inspection reports verifying this part of Work is in accordance with Contract Documents and reviewed Shop Drawings. Perform inspections a minimum of once per month.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area;
 - .2 Store and protect formwork from damages;
 - .3 Replace defective or damaged materials with new.

Part 2 Products**2.1 MATERIALS**

- .1 Submit all formwork material in direct contact with fresh concrete to the Departmental Representative for review.
- .2 Construction Lumber:
 - .1 in contact with concrete: Form plywood;
 - .2 other: Structural timber not warped and sawed straight.
- .3 Formwork Materials:
 - .1 To pour concrete with no particular architectural characteristics, use forms made of wood and wood products that comply with the CSA O121, CSA O86, CSA O437, CSA O153 Standards;
 - .2 To pour concrete with specific architectural characteristics, use form materials that comply with the CAN/CSA-A23.1/A23.2 Standard;
 - .3 Rigid insulating boards: Complying with CAN/ULC-S701 Standard.
- .4 In the case of exposed formwork surfaces (architectural concrete), use new formwork materials. The forms shall be made of 1,200 x 2,400 x 20 mm thick plywood, sanded and covered with a coat of high-quality form release oil. For lining only, use 7 mm thick three-ply plywood.

Exposed formwork surfaces are those indicated in Section 1.5 of these specifications and those shown on the architectural plans. For lining only, use 7 mm thick three-ply plywood. Exposed formwork surfaces are those indicated in Section 1.5 of these specifications and those shown on the architectural plans.

- .5 Interior formwork liners:
 - .1 Plywood: Douglas fir in compliance with the CSA O121;
 - .2 Waferboard: that complies with the CSA O437.0-93 Standard.
- .6 Form release agent: Non-toxic, biodegradable, and with low VOC content.
- .7 Form release oil: Colourless, non-toxic, biodegradable, low VOC content, mineral oil free from kerosene, whose viscosity is 15 to 24 mm²/s at 40°C and whose flashpoint in an open crucible is at least 150°C.
- .8 Falsework Materials: In compliance with the CSA S269-1, Table 1 Standard. Identify the materials using a quality index or provide certificates, trial data, or other attestations of compliance.
- .9 Form ties can be:
 - .1 Metal ties embedded in concrete, designed to be broken at least 25 mm under the surface of the hardened concrete after the forms have been removed;
 - .2 Fixed or variable length metal ties whose ends are moveable bolts. The part of the tie embedded in the concrete is embedded at least 25 mm under the surface of the hardened concrete;
 - .3 Form ties shall be equipped with moulded water barriers at each end, for all the work. Both ends of these formwork ties shall be equipped with plastic cones at least 25 mm in diameter, which provide a minimum 25 mm of coverage on the broken end of the tie embedded in the concrete.
- .10 In the case of an exposed formed surface (architectural concrete), type 1) or 2) ties shall be equipped with plastic cones a maximum 38 mm in diameter, which provide a minimum 25 mm of coverage.
- .11 In the case of concrete that requires architectural features, use ties equipped with plastic cones and pale grey concrete plugs.
- .12 Sleeves, fasteners, anchors, and other parts embedded in concrete meet the requirements of the drawings and specifications and comply with CAN/CSA-A23.1/A23.2 Standard. Sleeves embedded in concrete shall be equipped with a steel water barrier able to withstand a minimum of 60 kPa of hydrostatic pressure or the pressure in the line if it is greater.
- .13 Pre-moulded Joint Fillers: Pre-moulded resilient bitumen impregnated fibreboards in compliance with the ASTM D1751 Standard. The dimensions required match the joints to be put in place on the drawings.
- .14 Vapour barrier membrane under slabs-on-grade: 0.15 mm thick polyethylene sheets in compliance with the CAN/CGSB-51.33 Standard.

- .15 Bonding agent: three-component cement based and water-based modified epoxy product in compliance with the CAN/CSA-A23.1/A23.2 Standard approved by the Departmental Representative.
- .16 Chemical anchoring system: high-performance two-component (2) structural epoxy adhesive approved by the Departmental Representative.
- .17 Mechanical anchoring system: ultimate performance heavy duty expansion anchor approved by the Departmental Representative.
- .18 Mechanical rebar splicing system: Mechanical rebar system type and color approved by the Departmental Representative. Mechanical splices must develop 120% of the steel rebar's tension.
- .19 Waterstop: sealing strip made of rubberized bitumen with inert hard crushed stone around, 45 mm wide x 33 mm thick, maximum advisable water head of 4 m.

Part 3 Execution

3.1 CONSTRUCTION AND ASSEMBLY

- .1 Unless otherwise specified, build and use the formwork in compliance with the CAN/CSA-A23.1/A23.2 Standard.
- .2 Before using the forms, clean and treat the form surfaces with form release oil in compliance with Section 6.5.3.3 of the CAN/CSA-A23.1/A23.2 Standard.
- .3 Before starting formwork and falsework construction, check the alignments, levels and centrelines, and make sure the dimensions match those indicated on the drawings.
- .4 Build and assemble the formwork in compliance with the CAN/CSA-S269.3 Standard to obtain finished concrete structures whose shape, dimensions and levels comply with the indications and are situated in the locations indicated on the drawings and specifications.

Properly truss the forms and join them so as to keep the desired position and shape while the concrete is being poured and keep them trussed until the concrete has set.
- .5 Location tolerances and tolerances regarding the geometric configuration of components embedded in concrete after removal of the forms according to indications in the drawings shall comply with Section 6.4 of the CAN/CSA-A23.1/A23.2 Standard.
- .6 Manufacture and build the falsework and assemble it in compliance with the CSA S269.1 Standard.
- .7 Obtain the Departmental Representative's written approval before pouring concrete directly on the ground or making openings in a form component, which are not indicated on the drawings, but which may be required for construction purposes.

- .8 Align the formwork joints and seal them to prevent any loss of cement. The formwork shall contain as few joints as possible. Adequate reinforcements shall be installed behind the joints between the plywood panels to ensure that the plywood panels form a smooth, continuous surface capable of withstanding all phases of the pour without losing their shape or shifting.
- .9 Before pouring concrete directly on the ground, level the walls, and bottom of the excavated area, then remove the loose soil.
- .10 Refer to the architectural drawings regarding concrete components with visible architectural finishes.
- .11 The footings and supports installed on the ground shall not be assembled on a frozen surface.
- .12 Design lot drainage to prevent the ground from being washed away from under the footings and the supports installed at ground level.
- .13 Arrange all formwork joints and ties symmetrically on all concrete surfaces that will be visible (architectural concrete) after the forms are removed. Submit for inspection by the Departmental Representative.
- .14 Build the grooves, dovetail joints, mouldings, mortises and tenons, openings, drips, recesses, expansion and construction joints according to the indications of the drawings and specifications.
- .15 Place the formwork, trusses, and supports so workers are able to remove them without causing any shocks or damage to the concrete.
- .16 Forms may be reused except in the case of exposed formed surfaces. They may be reused after sufficient cleaning, providing their surfaces are not cracked or rough; cracked or rough forms must be trimmed and patched to the Departmental Representative's satisfaction.
- .17 Install openings in the forms or other devices to enable workers to inspect and clean the forms, and to enable concrete placement and consolidation.
- .18 Unless otherwise indicated, provide and install in the forms the sleeves, fasteners, anchors and other embedded components required in the drawings and/or specifications of all disciplines, in compliance with CAN/CSA-A23.1/A23.2 Standard. Immediately before pouring the concrete, use surveyor's equipment to check the dimensions required in the drawings and specifications and make sure that these parts meet specified tolerances.
- .19 Before closing the forms, notify the Departmental Representative beforehand to allow him to perform the required inspections. The pouring of the concrete into the forms shall not take place before the Departmental Representative's written authorization has been received.
- .20 Use 25 mm bevelled moulding for exterior corners and/or 25 mm corner guards for the inside corners of beams, walls, slabs, joints, and columns, unless otherwise indicated.
- .21 Build forms for the architectural concrete components and install the ties according to the indications or directives provided. At times, the location of the joints may preclude the use of Standard-sized panels or reduce the maximum allowable space between ties.

- .22 Install a liner inside formwork used for architectural surface.
- .23 If slip forms and flying forms are used, submit details concerning the equipment and procedures for the Departmental Representative approval.

3.2 ANCHORS, SLEEVES, AND EMBEDDED PARTS

- .1 Provide and install in the forms, the sleeves, fasteners, anchor plates and other embedded components required in the drawings and/or specifications, in compliance with CAN/CSA-A23.1/A23.2 Standard.
- .2 Provide and install in the forms, the anchor bolts for fasteners and machinery as shown and detailed in the drawings, in compliance CAN/CSA-A23.1/A23.2 Standard.
- .3 Install in the forms, the sleeves, conduits, and ducts provided by others at the levels and locations shown on the mechanical, electrical, procedural and architectural drawings.
- .4 In all cases, comply with the installation tolerances specified in the CAN/CSA A23.1/A23.2 Standard.
- .5 In slabs, place conduits between the upper and lower rows of reinforcement.
- .6 Install sleeves, conduits and ducts in compliance with the following requirements:
 - .1 The exterior diameter of the sleeves, conduits or ducts shall not exceed one third of the thickness of the beams, slabs or walls in which they are embedded;
 - .2 The centreline between adjacent components must be greater than or equal to three diameters;
 - .3 These parts shall not be positioned in a manner that reduces the strength of the structure;
 - .4 These parts shall not be embedded in ground slabs exposed to the weather.
- .7 If the requirements of Article 3.2.6 cannot be met, notify the Departmental Representative and await his instructions on how to proceed.
- .8 Make sure aluminium sleeves, conduits, or ducts embedded in concrete are covered or adequately coated to protect them against aluminum corrosion.
- .9 Submit a sleeve location plan for approval by the Departmental Representative.
- .10 Coordinate with subcontractors responsible for their supply the delivery (to the construction site) and the installation in the formwork of accessory parts.
- .11 It is forbidden to place in the formwork any accessory parts which are not indicated in the drawings or required in the specifications or the drawings referred to in Sub-article .2 above, unless the Departmental Representative so authorizes.

3.3 REMOVAL OF THE FORMS AND REINSTALLATION OF THE SUPPORTS

- .1 Remove the formwork and dismantle the falsework in compliance with Article 6.5.3.5 of the CAN/CSA-A23.1/A23.2 Standard, unless otherwise indicated.
- .2 Do not disturb or remove the formwork or falsework as long as the concrete has not become strong enough to support its own weight and the load it supports.
- .3 Have the Departmental Representative authorize the removal of the formwork and falsework.
- .4 Leave the formwork in place after the concrete has been poured for the following lengths of time:
 - .1 Walls and beam sides: 3 days;
 - .2 Slabs and beam's soffits: 28 days or 3 days if all removed support to allow removal of each formwork panel are reinstalled immediately in 30 minutes or less and remain in place until expiry of the deadline. of 28 days;
 - .3 Columns: 7 days;
 - .4 The periods of time specified above represent a cumulative number of hours, days or fractions of days, not necessarily consecutive, during which the ambient temperature is maintained above 10°C.
- .5 Reinstall all the supports required when frame components might be subject to additional loads during construction of the structure.
- .6 Notwithstanding the provisions of Sub-article .4 above, do not remove the forms unless the Departmental Representative authorizes their removal because he is satisfied with the measures taken to ensure the concrete cures properly and the concrete is protected against cold or heat and the weather.
- .7 However, the Departmental Representative may cancel the provisions of Sub-article .4 above if the non-destructive trials on the concrete placed in beam and slab forms indicate that the concrete has achieved 80% of the compression strength specified in Section 03 30 00 of these specifications. The non-destructive trials mentioned above shall have a recognized value and be approved by the Departmental Representative; he will determine beforehand the locations where they are to be performed. The costs of all these trials shall be borne by the Contractor.
- .8 Even when the Departmental Representative has authorized him to remove the forms, the Contractor remains solely responsible for all damage caused to concrete components if action is taken prematurely.
- .9 Depending on weather conditions, the placement of the concrete and curing conditions, the Departmental Representative may specify a minimum period of time that must elapse before the forms are removed from the various pours.
- .10 Reuse the formwork and falsework, notwithstanding the requirements of the CAN/CSA-A23.1/A23.2 Standard.

- .11 The maximum spacing between the supports reinstalled at each of the main load inflection points is 2,400 mm.

3.4 FILLING OF FORM TIE HOLES

- .1 Fill all cone-shaped cavities left after removal of the plastic cones at the ends of the form ties. Moisten beforehand as required by the manufacturer. Carefully smooth the surface after applying the mortar so that it blends in with the adjacent concrete surfaces. Allow to cure.
- .2 In the case of exposed surfaces (architectural concrete), check with the Departmental Representative whether the cone-shaped cavities need to be filled. Have the Departmental Representative approve the filling products used. The products used shall be of the same texture and colour as the concrete utilized.

3.5 JOINT FILLER

- .1 Locate and form isolation and / or expansion joints according to the indications provided. Install the joint filler.
- .2 Unless otherwise indicated on the drawings, use a 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces, and a 25 mm joint filler to separate slabs-on-grade from one another at the required locations.

3.6 VAPOUR BARRIER MEMBRANE

- .1 Install a vapour barrier membrane under concrete slabs-on-grade located inside buildings.
- .2 At locations where there are joints, overlap the sides of the polyethylene sheets by at least 150 mm.
- .3 Repair any perforations in the vapour barrier membrane before pouring the concrete. Use pieces that extend at least 150 mm beyond all the edges of the perforations.

3.7 JOINT CAULKING

- .1 Remove dust, loose mortar, and other foreign material and dry the surfaces of the joint.
- .2 Prepare the surfaces in compliance with the caulking manufacturer's instructions.
- .3 Clear the joint to the required depth to install a backer rod. This will allow the application of a layer of caulking that complies with the manufacturer's recommendations for the width of the joint involved.
- .4 Apply the primer on the contact surfaces, and then apply the caulking following the manufacturer's recommendations. Clean adjacent surfaces immediately after application.

3.8 WATERPROOFING THE JOINTS

- .1 Refer to the drawings to determine which construction joints need to be sealed with waterstops. Even if there are no indications on the drawings, all joints below the grade shall be sealed with waterstops.
- .2 Take care not to deform or damage the waterstops when fastening them to the form. Avoid moving adjacent reinforcements and ensure the waterstops cannot shift or bend during the pour.
- .3 Butt weld the waterstops together, following the manufacturer's recommendations. Each weld shall be perfectly watertight. Butting waterstops together on the construction site is only permitted in the case of waterstop segments that are an extension of one another.

3.9 IMPLEMENTATION – BINDING AGENT

- .1 Dry or wet sandblast the surfaces to clean them and remove all traces of grease, oil or rust, as well as loose aggregate.
- .2 Moisten the surface of the concrete to obtain a saturated, superficially dry substrate.
- .3 Following the manufacturer's recommendations, use a stiff brush or a roller to apply a 0.5 mm coat over the entire area to be bound.
- .4 Place the repair concrete within the maximum time limits prescribed by the manufacturer.

3.10 IMPLEMENTATION – CHEMICAL ANCHORING SYSTEM:

- .1 Drill a hole 4 mm wider than the bar to be anchored.
- .2 Make sure the drill hole is clean, dry, free of clay, debris and cement dust. The holes shall be drilled with a hammer drill and cleaned with compressed air.
- .3 Prepare and apply epoxy resin according to the recommendations provided on the manufacturer's data sheet.
- .4 Where possible, partially fill the hole with epoxy and insert the bar. If not, introduce the rod and inject epoxy resin.
- .5 Anchor the rod in the concrete to a depth at least 15 times the diameter of the bar unless otherwise indicated.

END OF SECTION

Part 1 General**1.1 DESCRIPTION**

- .1 Provide all expertise, labour, materials, products, equipment and services needed to supply, detail, manufacture and install all the reinforcement steel shear heads, dowels, metallic wires that must be incorporated in the concrete components indicated in the structural drawings.

1.2 RELATED REQUIREMENTS

- .1 03 10 00 – Concrete forming and accessories
- .2 03 30 00 – Cast-in-place concrete

1.3 REFERENCE STANDARDS

- .1 American Concrete Institute (ACI):
 - .1 SP-66-04, ACI Detailing Manual 2004.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A123/A123M - 15 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products;
 - .2 ASTM A143/A143M-07 (2014), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement;
 - .3 ASTM A641/A641M-09a(2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire;
 - .4 ASTM A775/A775M-17, Standard Specification for Epoxy-Coated Reinforcing Steel Bars;
 - .5 ASTM A884/A884M-14, Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement;
 - .6 ASTM A 1064/A 1064M-17, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .3 Canadian Standards Association (CSA):
 - .1 CSA A23.1-F14 /A23.2-14, Béton: Constituants et exécution des travaux/Méthodes d'essai et pratiques normalisées pour le béton;

- .2 CAN/CSA-A23.3-14, Calcul des ouvrages en béton;
 - .3 CSA G30.18-09 (C2014), Carbon Steel Bars for Concrete Reinforcement;
 - .4 CSA G40.20/G40.21-13 (C2014), Exigences générales relatives à l'acier de construction laminé ou soudé/Acier de construction;
 - .5 CSA W186-M1990 (C2016), Soudage des barres d'armature dans les constructions en béton armé.
- .4 Reinforcing steel institute of Canada (RSIC/IAAC):
- .1 RSIC-2004, Reinforcing steel, Manual of Standard Practice.

1.4 SAMPLING, TRIALS AND INSPECTION

- .1 Always provide the Departmental Representative with free access to the plant and the construction site to enable him to verify, examine and supervise the quality of materials and their manufacture, and if required, take samples for testing, trial, and analytical purposes.
- .2 Pouring of the concrete is not authorized before the Departmental Representative has inspected and approved the reinforcement in place.
- .3 At his request, send the Departmental Representative one (1) copy of the certificates issued by the steel mill attesting to the chemical composition and physical properties of the steel used to manufacture the reinforcement.
- .4 Upon request, inform the Departmental Representative regarding the proposed source of supply for the materials to be provided.

1.5 SHOP DRAWINGS

- .1 Submit for review and comments by the Departmental Representative, all shop drawings for all steel reinforcement for the work in compliance with the following requirements.
- .2 The format of the reinforcement drawings shall be the same as that of the drawings upon which they are based. The full project title and the name of the Ministry and the Contractors shall appear on each drawing.
- .3 Submitted drawings will be in the form of one (1) electronic copy of each reinforcement drawing. One (1) copy of each order slip will accompany the drawings. One (1) electronic copy of the commented shop drawings will be returned to the Contractor.
- .4 Drawings must bear the seal and signature of a qualified Engineer licensed or licensed to practice in the Province of Quebec, Canada.

- .5 The reinforcement drawing shall clearly indicate:
 - .1 The number, nominal diameter, length, position, spacing, and bending details of each type of bar shown on the drawings;
 - .2 The bar-supports, separators, additional bars and other accessories required to support and fasten the reinforcements while the concrete is being poured.
- .6 When not specified in the drawings:
 - .1 Reinforcement overlap and sealing lengths shall comply with the requirements of Articles 7 and 12 of the CAN/CSA-A23.3 Standard. Unless otherwise indicated on the drawings, all overlaps shall be Class B (1.3 Lc), in compliance with Table 17b: pre-stressed overlapping requirements for upper reinforcement in the Reinforcing Steel Institute of Canada's manual of Standard practice.;
 - .2 Overall dimensions of hangers, ties, and coils shall comply with the minimum concrete cover thicknesses stipulated in Article 6.6.2 of the CSA-CSA A23.1/A23.2 Standard.
- .7 Unless otherwise indicated in the drawings, the hooks required at the end of certain bars, including hangers, ties and spirals are all "Standard hooks", which shall comply with the description provided in Articles 6.6.2 of the CSA A23.1/A23.2 Standard.
- .8 The reinforcement shall be marked so that it is quick and easy to find on the purchase orders.
- .9 The Contractor shall provide shop drawings so the Departmental Representative has at least ten (10) working days to examine and comment on the shop drawings, which are submitted at each phase of the concrete work.
- .10 The reviewed shop drawings, which may or may not be annotated by the Departmental Representative, shall be returned to the Contractor, who shall revise these drawings and resubmit them to the Departmental Representative for review and comment, if required. However, if the Departmental Representative finds that too many revisions are required, he shall return the drawings without annotating them; in addition, if the drawings need to be submitted more than twice, the Departmental Representative shall withhold funds from the Contractor to pay for the cost of the Departmental Representative's additional reviews.
- .11 The Contractor is solely responsible for the accuracy of his drawings; he cannot claim any supplement for delays caused by the discovery, on site, of errors or omissions on his own drawings, even if they have been reviewed by the Departmental Representative.
- .12 Unless otherwise indicated, use steel reinforcement details that comply with the most recent edition of the "Manual of Standard Practice" published by the "Reinforcing Steel Institute of Canada", last Edition.
- .13 Wait for final approval of the shop drawings before cutting and bending the rebar.

- .14 Submit the steel schedules that match the various shop drawings at the same time as the shop drawings.

Part 2 Products

2.1 MATERIALS

Description	Standards
▪ High adherence billet-steel reinforcement bars, regular category (R).	CAN/CSA G30.18 Grade 400
▪ Weldable high adherence steel reinforcement bars made of low alloy weldable steel, weldable category (W).	CAN/CSA G30.18 Grade 400
▪ Tie wire, annealed cold-drawn steel wire	ASTM A1064/A1064M
▪ High adherence steel wire for concrete reinforcement, 16 gauge	ASTM A1064/A1064M
▪ Welded steel wire fabric provided in flat sheets only	ASTM A1064/A1064M
▪ High adherence welded steel wire fabric in flat sheets only	ASTM A1064/A1064M
▪ Chairs, bar chairs, bar supports, spacers (rustproof)	CSA A23.1/A23.2
▪ Metal coupling	Reinforcement steel, "recommended Standards manual" subject to the Departmental Representative's approval
▪ Round and plane rebars	CSA-G40.21

2.2 SUBSTITUTES

- .1 Obtain the Departmental Representative's written approval to substitute specified bars with bars of different dimensions, and to change spacing, overlapping or bending specified on the drawings.

2.3 FORMING

- .1 Form the bars at the factory, in compliance with requirements of the CAN/CSA-A23.1/A23.2 Standard.
- .2 Unless otherwise indicated, forming tolerances are those indicated in Chapter 6 of the "Manual of Standard Practice" published by the "Reinforcing Steel Institute of Canada". Bars that do not comply with these tolerances shall be rejected.

2.4 IDENTIFICATION

- .1 Clearly identify bar and wire fabric lots to conform to the shop drawings and steel schedules before shipping them to the construction site.
- .2 Use factory-labelled reinforcement bars. The label identifies the size, quality and manufacturer of the bar. All unlabelled bars shall be rejected.

Part 3 Execution**3.1 ON-SITE BENDING**

- .1 Unless otherwise expressly indicated or authorized by the Departmental Representative, do not bend steel reinforcement bars on the construction site.
- .2 It is forbidden to bend rebar partially embedded in hardened concrete on site unless the Departmental Representative has authorized this procedure.

3.2 MANUFACTURE OF REINFORCEMENT

- .1 The manufacture of the reinforcement shall not start until the Departmental Representative has reviewed the drawings of this reinforcement.
- .2 Cut and bend the bar in strict compliance with the details shown on the drawings and in accordance with the requirements of the CAN/CSA-A23.1/A23.2 Standard.
- .3 No substitution of the bars shown on the reinforcement drawing shall be allowed without the Departmental Representative's authorization.
- .4 Take every precaution to avoid deforming or dirtying the reinforcement during transportation, handling, and storage.

3.3 REINFORCEMENT INSTALLATION

- .1 Assemble and install the rebar with care and tie them with black annealed drawn steel wire. Use a pattern and number of supports that comply with Section 6.6.7 of the CAN/CSA-A23.1/A23.2 Standard.
- .2 Install the rebar and keep them in place during the pouring of the concrete in compliance with the tolerances stipulated in Section 6.6.8 of the CAN/CSA-A23.1/A23.2 Standard.
- .3 Unless otherwise indicated on the drawings or in Section 3.6 of these specifications, the minimum concrete cover thickness around reinforcement bars is that stipulated for each of the various structural components in Article 6.6.6 of the CAN/CSA A23.1/A23.2 Standard.

- .4 If required, before placing the rebar in the formwork, remove all excess rust, scale, mud, oil and any other dirt likely to reduce the concrete's adherence.
- .5 Use an adequate number of support bars of the height and rigidity required to ensure all concrete coverage of the rebar complies with the thicknesses stipulated on the drawings and in the Standards.
- .6 Have the Departmental Representative approve the rebar and its installation, before pouring the concrete. The Departmental Representative shall have 48 hours to approve the steel reinforcement before the concrete is poured.

3.4 OVERLAPS

- .1 Overlap the reinforcement as indicated on the drawings and typical details.
- .2 Overlapping lengths and extension lengths of bars beyond critical points shall comply with the CSA-A23.3 Standard. Unless otherwise indicated on the drawings, all overlaps shall be Class B (1.3 Lc), in compliance with Table 17b: tension overlapping requirements for upper reinforcement in the Reinforcing Steel Institute of Canada's manual of Standard practice.
- .3 Obtain the Departmental Representative's approval for the locations of reinforcement overlaps other than those shown on the drawings.
- .4 Overlap the wire fabric sheets on at least two meshes without ever being less than 150 mm wide.

3.5 WELDING

- .1 Do not weld steel rebar, unless authorized in writing by the Departmental Representative.
- .2 Where permitted by the Departmental Representative, perform the rebar welding work in compliance with Section 6.6.10. of the CAN/CSA-A23.1/A23.2 Standard and the requirements of the CSA W186 Standard. When welding is performed, the use of category W weldable bars is mandatory.
- .3 All welding work shall be assigned to a company accredited by the Canadian Welding Bureau and shall be performed in compliance with the requirements of the most recent version of the CSA W186 Standard. Prior to starting any welding work, submit to the Departmental Representative for verification, all details regarding the welds to be performed. In this case, the steel reinforcement to be welded shall comply with the requirements of the most recent version of the CSA G30.16 Standard. Pre-heat all steel reinforcement as required by these Standards.

3.6 REINFORCEMENT COVERAGE

- .1 Unless otherwise indicated on the drawings, the reinforcement bars shall be installed at the following specific distances from the surface of the concrete:

	Coverage
A) Concrete poured directly on the ground	75 mm
B) Concrete exposed to the ground or the weather	
a) Bars larger than 15 M in walls and slabs or main bars in beams and columns	40 mm
b) Bars 15 M or smaller	40 mm
c) Ties, hangers and spiral reinforcement	40 mm
C) Concrete not exposed to the weather Class N	
a) Slabs (other):	
- top steel rebar	25 mm
- bottom steel rebar	25 mm
b) Curbs and coping	50 mm
c) Beams (main steel rebar)	40 mm
d) Columns (main steel rebar)	50 mm
e) Walls	25 mm
f) Ties, hangers and column's spiral reinforcement	40 mm
D) Concrete exposed to chlorine (exposure Classes C-1, C-XL, C-3 and C-4)	The reinforcement coverage shall not be less than any of the following values; <ul style="list-style-type: none"> - 60 mm - twice the nominal diameter of the reinforcement - twice the maximum nominal diameter of aggregates

- .2 For conditions A-B-C of the preceding table, the ratio between coverage and the maximum size of the aggregate as well as the ratio between the coverage and the nominal diameter of the bars shall be at least 1.5 for concrete exposed to the ground and weather, and 1.0 for concrete not exposed to the ground and weather.

3.7 STORAGE AND DELIVERY

- .1 Deliver the reinforcement and wire fabric to the construction site in clearly identified lots.
- .2 Handle the reinforcement and wire fabric with care to avoid deforming them.
- .3 As soon as they are delivered on site, properly stack the steel reinforcement and wire fabric on wood skids to protect them against rust and keep them off the ground, water, or snow.
- .4 Cover all stored steel with a woven tarp to protect it from the weather.

- .5 During transportation and handling, use a covering to protect the parts of the bars coated with epoxy and paint.

3.8 CLEANING

- .1 For the pouring of the concrete to take place, the condition of the reinforcement bars shall comply with Section 6.1.5 of the CAN/CSA A23.1/A23.2 Standard.
- .2 If required, clean the reinforcement immediately before the concrete is poured.

3.9 REINFORCEMENT DOWELLING

- .1 The installation of reinforcement dowels in concrete that has already been poured shall be performed using a Hilti HIT, HY-150 epoxy-based system.
- .2 The sealing length of the dowels is that indicated in the sealing lengths table provided on the drawings.
- .3 Certain types of dowels shall have conical threads designed to work with anchors equipped with conical threads.

3.10 ON-SITE TOUCH-UPS

- .1 Using a compatible finishing product, touch up damaged or cut ends of galvanized or epoxy-coated reinforcement to provide a continuous coat.

END OF SECTION

Part 1 General**1.1 DESCRIPTION**

- .1 This section specifies the requirements regarding the providing, placement, finishing, protection and curing of the cast-in-place concrete.

1.2 RELATED REQUIREMENTS

- .1 03 10 00 – Concrete forming and accessories
- .2 03 20 00 – Concrete reinforcement
- .3 03 35 00 – Finishing of concrete slabs
- .4 05 31 00 – Steel decking
- .5 31 23 33.01 – Excavating, trenching and backfilling

1.3 REFERENCE STANDARDS

- .1 The following Standards and Publications are mentioned in this section of the specifications. They form an integral part of the specifications and their provisions apply but are not limited by the other provisions of this section.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C260/C260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete;
 - .2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete;
 - .3 ASTM C494/C494M-16, Standard Specification for Chemical Admixtures for Concrete;
 - .4 ASTM C 881/C 881M-15, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete;
 - .5 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete;
 - .6 ASTM C 1059/C 1059M-13, Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete;
 - .7 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension;

- .8 ASTM D624-2012, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer;
- .9 ASTM D1751-04 (2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types);
- .10 ASTM D1752-04a (2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .4 Canadian Standards Association (CSA):
 - .1 CAN/CSA-A23.3-14, Design of Concrete Structures;
 - .2 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete;
 - .3 CSA A283-06 (R2016), Qualification Code for Concrete Testing Laboratories;
 - .4 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.4 SAMPLES

- .1 At least four (4) weeks before beginning the work, advise the Departmental Representative regarding the proposed source of supply for the aggregates, and allow him to access the source for sampling purposes.

1.5 CERTIFICATES

- .1 At least (4) weeks prior to starting concrete work, provide the Departmental Representative with copies of the manufacturer's trial reports, as well as a certificate issued by a qualified independent testing and inspection laboratory attesting that the materials listed hereinafter will comply with the 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 the mix formulas for approval by the Departmental Representative and a certificate attesting that the selected mix will produce concrete of the required quality, strength and performance, and that it complies with the requirements of the CSA-A23.1/A23.2 Standard.
- .3 Provide a certificate attesting that the batching plant, equipment and materials that will be used to produce the concrete comply with the requirements of the CSA-A23.1/A23.2 Standard.
- .4 The Departmental Representative's acceptance of the cement mix or mixes shall in no way release the Contractor from his responsibility to provide concrete whose properties, in both its elastic and hardened states, meet the requirements of these specifications.
- .5 All documents will be submitted in one (1) electronic copy. One (1) annotated electronic copy will be returned to the Contractor.
- .6 Certification for Sustainable Development:
- .1 Construction Waste Management: Provide a copy of the drawing;
 - .2 Content of recycled content (recycled content):
 - .1 Provide a list of products containing recycled materials, which will be used, with specification for the required percentage of recycled material, which should indicate the cost of these products and their percentage of pre-consumer and post-consumer recycled content, as well as the total cost. for recycled products / materials / materials that will be incorporated into the project;
 - .2 If applicable, provide a document certifying the percentage of cementitious additions used to replace cement in the manufacture of concrete.

1.6 QUALITY ASSURANCE

- .1 At least four (4) weeks prior to starting concrete work, submit proposed quality control methods for approval by the Departmental Representative, regarding the following items:
 - .1 Erection of temporary shoring works;
 - .2 Hot weather concreting;
 - .3 Cold weather concreting;
 - .4 Curing;
 - .5 Finishes;
 - .6 Stripping;
 - .7 Joints.

Part 2 Products**2.1 MATERIALS**

- .1 Cement: Type GU and/or Gub Portland cement that complies with the CSA-A3001 Standard. Use a single recognized brand of cement, by type of concrete for the entire contract.
- .2 Fine aggregate: Of normal density, complying with Article 4.2.3 of the CSA-A23.1/A23.2 Standard. The aggregate may be natural sand or manufactured sand containing at least 20% natural sand.
- .3 Coarse aggregate: of normal density, complying with CSA-A23.1/A23.2 Standard. The particles shall be clean, durable and free from dust and harmful materials. The maximum aggregate size shall be 20 mm, unless otherwise indicated. Subject to the Departmental Representative's approval, a 13 mm maximum aggregate size may be used in certain areas where concrete flow is restricted. Coarse aggregates must be of normal density. The quantity of flat and elongated particles shall be in accordance with Table 12 of CSA-A23.1 / A23.2 Standard.
- .4 Mixing Water: Complies with CSA-A23.1/A23.2 Standard.
- .5 Air-entraining Admixture: Complies with the ASTM C260 Standard.
- .6 Chemical and Pozzolanic Mineral Admixtures: Comply respectively with the requirements of the ASTM C494/C494M and ASTM C1017/C1017M Standards. The use of calcium chloride or admixtures that contain calcium chloride is not allowed. The Departmental Representative must approve accelerators or retarders during hot and cold weather concrete work.
- .7 Non-shrink mortar for concrete repairs: pre-mixed Portland cement-based product containing a non-metal aggregate and a plasticizer, capable of achieving at least 35 MPa of compression strength at seven (7) days.
- .8 Superplasticizer: Complies with requirements of the ASTM C494/C949M Standard.

- .9 Supplementary Cementing Materials: Comply with the CSA-A3001 Standard.
- .10 Cementitious Hydraulic Slag: Complies with the CAN/CSA-A3000 Standard.
- .11 Set Retarders: Comply with the ASTM C494/C494M water-based, low VOC content, solvent-free Standard. The set retarder film shall never be exposed to humidity.

2.2 MIX DESIGN

- .1 Assume responsibility for the mix of each type of concrete required, while taking into account the requirements described in Section 2.1 of these specifications and the following criteria in compliance with possibility No. 1 presented in Table 5 of the CSA-A23.1/A23.2 Standard:

- .1 Type of concrete:

- a) Concrete for foundation walls:

- Tested compressive strength: 30 MPa at 28 days;
 - Exposure category (Table No. 1, CSA-A23.1/A23.2): F-2;
 - Maximum nominal size of coarse aggregate: 20 mm;
 - Air content: 4 to 7%;
 - Chemical admixtures: comply with the ASTM C494/C494M Standard;
 - Normal density concrete.

- b) Concrete for footings and interior columns:

- Tested compressive strength: 30 MPa at 28 days;
 - Exposure category (Table No. 1, CSA-A23.1/A23.2): N;
 - Maximum nominal size of coarse aggregate: 20 mm;
 - Chemical admixtures: comply with the ASTM C494/C494M Standard;
 - Normal density concrete.

- c) Concrete for slabs on grade:

- Tested compressive strength: 25 MPa at 28 days;
 - Exposure category (Table No. 1, CSA-A23.1/A23.2): N;
 - Maximum nominal size of coarse aggregate: 20 mm;

- Chemical admixtures: comply with the ASTM C494/C494M Standard;
 - Normal density concrete.
- c) Concrete for foundation walls of exterior access ramp, sidewalks, curbs, slab on grade in garage area, exterior slabs and bases:
- Tested compressive strength: 35 MPa at 28 days;
 - Exposure category (Table No. 1, CSA-A23.1/A23.2): C-1;
 - Maximum nominal size of coarse aggregate: 20 mm;
 - Air content: 5 to 8%;
 - Chemical admixtures: comply with the ASTM C494/C494M Standard;
 - Normal density concrete.
- d) Concrete for slabs on steel deck:
- Tested compressive strength: 30 MPa at 28 days;
 - Exposure category (Table No. 1, CSA-A23.1/A23.2): N;
 - Maximum nominal size of coarse aggregate: 14 mm;
 - Chemical admixtures: comply with the ASTM C494/C494M Standard;
 - Normal density concrete.
- e) Lean concrete:
- Minimum tested compressive strength: 15 MPa at 28 days;
 - Exposure category (Table No. 1, CSA-A23.1/A23.2): N;
 - Normal density concrete.
- .2 Obtain the Departmental Representative's approval for all admixtures used in concrete mixes (superplasticizers and required air-entrainers or other admixtures needed for any specific purpose, designated by the Contractor). The use of calcium chloride is prohibited.
- .3 Provide a sample of the admixture(s) used, at the Departmental Representative's request.
- .4 Follow the manufacturer's instructions when using admixtures.

- .5 The Contractor is responsible for ensuring the admixtures are compatible with one another and with the materials included in the mix.
- .6 Enter the type and quantity of the admixture(s) used on the concrete shipping slip.
- .7 The use of an admixture shall never reduce the soundness of the concrete or its ability to withstand freezing and thawing.

2.3 CONCRETE CONTROL

- .1 Concrete quality control performed in compliance with the CSA-A23.1/A23.2 Standard by a laboratory designated by the Departmental Representative.
- .2 Submit to the laboratory for approval, proposed formulas for batching the mixes for each class of concrete; specify the type and brand of all admixtures used.
- .3 Provide the laboratory with samples of the fine and coarse aggregates that will be incorporated into the concrete blends and identify the quarry they come from.

Unless otherwise directed in writing by the Departmental Representative, also provide the laboratory with a document signed by a recognized petrographer certifying that none of the harmful alkali-aggregate and cement-aggregate reactions described in Appendix B of the CSA-A23.1/A23.2 Standard are likely to occur in the concrete after it has been poured.

- .4 Notify the laboratory at least 24 hours before each concrete pour, whatever the volume involved.
- .5 Cooperate with sampling and facilitate testing. Provide free access to the structures. Provide the required concrete at no cost. If applicable, protect and provide a storage area for the samples taken.
- .6 The concrete's compression strength shall be checked during construction by taking 3 core samples per 75 m³ poured or at least 3 core samples per pour. The Departmental Representative may ask the laboratory to produce a fourth core sample and let it cure on the construction site as a control sample. A sample shall be crushed on the 7th day; the two other samples shall be crushed on the 28th day.
- .7 The cylinders shall be numbered consecutively, and the laboratory report shall indicate the exact location of the concrete they represent in the framework, as well as the number of the truck that delivered the concrete.
- .8 The laboratory shall measure the concrete slump and air content every time it samples the concrete for strength tests and as often as necessary depending on the type of structure to be built.
- .9 Provide a sheltered location on site where the concrete core samples can be stored at an ambient temperature ranging from a minimum of 10°C to a maximum of 25°C before they are shipped to the trial laboratory.

- .10 If the core sample test results do not comply with Article 4.4.6.6 of the CSA A23.1/A23.2 Standard, the Departmental Representative may require that Article 4.4.6.7 of the Standard be applied.
- .11 The Contractor is solely responsible for the all concrete work required to complete the structures as indicated on the drawings or stipulated in the Specifications.

All work that does not meet the requirements of the Specifications, for any reason whatsoever (quality of materials, batching, placement, strength, impermeability, etc.), shall be modified in compliance with the Departmental Representative's requirements, or it shall be completely demolished and rebuilt in compliance with the provisions of the Specifications and drawings, at the Contractor's expense.

Part 3 Execution

3.1 PREPARATION

- .1 Ensure that the forms are erected and that they are clean and free of ice, snow, and water, and that form reinforcement and hardware are installed in compliance with the requirements of Sections 03 10 00 and 03 20 00 of the specifications.
- .2 Before starting the work, obtain the Departmental Representative's approval of the concrete placement methods, which shall comply with Section 7.2 of the CAN/CSA-A23.1/A23.2 Standard.
- .3 Obtain the Departmental Representative's written authorization before performing the concrete work and notify him 24 hours before beginning the work. To notify the Departmental Representative, the "Concrete notice" form provide by the latter must be used and duly completed by the Contractor.
- .4 When concrete is pumped, concrete formulas must be adjusted accordingly. The concrete must maintain its characteristics until the exit of the pump's pipe.
- .5 Ensure that the reinforcement and embedded components are not moved while the concrete is being poured.
- .6 Before performing the concrete work, obtain the Departmental Representative's written authorization regarding the proposed method for protecting the concrete during the pour and the subsequent cure.
- .7 No concrete shall be poured without the Departmental Representative's written authorization.
- .8 Authorization to pour concrete shall only be provided once the Departmental Representative has completed his own inspection of the formwork and determined that the requirements of Article 3.1 appear to have been met.

- .9 It is forbidden to pour concrete when it is raining or snowing, unless the Departmental Representative provides the required authorization, being satisfied with the measures taken to shelter the concrete while it is being transported and placed.
- .10 The Departmental Representative's authorization to pour concrete when the outside temperature is below 5°C or above 25°C shall in no way release the Contractor from his full responsibility regarding the strength and soundness of the concrete to be poured.
- .11 Keep a concrete placement log, which indicates the date and location of each placement, the concrete's characteristics, the truck numbers, the ambient temperature, samples taken and other relevant information.
- .12 Immediately before placing the concrete, carefully clean and remove all waste and debris of any kind from the space the concrete will occupy.
- .13 In areas where new concrete is bonded to an existing structure, drill holes in the existing concrete and install steel dowels made of high adherence steel rebar in it and thoroughly embed the dowels with non-shrink epoxy grout to anchor and maintain them in the positions indicated.
- .14 No load shall be exerted on the new concrete components until the Departmental Representative has provided the required authorization.

3.2 MANUFACTURE AND DELIVERY OF THE CONCRETE

- .1 Provide ready-to-use concrete manufactured in a concrete plant, transported and discharged at the site in compliance with Section 5.2 of the CAN/CSA-A23.1/A23.2 Standard, or provide concrete manufactured on site, in compliance with all the requirements of that same section. If the second alternative is chosen, submit the entire procedure to the Departmental Representative for approval.
- .2 The manufacturer of the ready-to-use concrete is solely responsible for batching the concrete, and he shall personally, at his expense, take all necessary measures to ensure the quality and uniformity of his product.
- .3 Require that the concrete supplier provide a delivery slip for each load of concrete and provide the Departmental Representative with a copy of these slips. The slips shall contain the following information: name and address of the supplier's company, truck number, Contractor's name, project name and location, class of concrete, cumulative quantity, start of discharge, end of discharge, maximum size of aggregate, slump and air-entrainment required, types of admixtures used, quantity and type of cement and quantity of water.
- .4 The addition of water to the mix after the initial batching shall only be carried out in strict adherence with Article 5.2.5.3.2 of the CAN/CSA-A23.1/A23.2 Standard. Submit all anticipated additions to the Departmental Representative for approval and control. Indicate on the delivery slip the quantity of all water added at discharge.

- .5 Plan the manufacture of the concrete and schedule the deliveries to the site so that each pour can be performed without any interruptions. Each batch of concrete shall be completely discharged into the forms within two (2) hours of beginning of batching.
- .6 Never remix concrete or mortar that has started to set.
- .7 The temperature of the concrete at discharge shall be within the range presented in Table 1 of the CAN/CSA-A23.1/A23.2 Standard and shall be controlled according to Article 5.2.5.4 of the same Standard. Use all protective measures required for this purpose.
- .8 No aluminum component shall be used to batch, transport or place the concrete.

3.3 IMPLEMENTATION

- .1 Place the concrete in compliance with the requirements of the CAN/CSA-A23.1/A23.2 Standard.
- .2 Carry out the consolidation of the concrete using models and sizes of mechanical vibrators approved by the Departmental Representative.
- .3 Select an appropriate type and number of vibrators and use them in accordance with Article 7.4.4.2 of the CAN/CSA-A23.1/A23.2 Standard.
- .4 Bind the fresh concrete with rock or hardened concrete in accordance with Section 7.2 of the CSA-A23.1/A23.2 Standard.
- .5 Saturate hardened concrete surfaces with water immediately before pouring concrete on these surfaces.
- .6 Lay the concrete without interruption or in layers thick enough that each new layer will bind with the underlying layers before they have hardened enough to form cold joints.
- .7 If difficulties arise during pouring, change the concrete formula following the laboratory's directives and use the admixture(s) prescribed by the laboratory, and assume all expenses for this procedure.
- .8 Adding a superplasticizer to the concrete before it has been poured into the forms is mandatory when pouring walls (including retaining walls) and columns.

3.4 CONCRETE CURING

- .1 The concrete shall be cured according to the requirements of section 7.7 of the CSA-A23.1/A23.2 Standard. Walls and slabs 500 mm thick or thicker are considered mass concrete.
- .2 The use of curing compounds is prohibited.
- .3 The concrete of walls and other vertical elements shall be cured using two layers of jute kept moist at all times.

- .4 The concrete of slabs shall always be cured using a using a cover kept moist.
- .5 Slabs and other unformed surfaces shall be kept moist for a period of at least 7 days.
- .6 Walls, beams, columns, and other formed surfaces shall undergo the following 7-day curing schedule:
 - .1 Forms left in place: 3 days;
 - .2 Moist curing after removal of the forms: 4 days.
- .7 When the outside temperature exceeds 20°C for mass concrete or otherwise 27°C, keep the forms moist before pouring the concrete and throughout the entire time they remain in place.
- .8 In cold weather, water curing ends 12 hours before the end of protection.
- .9 Throughout the entire cure, the concrete shall never be under any load and shall be adequately protected against violent shocks, excessive vibration, weather, and other disturbances.
- .10 The provision, installation, and maintenance of all falsework and devices required for the curing and protection of the concrete in hot or cold weather, as well powering the equipment, are part of the contract work, for which all costs are to be assumed.

3.5 CONCRETE PROTECTION

- .1 In hot weather, the concrete shall be protected according to Article 7.1.1 of the CSA-A23.1/A23.2 Standard.
- .2 Other concrete components shall be protected from dryout based on Appendix D of the CSA-A23.1/A23.2 Standard.
- .3 In cold weather, the concrete shall be protected according to Article 7.1.2 of the CSA-A23.1/A23.2 Standard.
- .4 Methods for protecting concrete are detailed in Article 7.5 of CSA-A23.1/A23.2 Standard.

3.6 FINISHING OF FORMED SURFACES

- .1 Clean and finish the formed surfaces in compliance with Section 7.9 of the CSA-A23.1/A23.2 Standard. Visible surfaces in completed buildings require smooth formed surfaces in accordance with Article 7.9.2.6 of the CSA-A23.1/A23.2 Standard. All other surfaces require a rough formed surface in accordance with Article 7.9.2.5 of the CSA A23.1/A23.2 Standard.
- .2 Fill the holes left by the form ties in compliance with Section 03 10 00 – concrete forming and accessories of these specifications.

3.7 EXPOSED CONCRETE

- .1 The cement, fine aggregate and coarse aggregate shall come from the same sources for the whole duration of the concrete work to ensure a uniform color of the exposed concrete.
- .2 Fine aggregate shall comply to the Article 2.1.2 of this section and produce a pale color mortar.
- .3 Finish exposed concrete surfaces as specified in architectural drawings and specifications.
- .4 Provide, at the beginning of work, a sample of approximately 1m for each element type of exposed concrete using the same concrete mix and the same forming type that will be use subsequently. After examination and approval of the Departmental Representative, the Contractor shall make sure to obtain the same color and same texture for all the exposed concrete.
- .5 Refer to Article 3.6.1 of this section and to section 03 10 00 - concrete forming and accessories of these specifications for requirements related to exposed concrete formed surfaces.
- .6 Refer to Section 3.8 for concrete repair. The repair shall make possible to obtain finish and texture corresponding to adjacent concrete. If surface defects are such that it is not possible to repair properly, the Contractor shall demolish and rebuild the entire unit up to the next joint.

3.8 CONCRETE REPAIR

- .1 Remove and replace all damaged or defective concrete with concrete that meets the specifications and requirements of the drawings.
- .2 After the forms have been removed, the Departmental Representative shall examine all voids, honeycombs and other defects. If applicable, submit the methods for repairing the voids, honeycombs and other defects to the Departmental Representative for approval. Do not repair any of the surfaces before having received the Departmental Representative's authorization.
- .3 Wherever possible, repair formed surfaces as soon as possible after the forms have been removed.
- .4 Cover the concrete surfaces with a cement-latex slurry or an epoxy-based glue before performing concrete or mortar repairs.
- .5 The product used shall comply with Article 2.1.7 of this section.

3.9 CUTS, DRILL HOLES, AND CUT-OUTS IN HARDENED CONCRETE

- .1 Components that have already been poured shall never be cut, drilled or cut-out for any reason whatsoever, unless the Departmental Representative has authorized these procedures.
- .2 Any cut, drill hole or cut-out in hardened concrete authorized by the Departmental Representative shall be performed at the specific location, using the exact dimensions he has approved. Use rotary tools that prevent the concrete from shattering.

3.10 TOLERANCES

- .1 If the tolerances specified in Article 6.4 of the CSA-A23.1/A23.2 Standard have not been met during the construction of any component of a structure shown on the drawings, the Departmental Representative may require that this component be demolished and rebuilt according to the tolerances of said article, at no additional expense to the Departmental Representative.

3.11 CONSTRUCTION JOINTS

- .1 Follow the indications of Article 7.2.1 of the CSA-A23.1/A23.2 Standard for construction joints.
- .2 The Departmental Representative shall approve the location of the construction joints that demarcate each concrete pour. If the Departmental Representative deems it appropriate, he may require that these joints be brought closer together or relocated.
- .3 None of the construction joints already indicated on the drawings shall be moved or eliminated without prior authorization from the Departmental Representative.
- .4 Immediately before resuming pouring against a construction joint or above it, clean and score the surface of the hardened concrete to eliminate all loose fragments and any trace of bleeding, moisten the surface and allow to dry to obtain saturated, dry surface conditions.
- .5 Install 38 mm thick shear keys on construction joints along the entire length/height of the component, of a width equal to one-third the thickness of the component. Slightly bevel the sides of the shear keys.
- .6 For vertical components (walls, strip footings), construction joints shall be a maximum of 20 m apart. For raft foundation and structural slabs, install construction joints with maximum 20 m x 20 m spacing. Submit the location of the construction joints to the Departmental Representative.
- .7 Allow a section to cure for a minimum of 7 days before pouring a new section next to it.

3.12 WATERSTOPS

- .1 Where indicated on the drawings, install waterstops to provide continuous watertightness. Do not bend or puncture the waterstops in order to avoid hindering their performance. Do not move the reinforcement when installing waterstops. Splice waterstops on site using equipment that complies with the manufacturer's requirements. Firmly secure the waterstops before the concrete is poured.
- .2 Joints butt-welded on site are only allowed between the points of intersection of the straight lengths. Weld the intersecting parts on site.

3.13 BONDED SCREEDS

- .1 Pour concrete screeds shown on plan in accordance with section 7.8 of CSA-A23.1/A23.2 Standard.

- .2 On existing concrete surfaces, prepare surface in accordance with Clause 7.8.3.2 of CSA A23.1/A23.2 Standard to remove laitance, dirt, dust, debris, grease and other substances that would interfere with the bond between the existing concrete and the new concrete. However, only methods c) and d) of Article 7.8.3.2 are accepted.
- .3 Have surfaces approved by Departmental Representative approved prior to placement of bonding product.
- .4 Apply bonding agent immediately prior to placing new concrete meeting the requirements of Article 7.8.4 "Bonding System" of CSA A23.1/A23.2 Standard and the following requirements:
 - .1 Keep the surface of the slab continuously wet before placing the screed;
 - .2 Moisten the surface as recommended by the supplier of the bonding system.
- .5 Pour and finish the surface of the screed in accordance with section 3.6 of this section.

3.14 ON-SITE QUALITY CONTROL

- .1 A testing laboratory designated by the Departmental Representative shall inspect and test the concrete and its constituents in accordance with the CSA-A23.1/A23.2 Standard.
- .2 The Ministry shall assume the costs for the trials.
- .3 The Laboratory shall take additional core samples during cold weather concrete work. These core samples shall be cured on site, under the same conditions as the concrete pours they represent.
- .4 Non-destructive concrete trials shall be performed according to the methods described in the CSA-A23.1/A23.2 Standard.
- .5 The inspection and trials performed by the Laboratory shall not replace or finalize the quality control performed by the Contractor, nor shall they release the Contractor from his contractual obligations in this respect.

3.15 CLEANING

- .1 Provide on site, adequate space for safe washing of concrete trucks.
- .2 Dispose of waste in accordance with the requirements of provincial/territorial and federal local regulations.

END OF SECTION

Part 1 General**1.1 DESCRIPTION**

- .1 Work covered by this section of the specifications includes the provision of all materials, equipment, supplies and services, labour and transportation required for the complete performance of the following work:
 - .1 Finishing of all the cast-in place slab surfaces;
 - .2 Treatment of all the cast-in place slab surfaces;
 - .3 Preparation and application of all protective products and special surfaces for concrete slabs.

1.2 RELATED REQUIREMENTS

- .1 03 10 00 – Concrete forming and accessories
- .2 03 30 00 – Cast-in-place concrete

1.3 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - .1 ASTM C309-03, Liquid Membrane-Forming Compounds for Curing Concrete.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .3 CSA Group (CSA):
 - .1 CSA A23.1-14 /A23.2-14, Concrete Materials and Methods of Concrete Construction//Methods of Test for Concrete.
- .4 South Coast Air Quality Management District (SCAQMD), California State:
 - .1 SCAQMD Rule 1113-A2016, Architectural Coatings.

1.4 MANUFACTURED PRODUCTS

- .1 The brand of each of the manufactured products described in this section of the specifications shall be approved by the Departmental Representative. At the Departmental Representative's request, provide him with the technical description and/or samples of these products as well as certified copies of the results of analyses and trials conducted by independent laboratories attesting that these products are compliant.

1.5 DATA SHEETS

- .1 Submit all data sheets for the various products utilized to the Departmental Representative for review and comments.
- .2 All documents to be provided in a single electronic copy. A single (1) annotated electronic copy shall be returned to the Contractor.

1.6 SITE CONDITIONS

- .1 Temporary lighting: Minimum 1,200 W light source, placed 2.5 m above floor surface, for each 40 sq. m. of floor being treated.
- .2 Electrical Power: Use sufficient electrical power to operate equipment normally used during construction.
- .3 Work area: Make work area watertight protected against rain and detrimental weather conditions.
- .4 Temperature: Maintain minimum 10°C ambient temperature for 7 days before installation and minimum 48 hours after completion of work and maintain relative humidity maximum 40% during same period.
- .5 Moisture: Ensure concrete substrate within moisture limits prescribed by manufacturer.
- .6 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
 - .1 Provide continuous ventilation during and after coating application.

Part 2 Products**2.1 MATERIALS**

- .1 Auxiliary backer rod for joints: Made of closed cell polyethylene foam, required diameters based on the dimensions shown on the drawings.

- .2 Joint sealers: Two-component, polysulphide-based product with a chemical cure, in compliance with the CAN/CGSB 19.24 Type 2, Class A standard.
- .3 Hardener: Colourless, non-metallic floor hardening product.

Part 3 Execution

3.1 FINISHES

- .1 Unless otherwise specified, the upper surface of slabs-on-grade shall be finished with a steel surfacing machine. The final trowelling shall leave the surface free from streaks, trowel marks, or ripples.
- .2 For the upper surface of concrete slabs, finish tolerance classes measured according to CSA-A23.1/A23.2 standard, Table 22 (Straightedge Method and F-Number Method) are as follows:
 - .1 Base concrete for concrete topping only (straightedge method) = ± 12 mm: Brush finishing or manual floating;
 - .2 For all slabs and toppings – Class A; Straightedge method = ± 8 mm; F-Number Method: $F_F = 35$, $F_L = 25$.
- .3 For areas of exposed concrete slab, refer to architectural drawings and specifications and to the section 03 30 00 – Cast-in-place concrete of these specifications.

3.2 CONTROL JOINT SAWING

- .1 Unless otherwise indicated, within a maximum delay of 12 to 18 hours after concreting, use a mechanical saw appropriate to saw the control joints required on the slab-on-grade, topping and deck slab drawings. Maximum distance between control joints in each direction is 6 m or the maximum distance indicated on the drawings. Check with the Departmental Representative regarding all joints not shown on the drawings with a saw cuts proposition before the concrete pouring.
- .2 Use polysulphide caulking to seal sawed control joints in accordance with the applicable requirements presented in paragraph 3.3 of this section.
- .3 Unless otherwise specified, saw the control joints as indicated on the drawings:
 - .1 The saw cut shall be 6 mm wide;
 - .2 The saw cut shall be 40 mm deep except where there is any steel rebar. Where there is any steel rebar, the depth of the saw cut shall be modified to avoid damaging the rebar.

3.3 JOINT CAULKING

- .1 Remove dust, loose mortar, and other foreign material, and dry the surfaces of the joint.
- .2 Prepare the surfaces in compliance with the caulking manufacturer's instructions.
- .3 Clear the joint to the depth required to install a backer rod. Then apply a layer of caulking that complies with the manufacturer's recommendations for the width of the joint involved.
- .4 Apply the primer on the contact surfaces, and then apply the caulking following the manufacturer's recommendations. Clean adjacent surfaces immediately after application.

3.4 FLOOR HARDENER

- .1 During finishing operations, the Contractor shall incorporate the floor hardener on slab surfaces according to the architectural drawings.
- .2 The hardener shall be applied in steps according to manufacturer's recommendation the following procedures:

- .1 First sprinkling:

As soon as the concrete is hard enough to support the weight of the workers and their equipment and there is no more water on the surface, proceed with the first sprinkling of hardener;

Use 2/3 of the blend for the first application. Treat areas adjacent to walls and columns first;

Spread the material evenly at right angles in two passes close to floor level. Do not broadcast from a stationary position to avoid a non-uniform distribution of the hardener.

- .2 First floating operation:

Float the sprinkled material promptly. Work walls and columns first. Avoid excessive floating, but ensure the sprinkled material is completely wetted and incorporated into the base slab.

- .3 Second sprinkling / floating operation:

Immediately begin the second sprinkling operation, applying the remainder of the material. Then promptly perform the second power floating operation. A third floating may be necessary for improved compaction.

- .4 Power trowelling:

Power trowel as soon as the surface begins to lose its sheen and stiffen. Set the trowel blades at a flat angle. As floor stiffens further, proceed with second trowelling with

trowel angle raised. When a little cement paste clings to the trowel edges, begin the second trowelling. Remove trowel marks, pinholes, and any other flaws.

3.5 CONCRETE TOPPINGS

- .1 Pour the concrete toppings shown on the drawing in accordance with CSA-A23.1/A23.2 standard.
- .2 Prepare existing concrete slab and lightweight concrete surfaces in compliance with CSA-A23.1/A23.2 standard to remove all bleeding, dirt, dust, debris, grease and other substances that may hamper the bond between the existing concrete slab and the topping.
- .3 Have the Departmental Representative approve the prepared surfaces before applying the bonding agent.
- .4 Install a bonding agent composed of styrene-butadiene-based latex and cement grout. The bonding method shall achieve traction resistance in adhering to the existing concrete slab in excess of 1.0 MPa according to the CSA-A23.2-6B testing method.
- .5 Pour and finish the surface of the topping in compliance with Article 3.1 of this section of the specifications.
- .6 Install the control joints in compliance with Article 3.2 of this section of the specifications.

END OF SECTION

DIVISION 05

Part 1 General**1.1 DESCRIPTION**

- .1 The Contractor shall provide all the materials, equipment and labour required to perform the detailing, joint design, manufacturing, fitting-up, factory painting, transportation, and installation of the steel framework.
- .2 The Contractor shall also provide all parts to be embedded in concrete as well as the anchor bolts.

1.2 RELATED REQUIREMENTS

- .1 05 21 00 – Steel joist framing
- .2 05 31 00 – Steel decking

1.3 REFERENCE STANDARDS

- .1 The following Standards and Publications are mentioned in this section of the specifications. When reference is made to them, they must be consulted:
 - .1 Canadian Standards Association (CSA):
 - .1 CAN/CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;
 - .2 CAN/CSA-G164-M92 (C2003), Hot Dip Galvanizing of Irregularly Shaped Articles;
 - .3 CAN/CSA-S16-14, Limit States Design of Steel Structures and CAN/CSA S16S1-05, Supplement no 1;
 - .4 CSA S136-12, North American Specification for the Design of Cold Formed Steel Structural Members including Update No. 1 (2014), Update No. 2. (2014), Update No. 3 (2015);
 - .5 CSA W47.1-09, Certification des compagnies de soudage par fusion des structures en acier;
 - .6 CAN/CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding;
 - .7 CAN/CSA W55.3-09 (R2014), Certification of Companies for Resistance Welding of Steel and Aluminium;
 - .8 CSA W59-03, Welded Steel Construction (Metal Arc Welding).

- .2 American Society for Testing and Materials International, (ASTM):
 - .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel;
 - .2 ASTM A193/A193M-14, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications;
 - .3 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength;
 - .4 ASTM A325-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength;
 - .5 ASTM A325M-14, Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric);
 - .6 ASTM A490M-14, Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric);
 - .7 ASTM F1554-18, Standard Specification for Anchor Bolts, Steel 36, 55, and 105 ksi Yield Strength.
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.
- .4 Canadian Institute of Steel Construction (CISC)/Canadian Paint and Coatings Association – CPCA (formerly the Canadian Paint Manufacturers Association - CPMA):
 - .1 Handbook of the Canadian Institute of Steel Construction;
 - .2 CISC/CPMA 1-73A (1975), A Quick-drying One-coat Paint for Use on Structural Steel;
 - .3 CISC/CPMA 2-75 (1975), A Quick-drying Primer for Use on Structural Steel.
- .5 Master Painters Institute:
 - .1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications;
 - .2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.
- .6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:
 - .1 SSPC SP3-06, Power Tool Cleaning;

.2 NACE No. 3/SSPC SP6-06, Commercial Blast Cleaning.

- .2 Unless otherwise specified, perform structural steel work and welding work in compliance with the CAN/CSA-S16-01 and CAN/CSA S136 Standards.
- .3 The framework welding shall only be performed by a duly approved member of the Canadian Welding Bureau (CWB), in accordance with the requirements of the CAN/CSA W47.1 standard, Division 1 or Division 2.1. Check whether the subcontractor is a certified member of the CWB in the Division concerned, because the Departmental Representative will reject any contractor that does not meet this requirement.

1.4 DESIGN CRITERIA

- .1 Structural and jointing details shall be designed in accordance with the requirements of the CAN/CSA-S16, CAN/CSA-S136, so that they can withstand the indicated forces, moments and shear stresses, and accommodate anticipated thermal movements.
- .2 Factory connections shall be welded.
- .3 Unless otherwise indicated on the drawings, the types of bolted joints are as follows:

Components	Types of Connections
Beams, Columns	Bearing type
Bracings	Bearing type

- .4 Unless otherwise indicated on the drawings, the stresses to be used in the design of connections are as follows:

Components	Stresses
Beams, Columns	The more stringent of two (2) criteria: <ul style="list-style-type: none"> Reaction of the uniform load producing the section's ultimate resisting moment; Or 50% of the beam's shear strength
Columns	<ul style="list-style-type: none"> The section's ultimate compressive strength and shear strength

- .5 Additional stresses induced on components to be connected:

- .1 All joints shall be designed so that no additional stresses are induced on the components to be connected;

- .2 The Departmental Representative shall reject all details that create torque, bending moment or other stresses;
- .3 The Departmental Representative shall be the only one to decide whether the details submitted are accepted or rejected;
- .4 All modifications relating to changes required by the Departmental Representative shall be at the Contractor's expense.
- .6 For non-standard joints, submit sketches and design notes bearing the seal and signature of a qualified Engineer recognized in the Province of Quebec, Canada.
- .7 Use at least two bolts per bolted joint (including those where anchors are used).
- .8 The depth of a beam joint shall never be less than 50% of the beam.

1.5 SHOP DRAWINGS

- .1 Submit the shop drawings to the Departmental Representative.
- .2 Each shop drawing must bear the seal and signature of an Engineer who is a member in good standing of the "Ordre des Ingénieurs du Québec".
- .3 Clearly indicate on the shop drawings all forming and assembly details, including cuts, cut-outs, joints, drill holes, threaded anchors, bolts, shear connectors and welds. Use the symbols indicated in the CAN/CSA W59 Standard to represent welds.
- .4 Submit to the Departmental Representative the description of the work methods, the order in which the components are to be assembled, and the type of material intended for use. Even if this formality has been fulfilled and the document submitted, the Contractor remains solely responsible regarding the use of the methods, equipment, delivery mode and safety measures.
- .5 Provide the Departmental Representative with one (1) electronic copy of each complete and detailed shop and erection drawings of the steel framework to be built. The drawings shall be provided in metric units (SI).
- .6 The shop and erection drawings shall contain all the information mentioned in Articles 4.2 and 4.3 of the CAN/CSA-S16 Standard and bear the signature of the person who verified them before their submission to the Departmental Representative.
- .7 The project title as well as the names of the Ministry and of the Contractor shall appear on each shop and erection drawing.
- .8 The shop and erection drawings shall be sent soon enough to ensure that the Departmental Representative has at least ten (10) working days to examine them.

- .9 A copy of each drawing shall be returned to the Contractor who, if required, shall revise the annotated drawing(s) and resubmit it (them). If the Departmental Representative determines that the revisions are too numerous or complex, he shall return the drawing(s) without annotating it (them). The Contractor shall be responsible for making any additional copies he requires.
- .10 The Contractor shall only manufacture the framework components after the Departmental Representative has returned the shop and erection drawings.

1.6 ERECTION DIAGRAMS

- .1 The steel framework Contractor shall prepare erection diagrams that shows in detail the components installation sequences.
- .2 The sequences shall be ordered as to balance the various loads exerted on the main trusses to avoid any torsion.

1.7 VERIFICATION OF DIMENSIONS, MEASUREMENTS AND LEVELS

- .1 Before manufacturing the components of the framework, take and check all the dimensions, measurements and levels on site to compare them with the ones on the drawings or to complete the information shown on the drawings.
- .2 Notify the Departmental Representative of any errors on the construction site or of any incompatibility between the dimensions taken and the instructions provided on the drawings. Await the Departmental Representative's instructions on how to correct the errors and/or make the required adjustments.
- .3 If connecting to an existing framework, check all the dimensions, measurements and levels of the existing framework before producing shop drawings of the new frame that will be connected to it. Adjust the dimensions of the parts to be built to the situation and submit the modifications to the Departmental Representative.

1.8 QUALITY ASSURANCE

- .1 Submit 1 copies of shop trial reports (4) weeks prior to assembly of the structural steel work:
 - .1 The shop trial reports shall indicate the steel's chemical and physical properties, as well as other relevant details before it is used for this work;
 - .2 The trial reports shall be certified by qualified metallurgists authorized to work in the Province of Quebec Canada.
- .2 Also provide an affidavit from the manufacturer of the structural steel work certifying that the products, equipment, and materials used for this work comply with the relevant standards that apply to the required or indicated products, equipment, and materials.

Part 2 Products

2.1 MATERIALS

- .1 Use materials free of dirt, rust, scale, pinholes, leafing, or any other defect. No used materials shall be accepted.
- .2 General Structural Steel: In compliance with the CAN/CSA-G40.20/G40.21 Standard of grade 350W.
- .3 Hollow Structural Sections (HSS): In compliance with the CAN/CSA-G40.21 and CAN/CSA-S16 Standards, of grade 350W, class C, as indicated on the drawings.
- .4 High-strength bolts, nuts and washers: In compliance with the ASTM A325M or A490M Standard.
- .5 Anchor Bolts:
 - .1 Lower strength: In compliance with ASTM F1554, grade 36;
 - .2 High strength: In compliance with ASTM F1554, grade 105.
- .6 Welding Materials: In compliance with the CAN/CSA W59 Standard and the CAN/CSA W48 series Standards and approved by the Canadian Welding Bureau.
- .7 Shear connectors (if required on the drawings): In compliance with the CAN/CSA W59 Standard and its Appendix H.
- .8 Non-shrink Grout: Non-metallic pre-mixed Portland cement-based product, of a consistence appropriate for pouring and capable of achieving at least 50 MPa compression strength at 28 days, subject to the Departmental Representative's approval.
- .9 Paint:
 - .1 1-73A CISC/CPMA: "Quick-Drying One-Coat Paint for Use on Structural Steel", grey colour;
 - .2 2-75 CISC/CPMA: "Quick-Drying Primer for Use on Structural Steel", grey colour.
- .10 Mechanical anchor bolts (when specified on the drawings): As manufactured by Hilti Canada Ltd. or an equivalent approved by the Departmental Representative. The type required, the diameter and total length are specified on the drawings.
- .11 Hot-Dip Galvanizing: Apply a minimum 600 g/m² coat of zinc on the indicated areas, in compliance with the CAN/CSA-G164 Standard.

- .12 Touch-up Paint on Galvanized Steel: Complies with CAN / CGSB-1.181 with zinc metal content greater than 87% (non-volatile mass%). Coatings in aerosol form are not allowed. The dry film of the coating must contain 95% zinc metal.

2.2 FACTORY PAINTING

- .1 Structural steel components shall be cleaned, prepared and coated with a layer of primer at the workshop in compliance with the CAN/CSA-S16 Standard, with the exception of components to be embedded in concrete.
- .2 The components shall be cleaned and freed of millscale, rust, oil, dust and all other foreign material. The surfaces shall be prepared according to the SSPC SP3 method for standard structural steel and according to the NACE No.3/SSPC SP6 method for architecturally exposed structural steel.
- .3 A layer of primer shall be applied at the workshop to produce a dry film of at least 0.10 mm thick, on all steel surfaces, with the exception of the following surfaces:
 - .1 Surfaces embedded in concrete;
 - .2 Surfaces to which shear dowels will be fastened at the construction site;
 - .3 Surfaces and edges that are to be welded on site;
 - .4 Friction joint contact surfaces;
 - .5 Surfaces located below grade and in direct contact with the ground.
- .4 In cases where frame components are not visible in the finished building (structural steel components covered by other construction materials), at the shop, apply on the structural steel a quick-drying one-coat paint for use on structural steel, in compliance with the 1-73A CISC/CPMA Standard. Follow the requirements of this standard regarding the methods to be used, atmospheric conditions to maintain and temperatures to respect when applying the paint.
- .5 In cases where frame components are visible in the finished building (exposed structural steel components later covered with one or two coats of finish paint on site), at the shop, apply on the structural steel a quick-drying primer for use on structural steel, which complies with the 2-75 CISC/CPMA Standard. Follow the requirements of this standard regarding the methods to be used, atmospheric conditions to maintain and temperatures to respect when applying the paint.
- .6 Paint on nuts, bolts, straight edges, and angles shall be removed before it is dry.

Part 3 Execution**3.1 FORMING**

- .1 Form the steel components in compliance with the CAN/CSA-S16 Standard and according to the shop drawings submitted.
- .2 Structural members formed of welded sections shall be rejected if they are not shown as such on the shop drawings.
- .3 The use of members whose quality and/or dimensions differ from those shown is strictly forbidden without the Departmental Representative's written permission.
- .4 Drill or punch the bolt holes. All burning or cutting with a torch is forbidden.
- .5 The manufacturing and assembly tolerances are respectively those described in Sections 28.6 and 29.3 of the CAN/CSA-S16 Standard.
- .6 If required, reinforce the openings to maintain the design strength.
- .7 Where indicated on the drawings, continuously seal all steel members with a continuous weld bead and grind the welds.
- .8 Reinforce the girder web with stiffening plates at each girder-column intersection and at each concentrated load location.
- .9 Grind visible welds where required.
- .10 Provide the qualified trades persons with the templates and the parts to be embedded in the concrete or masonry.
- .11 Once the assembly is completed, touch-up the rivets, on-site welds, and bolts as well as burned or scratched surfaces.
- .12 Apply a zinc primer on galvanized surfaces in areas burned as a result of on-site welding work.
- .13 The welding companies shall be certified under the terms of Division 1 of these specifications or Article 2.1 of the CAN/CSA W47.1 Standard regarding fusion welding of steel structures, and/or the CAN/CSA W55.3 Standard regarding resistance welding of structural members.

3.2 MARKING

- .1 Mark the materials in compliance with the CAN/CSA-G40.21 Standard. Do not use die-stamping. When the steel part must not be painted, stamp the mark in locations that will not be visible after assembly.

- .2 Joint markings: At the factory, mark load-bearing assemblies, assembly joints and adjustment joints.

3.3 ERECTION

- .1 The proposed technique, as well as the equipment used to erect the frame are subject to the Departmental Representative's approval. However, this approval shall in no way release the Contractor from his full responsibility regarding the choice of technique and the handling of the equipment that will enable him to perform his work quickly and in complete safety.
- .2 Assemble the steel components in compliance with the CAN/CSA-S16 Standard and according to the shop drawings.
- .3 Assemble the metal structures ensuring that they are square, plumb, aligned, accurately adjusted, and have tight joints and intersections.
- .4 Where indicated on the drawings, continuously seal all steel members with a continuous weld bead and grind the welds.
- .5 Obtain the Departmental Representative's written authorization before cutting or modifying structural steel members on site.
- .6 Once the assembly is completed, touch up the bolts, rivets, welds, and surfaces where the factory-applied galvanization is degraded.
- .7 Deliver, handle and store all steel on site to avoid any damage. Damaged members and joints shall be rejected.
- .8 Take measures so as not to overload on-site structures which are already completed or under construction, beyond the allowable loads indicated on the drawings for these structures.
- .9 Where required on the drawings, weld shear connectors to the load-bearing components of the frame, using steel decking if required, following the manufacturer's instructions.
- .10 Notify the Departmental Representative as soon as possible regarding any defects detected in the assembly of factory-built components and abide by his decision regarding the corrections to be made.
- .11 Straighten slightly deformed components before assembling them on site and replace those that are damaged to the point where the Departmental Representative raises doubts regarding their effectiveness.
- .12 It is strictly forbidden to perform joint welds on site unless they are indicated on the shop drawings or the Departmental Representative has approved them beforehand.
- .13 It is strictly forbidden to drill, cut or modify in any way a component of the frame on site without having obtained the Departmental Representative's written authorization beforehand.

- .14 Galvanized steel structural members may not be cut, drilled or otherwise modified on site. If site modifications are made to the galvanized steel structural members, they must be returned to the workshop for re-galvanizing.
- .15 Apply asphalt cover on entire structural steel surface, anchor rods, nuts, and any other steel parts in contact with the ground. When steel passes through a concrete element, apply the bituminous coating up to 50 millimeters below the finished surface of the concrete.

3.4 FIELD QUALITY CONTROL

- .1 The Departmental Representative shall always have access to the shop to inspect the manufacturing and assembly work performed there.
- .2 The Departmental Representative may require that analytical trials, estimates and calculations be performed. Replace all work or materials found to be defective, at no expense and without any unnecessary project delays.
- .3 At the Departmental Representative's request, provide a factory certificate attesting that the quality of the steel meets the requirements of the Contract Documents.
- .4 At the Departmental Representative's request, provide him with certified copies of the steel factory inspection reports concerning the chemical and physical properties of the steels used.
- .5 A testing laboratory approved by the Departmental Representative shall inspect and test materials and craftsmanship.
- .6 The Departmental Representative may require that the Laboratory assess certain welds he considers important through visual inspection, or by performing penetrating liquid, magnetic particle, x-ray, or ultrasound examinations. Cooperate fully on the performance of these tests and if required make the necessary repairs following these inspections.
- .7 The parts of welds that have been repaired shall be fully re-inspected following the same method used to perform the first inspection.
- .8 The Laboratory shall check the shear connectors using the following method: after welding, the Contractor shall remove the ceramic ring around each connector and the Laboratory shall visually inspect the weld bead. Beads extending less than 360 degrees shall undergo more thorough inspection. These types of connectors shall be tested using a hammer to bend the connector 15 degrees from vertical toward the nearest side of the embedded plate or structural component. Welds that bend without breaking are acceptable. Bent connectors shall not break when straightened after the test. In addition, the Laboratory shall use the same method to conduct random testing on one percent of connectors where the weld bead is visually acceptable. The Contractor shall replace defective connectors at his expense.
- .9 The Departmental Representative may ask the Contractor to check whether the columns are plumb, in his presence. The Contractor shall provide the equipment required to perform this audit.

- .10 The Departmental Representative may ask the Contractor to check the bolted joints, in his presence. High-strength joint shall comply with the CAN/CSA-S16 Standard, clauses 23.7 and/or 23.8.
- .11 The inspection and verification to ensure the framework is aligned, plumb and level shall comply with the CAN/CSA-S16 Standard, Clause 29.3.

3.5 CONNECTIONS

- .1 Unless otherwise indicated on the drawings, all factory-built connections shall be welded. If slip connections are specified, high-strength bolts shall be used.
- .2 High-strength bolts shall be used on all slip connection performed on site, in accordance with Section 23 of the CSA-S16 Standard.

3.6 TEMPORARY BRACING

- .1 Assembly the steel framework, ensuring it is aligned and plumb to specified tolerances. Use temporary bracing for the assembly where necessary to offset any load to which the frame may be subjected, including wind, snow, equipment and its use.

Leave these braces in place without disturbing them as long as they are required for safety, and until final installation of permanent braces.
- .2 The Contractor shall be responsible for any negligence in adequately anticipating the stresses exerted during assembly of the framework.
- .3 Do not perform permanent bolting, welding or riveting if the braced framework has not been properly aligned.
- .4 The Contractor is entirely responsible for the temporary stability of the steel frame.

3.7 GROUT APPLICATION

- .1 Where indicated on the drawings, after the framework has been erected and aligned, completely fill the space under column base plates or other supports with the specified non-shrink grout, following the manufacturer's written instructions.
- .2 Install the grout and wait until it has achieved 75% of its specified strength before pouring the concrete slabs on steel decking.

3.8 FIELD PAINTING

- .1 Touch up damaged surfaces and surfaces without shop coat with primer to NACE No.3/SSPC-SP-6, except as specified otherwise. Apply in accordance: MPI Architectural Painting Specification Manual.

- .2 After approval by the Departmental Representative, galvanized structural members with surfaces that have been damaged or scuffed during transportation, handling or assembly shall be retouched with zinc-rich paint on the surfaces in question.
- .3 Galvanized steel structural members with a cumulative damaged or scuffed surface area for an element greater than 10 cm² shall be dismantled, returned to the workshop and galvanized again for subsequent re-installation.

3.9 SUBSTITUTION

- .1 Do not change the dimension and size of the members shown on the drawings without the Departmental Representative's written authorization. Substitution of members with units stronger than those specified may be accepted at no additional cost.

END OF SECTION

Part 1 General**1.1 DESCRIPTION**

- .1 Work included in this section includes the supply of all materials, equipment, supplies and services, labor and transportation required for the complete performance of steel joist work, including:
 - .1 Supply and assembly of beams;
 - .2 Supply and installation of spacers.

1.2 RELATED REQUIREMENTS

- .1 05 12 23 – Structural steel for buildings
- .2 05 31 00 – Steel decking

1.3 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN / CGSB 1.40 97, Alkyd resins anticorrosive primer coating for structural steel;
 - .2 CAN / CGSB 1.105 M91, Fast drying primer paint;
 - .3 CAN / CGSB 85.10 99, Protective coatings for metals;
 - .4 CAN / CGSB 85.100 93, Painting.
- .2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA):
 - .1 CISC/CPMA 2-75, Quick-Drying, Primer for Use on Structural Steel;
 - .2 CISC/CPMA 1-73A, Quick-Drying, One-Coat Paint for Use on Structural Steel.
- .3 CSA International:
 - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;
 - .2 CSA S16-14, Design of Steel Structures;
 - .3 CSA S136-12, North American Specification for the Design of Cold Formed Steel Structural Members;

- .4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel;
- .5 CSA W55.3-09 (R2014), Certificate of Companies for Resistance Welding of Steel and Aluminum;
- .6 CSA W59-10, Welded Steel Construction (Metal Arc Welding) Metric.
- .4 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual.

1.4 QUALITY ASSURANCE

- .1 Submit 1 copies of mill test reports at least (4) weeks prior to fabrication of steel joists and accessories. Reports to show:
 - .1 Chemical and physical properties;
 - .2 Other details of steel to be incorporated into work;
 - .3 Certification by qualified metallurgists confirming that tests conform to requirements of CSA G40.20/G40.21.
- .2 Submit affidavit prepared by fabricator of structural steel joists stating that materials and products used in fabrication conform to this specification.

1.5 STEEL JOISTS AND JOIST BRIDGING CALCULATION

- .1 Steel joists and bridging must be designed to withstand the loads shown on the drawings in accordance with CAN / CSA S16.
- .2 Beams and anchors shall be designed to withstand lifting due to the specified pressure, if any.
- .3 Beams must be constructed to withstand the stresses during shaping, handling and erection.
- .4 The roof joists deflection caused by the prescribed overload must not exceed 1/360 of the span, unless noted otherwise on the drawings.
- .5 The floor joists deflection caused by the prescribed overload must not exceed 1/360 of the span, unless noted otherwise on the drawings.
- .6 Design the joists to meet the requirements of Annex "E" of CAN / CSA-S16 for floor vibration, if indicated on the drawings.
- .7 Design the joists so that they can withstand, in addition to the loads shown in the drawings, a concentrated live load of 2.25 kN placed at any node.

1.6 SHOP DRAWINGS AND NOTE OF CALCULATIONS

- .1 Submit to the Departmental Representative shop drawings and calculation notes for steel joists. All drawings and calculation notes will be submitted in one (1) electronic copy. One (1) annotated electronic copy will be returned to the Contractor.
- .2 Have all drawings and calculation notes submitted by a member in good standing of the Ordre des Ingénieurs du Québec signed and sealed.
- .3 Mark on the shop drawings the spacings, support and anchoring details, openings reinforcements, accessories, material lists, depths, coves, loadings, marks, spacer lines and other relevant details.
- .4 Indicate on the calculation notes the loading cases used, the forces in each frame, the choice of chords and spacers and all other relevant details.
- .5 Indicate, on shop drawings, the characteristics of beam geometry, frames, supports, joints and anchors, as well as the dimensions and properties of the elements, the stresses and stresses, specified and weighted, considering various loads, as well as the arrow and the arch.

Part 2 Products**2.1 MATERIALS**

- .1 Open web steel joists: to CSA S16 and CSA S136.
- .2 Structural steel: to CSA G40.20/G40.21
- .3 Welding materials: to CSA W59.
- .4 Painting: following standards from the Canadian Institute of Steel Construction and the Paint Manufacturers Association of Canada:
 - .1 CISC / CPMA 1-73A: "One-coat, quick-drying paint for structural steel", gray color;
 - .2 CISC / CPMA 2-75: "Fast drying primer paint for structural steel", gray color.
- .5 Shear studs: to CSA W59, Appendix H.

Part 3 Performance**3.1 SHAPING**

- .1 Shape steel beams, spacers and accessory parts in accordance with CAN / CSA-S16, CSA-S136 and approved shop drawings.
- .2 Perform welding in accordance with CSA W59.

- .3 Provide all steel parts forming the joists in one piece, without butt welding.
- .4 Provide anchors and type of spacers required on drawings.
- .5 Provide or exceed the number of spacer lines required in the drawings, if calculations demonstrate that this is necessary.
- .6 Upper and lower chords must be extended at the indicated locations.

3.2 PAINTING IN WORKSHOP

- .1 Clean, prepare and prime steel in accordance with CAN / CSA-S16 and SSPC SP6.
- .2 Prepare surfaces to be painted in accordance with CISC / CPMA 1-73A or CISC / CPMA 2-75 in accordance with the type of paint used.
- .3 In the case where the beams and spacers are not visible in the finished building (beams and spacers covered by other building materials), apply on the beams and spacers, in the workshop, a one-coat paint, fast drying, for structural steel, in accordance with CISC / CPMA 1-73A. Follow the prescriptions of this standard on the methods to be used, the atmospheric conditions to maintain and the temperatures to be respected when applying the paint.
- .4 In the case where the beams and spacers are visible in the finished building (beams and spacers left visible and subsequently painted on the building site with one or more finishing layers), apply, on the joists and beams, spacers, in the shop, a quick-drying primer paint for structural steel, in accordance with CISC / CPMA 2-75. Follow the prescriptions of this standard on the methods to be used, the atmospheric conditions to maintain and the temperatures to be respected when applying the paint.

3.3 ASSEMBLY

- .1 Install steel joists and spacers as indicated on shop drawings approved by Departmental Representative and in accordance with CAN / CSA-S16.
- .2 Perform welding work in accordance with CSA-W59.
- .3 Welding companies to be certified under Division 1 or 2 of CSA-W47.1 for Fusion Welding and / or CSA-W55.3 for Resistance Welding.
- .4 Provide a certificate confirming that all welded joints meet the Canadian Welding Bureau Qualification Rules.
- .5 It is forbidden to cut or modify, at work, beams or spacers.
- .6 At the end of the assembly, retouch bolts, welds and surfaces where the shop-applied primer is burned or scuffed.
- .7 Fasten beams to beams and columns with bolts in accordance with current safety regulations.

- .8 Use connecting beams for cantilever columns and beams.
- .9 Complete installation of spacers and anchors before subjecting beams to permanent loads to be supported.

3.4 CONNECTION TO AN EXISTING WORK

- .1 Verify dimensions of existing structure before beginning to form joists.
- .2 Notify the Departmental Representative of any site error or incompatibility between the dimensions found and the instructions given on the drawings. Wait for instructions from the Departmental Representative on how to make corrections and / or adjustments.

3.5 QUALITY CONTROL

- .1 Departmental Representative may require inspections and non-destructive testing of welds and materials. Test methods are at the discretion of the Departmental Representative.
- .2 Inspection and verification of materials and workmanship will be performed by the test laboratory designated by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

- .1 The work included in this section includes the supply of all materials, equipment, supplies and services, labor, installation and transportation necessary for the complete execution of the steel deck work.

1.2 RELATED REQUIREMENTS

- .1 03 30 00 – Cast-in-place concrete
- .2 05 12 23 – Structural steel for buildings
- .3 05 21 00 – Steel joist framing

1.3 REFERENCE STANDARDS

- .1 ASTM International:
 - .1 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process;
 - .2 ASTM A780-01, Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings;
 - .3 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .2 CSA Group:
 - .1 CSA C22.2 No. 79-2016, Cellular Metal and Cellular Concrete Floor Raceways and Fittings (Chemins de câbles et accessoires pour planchers cellulaires en métal et en acier);
 - .2 CSA S16-14, Règles de calcul des charpentes en acier;
 - .3 CSA S136-12, North American Specification for the Design of Cold Formed Steel Structural Members including Update No. 1 (2014), Update No. 2. (2014), Update No. 3 (2015);
 - .4 CSA W47.1-09, Certification des compagnies de soudage par fusion des structures en acier;
 - .5 CSA W55.3-09 (R2014), Certification of Companies for Resistance Welding of Steel and Aluminum;

- .6 CSA W59-13, Welded Steel Construction, (Metal Arc Welding) including Update No. 1 (2014), Update No. 3 (2015), Update No. 4 (2015).
- .3 Canadian Sheet Steel Building Institute (CSSBI):
 - .1 CSSBI 10M-13, Standard for Steel Roof Deck;
 - .2 CSSBI 12M-15, Standard for Composite Steel Deck.
- .4 Green Seal Environmental Standards (GS):
 - .1 GS-11-Edition 3.2 (2015), Paints and Coatings.

1.4 CALCULATION CRITERIA

- .1 Structural calculation of steel deck using limit state method in accordance with CAN / CSA-S136, CSSBI 10M, and CSSBI 12M.
- .2 The steel deck and their fasteners to the steel framework of a structure shall withstand permanent loads, overloads and other stresses and stresses, including side loads, diaphragm effect, form-reinforcement composite effect, and lifting force, as indicated.
- .3 Calculate steel deck so that the arrow under the overload alone is less than 1/360 of the floor span and 1/240 of the roof span, unless otherwise indicated on the drawings, unless otherwise indicated on drawings.
- .4 To limit the effects of vibration when required on the plans, the dynamic characteristics of the decking system shall be calculated in accordance with the Standard.

1.5 SHOP DRAWINGS

- .1 Submit to Departmental Representative shop drawings for steel deck. All drawings will be submitted in one (1) electronic copy. One (1) annotated electronic copy will be returned to the Contractor.
- .2 Sign and seal all shop drawings submitted by a member in good standing of the "Ordre des ingénieurs du Québec".
- .3 Upon request of Departmental Representative, submit design calculations.
- .4 Shop drawings must indicate, show or understand the plane, profile and dimensions of the deck, the thickness of the base metal, the designation of the metal cladding, the projections, the openings, the fasteners to the supports. and spacing of these, details and accessories.
- .5 In the case of concrete deck, shop drawings shall indicate, show or understand the relevant details concerning the temporary shoring of the deck, including the location of the shores, the timing of their placement and removal, and the expected duration of each of these operations.

Part 2 Products**2.1 MATERIALS**

- .1 Zinc-iron Alloy (ZF) coated steel sheet: To ASTM A653/A653M structural quality Grade 275, with ZF75 coating, for interior surfaces not exposed to weather, unpainted.
- .2 Decks to be Painted: Zinc-iron alloy coated decks suitable for finish painting.
- .3 Zinc (Z) Coated Steel Sheet: To ASTM A653/A653M structural quality, Grade 275, with ZF75, coating, regular spangle surface, chemically treated for unpainted finish, for exterior surfaces exposed to weather,
- .4 Aluminum-zinc alloy (AZ) coated steel sheet: To ASTM A792/A 792M structural quality grade 230 chemically treated for unpainted finish, for exterior surfaces exposed to weather.
- .5 Acoustic insulation: Fibrous glass 17.5 kg/m³ density minimum profiled to suit deck flutes.
- .6 Cover Plates, Cell Closures, and Flashings: Steel sheet with minimum base steel thickness of 3 mm minimum. Metallic coating same as deck material.
- .7 Primer: Zinc rich, ready mix to CAN/CGSB-1.181.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts acceptable for steel decking installation in accordance with manufacturer's written instructions:
 - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery;
 - .2 Proceed with installation after unacceptable conditions remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Locate bundles of deck materials to prevent overloading of supporting members.

3.3 INSTALLATION

- .1 Work on steel decking in accordance with CAN / CSA-S136, CSSBI 10M, and CSSBI 12M.
- .2 Unless otherwise specified, perform welding in accordance with CSA W59.
- .3 Welding companies to be certified under Division 1 or 2 of CSA W47.1 in the case of fusion

welding of steel and CSA W55.3 in the case of welding, by resistance.

3.4 ERECTION

- .1 Mount steel deck strictly in accordance with shop drawings approved by Departmental Representative and in accordance with manufacturer's instructions and CAN / CSA-S136, CSSBI 10M, and CSSBI 12M.
- .2 Cover as many spans as possible with the same element of steel deck. A minimum of three bays is required.
- .3 Overlap joints as much as possible and locate each joint on top of a support. A minimum overlap of 50 mm is required.
- .4 Butt the ends of the metal deck sheets leaving a clearance of 1.5 to 3 mm. Close gaps larger than 3 mm with steel cover plates.
- .5 Weld shear studs, if required in drawings, through steel deck to underlying steel beams / girders and subject to testing as per requirements of CSA W59.
- .6 Metal deck shall be cleared of dirt, debris, standing water, loose mill slag and other foreign material prior to concrete placement.
- .7 Temporary shoring, if any, shall be designed to withstand construction overload and to support wet concrete and equipment used in the work. Do not remove temporary shoring until concrete has reached 75% of the prescribed 28-day compressive strength.
- .8 Arrange reinforcing steel and support as indicated.

3.5 FASTENING METHOD REGULAR STEEL DECK

- .1 By nailing and screws:
 - .1 Attach the steel deck to the supports with the fastening pattern indicated in the drawings and with the following fasteners:
 - .1 High shear nail fastener type used for attaching steel deck to structural support steel, made of carbon steel with 5 µm of zinc plating. Nominal pullover resistance of 9.96 kN in tension and 9.40 kN in shear in a deck 0.91 mm thick. Nominal pullover resistance of 8.79 kN in tension and 7.10 kN in shear in a deck 0.76 mm thick. Nominal hardness of 58 HRC. Support steel thickness of 10 mm and more;
 - .2 High shear nail fastener type used for attaching steel deck to structural support steel, made of carbon steel with 5 µm of zinc plating. Nominal pullover resistance of 7.50 kN in tension and 9.37 kN in shear in a deck 0.91 mm thick.

Nominal pullover resistance of 6.66 kN in tension and 7.08 kN in shear in a deck 0.76 mm thick. Nominal hardness of 55.5 HRC. Support steel thickness of 3 mm to 10 mm;

- .2 Join adjacent sections of steel deck with sidelap connectors made of carbon steel with 5 μ m of zinc plating. nominal pullover resistance of 1.59 kN in tension and 3.87 kN in shear in a deck 0.91 mm thick. Nominal pullover resistance of 1.41 kN in tension 3.21 kN in shear in a deck 0.76 mm thick;
- .3 Unless otherwise indicated on the drawings, spacing of fasteners at supports should be a maximum of 300 mm c/c for floors and 150 mm c/c for the roof;
- .4 Unless otherwise indicated on the drawings, spacing of screws or connectors at sidelap should be a maximum of 150 mm c/c to connect adjacent sections of deck.

3.6 CLOSURE PARTS

- .1 Fill perforated spaces of the core with neoprene closure pieces as recommended by the manufacturer where the metal deck rests on the exterior beams.
- .2 Install closure plates, cell end closures and flashings required to allow the required concrete concreting of the concrete slab on the steel deck as recommended by the manufacturer.

3.7 REINFORCEMENT OF OPENINGS AND SURFACES SUBJECT TO TEMPORARY LOADS

- .1 Reinforce openings in steel deck to maintain required design strength.
- .2 Unless otherwise specified, reinforcement of 150 to 300 mm side openings shall be constructed in accordance with manufacturer's recommendations. No reinforcement is required for openings smaller than 150 mm.
- .3 In the case of openings exceeding 300 mm on one side and areas subject to point loads, reinforce in accordance with the details of the structure indicated in the drawings.

3.8 INSTALLING THE ASSEMBLY ELEMENTS

- .1 Install components in accordance with CSSBI recommendations, as indicated.

3.9 ACOUSTIC INSULATION

- .1 Supply and install acoustic insulation if required in the deck when beginning roof waterproofing work.

3.10 TOUCHES

- .1 After permanent installation of the steel deck and shear connectors (if required), retouch with zinc-rich primer the galvanized surfaces burned by the weld.

END OF SECTION

DIVISION 06

Part 1 General**1.1 DESCRIPTION**

- .1 The Contractor shall provide all the materials, equipment and labour required to perform the installation of shop fabricated wood trusses including all attachments pieces and bolt.
- .2 This section covers all parts of the structural woodwork shown on the drawings and implicitly require by other trades for the delivery of a complete work.

1.2 RELATED REQUIREMENTS

- .1 01 74 00 – Cleaning
- .2 01 74 19 – Construction / demolition waste management and disposal
- .3 06 17 53 – Shop-fabricated wood trusses

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute/National Particleboard Association (ANSI/NPA):
 - .1 ANSI/NPA A208.1-2009 Particleboard.
- .2 ASTM International (ASTM):
 - .1 ASTM A123/A123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products;
 - .2 ASTM A153/A153M-09 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware;
 - .3 ASTM A307-14 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength;
 - .4 ASTM A653/A653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process;
 - .5 ASTM D 5055-13e1, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists;
 - .6 ASTM D 5456-14b, Standard Specification for Evaluation of Structural Composite Lumber Products;
 - .7 ASTM F1667-13 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-11.3-M87, Hardboard;
 - .2 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .4 Canadian Wood Council:
 - .1 Wood Design Manual 2010 (R2014) Edition;
 - .2 Engineering Guide for Wood Frame Construction 2014.
- .5 CSA Group (CSA):
 - .1 CAN/CSA-A123.2-03 (R2013), Asphalt Coated Roofing Sheets;
 - .2 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples;
 - .3 CSA O86-14 Engineered Design in Wood;
 - .4 CSA O112.9-1, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure);
 - .5 CSA O121-08 (R2013), Douglas Fir Plywood;
 - .6 CSA O141-05 (R2014), Softwood Lumber;
 - .7 CSA O151-09 (R2014), Canadian Softwood Plywood;
 - .8 CSA O153-13, Poplar Plywood;
 - .9 CSA O325-07 (R2012), Construction Sheathing;
 - .10 CAN/CSA-S406-92 (R2008), Construction of Preserved Wood Foundations;
 - .11 CAN/CSA-Z809-08, Sustainable Forest Management.
- .6 Forest Stewardship Council (FSC):
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .7 National Lumber Grades Authority (NLGA):
 - .1 Standard Grading Rules for Canadian Lumber 2010.
- .8 National Research Council Canada (NRC):
 - .1 National Building Code of Canada 2015 (NBC).

- .9 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD):
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
- .10 Sustainable Forestry Initiative (SFI):
 - .1 SFI-2015-2019 Standard.
- .11 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit all required documents and samples.
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations;
 - .2 Include manufacturer's pre-engineered floor, ceiling and roof joist span charts, and manufacturer's pre-engineered installation details;
 - .3 Submit certified test reports for prefabricated structural members from approved independent laboratory indicating compliance with specifications for specified performance characteristics and physical properties;
 - .4 Submit CCMC Product Evaluation Report for engineered wood products;
 - .5 Submit manufacturer's installation instructions.
- .2 Shop Drawings:
 - .1 For structural applications or conditions beyond the scope of the manufacturer's pre-engineered design information, submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec;
 - .2 Assemblies: stirrups and other assemblies must be calculated by an engineer mandated by the contractor. The assemblies must take up the loads indicated on the plans according to the combinations of the NBC. Submit for approval an assembly plan identifying the location of each stirrup or assembly, signed and sealed by an engineer member of the Ordre des Ingénieurs du Québec. Also provide the technical sheets of the prefabricated stirrups;
 - .3 Design data in accordance with CAN/CSA-O86 and CWC Engineering Guide for Wood Frame Construction;
 - .4 Indicate configuration and spacing of joists, hanger and connector types, fasteners, locations and design values, bearing details;

- .5 Submit stress diagrams or print out of computer design indicating design loads for members. Indicate allowable load and stress increase;
- .6 Indicate arrangement of webs or other members to accommodate ducts and other specialties.

Part 2 Products

2.1 STRUCTURAL FRAMING

- .1 Unless noted otherwise, all softwood shall be spruce, pine and fir, wood no.1 or no.2 (SPF no.1/no.2) in accordance with following standards:
 - .1 In accordance to CSA O141;
 - .2 NLGA Standard Grading Rules for Canadian Lumber;
 - .3 Must be officially stamped with a seal of a known body with classification;
 - .4 Factory number or name, category, species and conditions of factory drying, stamped "s-dry";
 - .5 Wood must have a moisture rate below 19% during construction.
- .2 Glued end-jointed (finger-jointed) lumber NLGA Special Products Standard SPS, are acceptable for studs.
- .3 Sustainable Standards Certification:
 - .1 Certified Wood: submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.
- .4 Plant fabricated structural wood:
 - .1 Proprietary prefabricated I-joists of solid, laminated veneer lumber glue laminated lumber flanges or oriented strandboard panel web, and ventilation holes for roof joists with factory pre-punched knock-out holes for electrical services;
 - .2 Adhesive: Exterior rated phenol-formaldehyde or phenol-resorcinol: to CSA O112.9;
 - .3 Plant fabrication with quality control in accordance with ASTM D 5055.

2.2 FURRING AND BLOCKING

- .1 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
 - .1 S2S is acceptable;
 - .2 Board sizes: "Standard";

.3 Dimension sizes: "Standard" ;

.4 Post and timbers sizes: "Standard" .

2.3 PANEL MATERIALS AND APPLICATION

.1 Panels in accordance with following standards:

.1 Plywood made of Canadian soft wood and OSB panel board: in accordance with CSA O151.

2.4 ACCESSORIES

.1 Subflooring adhesive: to CAN/CGSB-71.26, cartridge loaded.

.2 General purpose adhesive: to CSA O112.9.

.3 Nails, spikes and staples: to ASTM F1667.

.4 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.

.5 Joist hangers, connectors and fasteners: in accordance with accepted shop drawings, galvanized to minimum ZF001 coating designation.

.6 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.

.7 Roof sheathing H-Clips: formed "H" shape, thickness to suit panel material, extruded 6063-T6 aluminum alloy type approved by Departmental Representative.

.8 Steel angles and other galvanized hardware as shown on drawings.

.9 Fastener Finishes:

.1 Galvanizing: to CAN/CSA-G164, use galvanized fasteners for exterior work;

.2 Proprietary corrosion resistant fasteners as recommended by manufacturer;

.3 Stainless steel: use stainless steel 316 ;

.4 Plated finish: use cadmium plated fasteners for interior work.

.10 Sill Plate Gasket: Closed cell polyethylene foam gasket in width to match sill plate width, 6 mm thick.

Part 3 Execution**3.1 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area;
 - .2 Store materials off ground with moisture barrier at both ground level and as a cover forming a well-ventilated enclosure, with drainage to prevent standing water;
 - .3 Store wood I-beams and joists on edge;
 - .4 Stack, lift, brace, cut and notch engineered lumber products in strict accordance with manufacturer's instructions and recommendations;
 - .5 Store and protect architecturally exposed lumber from nicks, scratches, and blemishes;
 - .6 Replace defective or damaged materials with new;
 - .7 Store separated reusable wood waste convenient to cutting station and work areas.

3.2 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions:
 - .1 Visually inspect substrate;
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery;
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.3 SYSTEMS INTEGRATION

- .1 Install air barrier and vapour retarder sheeting around framing members to ensure continuity of protection and to lap and seal to main sheets.
- .2 Install insulation in exterior wall framing cavities that will not be accessible after completion of framing.

- .3 Install sill plate gasket in continuous lengths between concrete surfaces and wood framing.

3.4 FRAMING INSTALLATION

- .1 All joists should respect dimensions and spacing indicated on drawings. Support length should be at less 38 mm. Joists should fixed at supports with 90 mm nails at each on each ends.
- .2 Install engineered framing and plant fabricated structural wood components, including all hangers, connectors and fasteners, in accordance with accepted shop drawings and manufacturers' instructions.
- .3 Install members true to line, levels and elevations, square and plumb.
- .4 Construct continuous members from pieces of longest practical length.
- .5 Install spanning members with "crown-edge" up.
- .6 Select exposed framing for appearance. Install lumber panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .7 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .8 Countersink bolts where necessary to provide clearance for other work.
- .9 Install specified panel product for each application.
- .10 Install subflooring combined subfloor and underlay with panel end-joints located on solid bearing, staggered at least 800 mm:
 - .1 In addition to mechanical fasteners, floor panels secure floor subflooring to floor joists using screws. Place continuous adhesive bead in accordance with manufacturer's instructions, single-bead on each joist and double-bead on joists where panel ends butt.
- .11 Install wall sheathing in accordance with manufacturer's printed instructions.
- .12 Install roof sheathing in accordance with requirements of NBC and CAN/CSA O86.
- .13 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.
- .14 Spacers member should be installed in bearing or non-bearing stud wall partition. For partitions 2400 mm height or less. Only one intermediate line is required. For partitions over 2400 mm height, 2 lines of spacers should be installed.

3.5 FURRING AND BLOCKING

- .1 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit.

- .2 Install furring to support siding applied vertically [where there is no blocking and] where sheathing is not suitable for direct nailing.
 - .1 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .3 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .4 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.
- .5 Install sleepers as indicated.

3.6 CLEANING

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

3.7 WASTE MANAGEMENT

- .1 Waste materials management in accordance with Section 01 74 19 - Construction / demolition waste management and disposal.
- .2 Re-use scrap lumber to the greatest extent possible. Separate scrap lumber for use on site as accessory components, including shims, bracing, and blocking.
- .3 Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill. Prevent saw dust and wood shavings from entering the storm drainage system.
- .4 Do not burn scrap lumber that has been pressure treated.
- .5 Do not send lumber treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

END OF SECTION

Part 1 General**1.1 DESCRIPTION**

- .1 The Contractor shall provide all the materials, equipment and labour required to perform the installation of shop fabricated wood trusses including all attachments pieces and bolt.

1.2 RELATED REQUIREMENTS

- .1 01 74 00 – Cleaning
- .2 01 74 19 – Construction / demolition waste management and disposal
- .3 06 10 53 – Miscellaneous rough carpentry

1.3 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CAN/CSA O80 Series-08, Wood Preservation;
 - .2 CSA O86 Consolidation-09, Engineering Design in Wood;
 - .3 CSA O141-05 (R2009), Softwood Lumber;
 - .4 CSA S307-M1980 (R2001), Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings;
 - .5 CSA S347-99 (R2009), Method of Test for Evaluation of Truss Plates Used in Lumber Joints;
 - .6 CSA W47.1-F09, Certification of Companies for Fusion Welding of Steel;
 - .7 CAN/CSA-Z809-08, Sustainable Forest Management;
 - .8 CSA S307-M1980 (R2001), Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings.
- .2 Forest Stewardship Council (FSC):
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .3 National Lumber Grades Authority (NLGA):
 - .1 Standard Grading Rules for Canadian Lumber 2010.
- .4 National Research Council Canada (NRC):
 - .1 National Building Code of Canada 2015 (NBC);

- .2 Canadian Construction Materials Centre (CCMC), Registry of Product Evaluations.
- .5 Truss Plate Institute of Canada (TPIC):
 - .1 TPIC - 2007, Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses (Limit States Design).
- .6 Sustainable Forestry Initiative (SFI):
 - .1 SFI-2010-2014 Standard.

1.4 DESIGN REQUIREMENTS

- .1 Design light metal plate connected wood trusses in accordance with TPIC truss design procedures and in accordance with the requirements of CSA O86.
- .2 Design trusses, bracing and bridging in accordance with CSA O86 for loads indicated on the drawings and for minimum uniform and minimum concentrated loadings stipulated in NBC commentaries.
- .3 Limit live load deflection to 1/360th of span.
- .4 Specify camber for trusses following indications.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Fabricator for trusses to show evidence of quality control program such as provided by regional wood truss associations, or equivalent;
 - .2 Fabricator for welded steel connections to be certified in accordance with CSA W47.1.
- .2 Sustainable Standards Certification:
 - .1 Certified Wood: submit listing of wood products and materials used in accordance with CAN/CSA-Z809 or FSC or SFI.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 All drawings should be submitted to the Departmental Representative.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in province of Quebec.
- .3 Indicate special structural application and specification as according to local authorities having jurisdiction.

- .4 Indicate TPIC Truss Design Procedure and CSA O86 Engineering Design in Wood and specific CCMC Product Registry number of the truss plates.
- .5 Indicate species, sizes, and stress grades of lumber used as truss members. Show pitch, span, camber, configuration and spacing of trusses. Indicate connector types, thicknesses, sizes, locations and design value. Show bearing details. Indicate design load for members;
- .6 Submit stress diagram or print-out of computer design indicating design load for truss members. Indicate allowable load and stress increase;
- .7 Submit to the Departmental Representative all results for review;
- .8 Indicate the layout of webs or other members to facilitate the installation of pipes, ducts and other accessories;
- .9 Show location of lateral bracing for compression members;
- .10 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties;
- .11 Instructions: submit manufacturer's installation instructions.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area;
 - .2 Store and protect wood trusses from nicks, scratches, and blemishes;
 - .3 Replace defective or damaged materials with new;
 - .4 Provide bearing supports and bracings. Prevent bending, warping and overturning of trusses.

Part 2 Products

2.1 MATERIALS

- .1 Lumber: Canadian wood according species recognized by CSA O86, S4S, with maximum moisture content of 19 % at time of fabrication and to following standards:
 - .1 CSA O141;

- .2 NLGA (National Lumber Grading Association), Standard Grading Rules for Canadian Lumber.
- .2 Fastenings: in accordance with CSA O86.
- .3 Joining devices: galvanized steel plate in accordance with ASTM A924/A924M, size required, type of surface G90, with holes, dowel spaced uniformly.
- .4 Nails: Zinced steel in accordance with CSA B111.
- .5 Bolt: in accordance with ASTM-307-07b.
- .6 Lag screws: in accordance with CSA B34.
- .7 Gusset plate: steel plate, in accordance with CAN/CSA G40.21, type 300W.

2.2 FABRICATION

- .1 Fabricate wood trusses in accordance with reviewed shop drawings.
- .2 Provide for design camber and roof slopes when positioning truss members.
- .3 Connect members using metal connector plates metal gussets.
- .4 Apply preservative/fire retardant in accordance with CAN/CSA O80 Series.
- .5 Trusses elements should be cut with precision and right length, whit templates, to obtain tight joint at final assembly.
- .6 Assemble elements according to the theoretical layout using assembly templates or staple.

2.3 SOURCE QUALITY CONTROL

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.
- .2 Certify by agency accredited by Standards Council of Canada that preservative/fire retardant treated wood in accordance with CAN/CSA O80 Series.

Part 3 Execution

3.1 EXAMINATION

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

- .2 Inform the ministerial 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 the Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 ERECTION

- .1 Erect wood trusses, handling, installation, erection, bracing and lifting in accordance with manufacturers instructions.
- .2 Make adequate provisions for handling and erection stresses.
- .3 Exercise care to prevent out-of-plane bending of trusses.
- .4 Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing and decking are installed.
- .5 Install permanent bracing in accordance with reviewed approved shop drawings, prior to application of loads to trusses.
- .6 Do not cut or remove any truss material without approval of manufacturers or Departmental Representative.
- .7 Remove chemical and other surface deposits on treated wood, in preparation for applied finishes.
- .8 Limit loads on truss during the installation.
- .9 All wood trusses should be installed using lifting cables fixed at indicated manufacturer lifting points.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its 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 on which work of this Section depends is complete, but before installation begins;
- .2 Twice during progress of work at 25% and 100% complete.
- .2 Obtain reports within three days of review and submit immediately to Departmental Representative.

3.5 CLEANING

- .1 One the installation is completed, evacuate materials, waste, tools and equipment form site in accordance with Section 01 74 00 - Cleaning. Leave Work

3.6 WASTE MANAGEMENT

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

END OF SECTION

DIVISION 07

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .2 National Research Council Canada (NRC).
 - .1 National Building Code of Canada 2015 (NBC).
- .3 Underwriters Laboratories of Canada (ULC).
 - .1 ULC-S115-1995, Fire Tests of Fire-Stop Systems.

1.3 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 which are identified within Listed Systems Design to create on site fire-stop system.
- .4 Tightly Fitted (ref: NBC Part 3.1.9.1(1) and 9.10.9.6(1)): Penetrating items which are cast-in-place in buildings of noncombustible construction, or have 0 annular space, in buildings of combustible construction.
 - .1 Work tightly fitted should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and data sheets, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings to show, proposed material, reinforcement, anchorage, fastenings, and method of installation.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common 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, and 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.

1.6 DESCRIPTION OF WORK

- .1 Provide personnel, materials, equipment, and services required to install firebreaks and smoke controls around mechanical services passing through fire-resistant building components.

1.7 QUALITY ASSURANCE

- .1 The work in this Section shall be carried out by a qualified person, approved by the fire-stop manufacturer, employing qualified and certified personnel with experience in the installation/application of fire-stop and smoke controls.
- .2 All work shall be of superior quality and performed in accordance with the industry's best practices and in strict accordance with manufacturers' written specifications.
- .3 In case of fire-rated elements for which the manufacturer does not provide any ULC or CUL approved assembly, derived from similar UL listed or otherwise tested, drawings of such elements produced by the manufacturer's engineer must then be presented to local Authorities Having Jurisdiction, who will review and approve them prior their installation.
- .4 Site Meetings: Onsite inspections by the manufacturer, as prescribed in PART 3 ON-SITE QUALITY CONTROL, shall include site visits at the following stages:
 - .1 Once the products have been delivered and stored onsite, and preparatory work and other preliminary work were completed, but before the work begins;
 - .2 Twice during work, the first when completed at 25%, and the second at 60%;
 - .3 After completion of work and cleaning.

Part 2 Products**2.1 GENERAL**

- .1 All products used in the fire protection system shall be cUL, ULC, and FM certified, and shall be labeled as such.

2.2 MATERIAL

- .1 Fire-stop and smoke barrier assemblies:
 - .1 Asbestos-free materials and assemblies providing an effective barrier against flames, smoke, and gases, in accordance with CAN/ULC S115, having dimensions not exceeding those of the traverse or access point for which they are intended.
 - .2 Installation of fire-stop and smoke control assemblies: Certified by ULC, in accordance with CAN/ULC S115 requirements.
 - .3 The fire-resistance rating of all installed firebreaks shall not be less than the fire rating of the surrounding floors and walls, as specified in the Architectural Drawings.
- .2 Fire-stop assemblies for utility and service traverses: Tested according to CAN/ULC S115 Standard.
- .3 Components of fire-stop assemblies for utility and service traverses: Certified by a testing laboratory, in accordance with CAN/ULC S115.
- .4 The degree of fire resistance of installed fire-stop assemblies shall comply with the requirements of the NBC.
- .5 Fire-stop and smoke control assemblies installed at access points to concealed installations, e.g. cables: Elastomeric joints.
- .6 Fire-stop and smoke protection assemblies installed on pipes, air ducts, and other mechanical equipment requiring acoustic and vibration insulation: Elastomeric joints.
- .7 Fire-Stop Devices:
 - .1 High-speed fire-stop devices for plastic piping, made of an intumescent material expanding when exposed to temperatures of 300°F (149°C) or more. Material can expand up to 25 times its original volume to seal opening created by the plastic piping.
 - .2 Devices certified to CAN/ULC S115, in accordance with a test conducted at 50 Pa (0.2 in. of water) differential pressure, providing one- or two-hour fire resistance.
- .8 Primers: In accordance with manufacturer's recommendations as for material, substrate, and intended use.
- .9 Water (if applicable): Potable, clean, and free from excessive amounts of harmful substances.
- .10 Mineral Wool: Rock and slag fibers glued with heat resistant binder. Maximum service temperature 1,035°C (1,895°F). Materials with practically neutral pH.
- .11 Restraining, Supporting, and Anchoring Devices: As recommended by the manufacturer and compatible with assemblies used, proven, and deemed acceptable by the Authority Having Jurisdiction.
- .12 Sealants for vertical joints: Non-sagging products, in accordance with ULC test assemblies.

Part 3 Execution**3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Comply with manufacturer's requirements, recommendations, and written specifications, including any technical bulletins available, instructions for handling, storing and processing products, and data sheets.

3.2 PREPARATORY WORK

- .1 Examine the dimensions and condition of voids to be filled to determine thickness of material required and the method of application to be used.
 - .1 Ensure surfaces are clean, dry, and unfrozen.
- .2 Prepare surfaces coming in contact with fire-stop and smoke control materials, as directed by the manufacturer.
- .3 Ensure integrity of insulation surrounding pipes and ducts through fire walls, including vapor barrier.
- .4 If required, cover contiguous surfaces to protect them from dripping and splashing and, after completion of work, remove unwanted stains or deposits.

3.3 INSTALLATION

- .1 Install fire-stop and smoke control assemblies and their component parts in accordance with manufacturer's instructions for tested and certified assemblies.
- .2 Seal gaps and clearances around piping or devices crossing, wholly or partly, the fire walls and seal openings reserved for later use and joints around them to ensure the continuity and integrity of the fire-stop protection provided.
- .3 If required, install temporary retainers and do not remove them until the initial cure is complete and the materials have attained sufficient strength.
- .4 Shape exposed surfaces or trowel smooth to get neat finish.
- .5 Remove excess surplus product as work is advanced and as soon as work is completed.

3.4 WORK SCHEDULING

- .1 Proceed with installation only after documents/samples to be submitted have been reviewed by the Departmental Representative.
- .2 Install fire-stop protection of floors before installing interior walls.
- .3 Connection to a metal support: The fire-stop protection shall be carried out prior application of any fire-retardant coating to ensure the required connection
- .4 Mechanical System Pipe Insulation: Component of an approved fire-stop protection assembly.
 - .1 Ensure pipe insulation is installed before fire-stop protection.

3.5 ONSITE QUALITY CONTROL

- .1 Inspections: Before concealing or covering materials or fire-stop systems, inform the Departmental Representative that work is ready for inspection.
- .2 Manufacturer's Field Services:
 - .1 Obtain manufacturer's written report confirming that work complies with specified criteria regarding product handling, installation, and application, as well as protection and cleaning of work before submitting report in accordance with SUBMITTALS, as stated in PART 1.
 - .2 Manufacturer must provide recommendations regarding use of products and conduct periodic visits to verify if implementation is such as recommended.
 - .3 Site visits shall be in accordance with QUALITY ASSURANCE, of PART 1.

3.6 SITE CONDITIONS

- .1 Application and drying of fire-stop and smoke barrier materials must be in accordance with manufacturer recommendations regarding temperature, relative humidity, and moisture content of basecoats.
- .2 Protect all work against potential damage and deterioration caused by other trades and protect other trade installations against dirt and potential damage originating from this work.
- .3 Once completed, correct all imperfections and leave workplace in impeccable condition.

3.7 VERIFICATION

- .1 Check the surfaces of all fire-stops to be sealed. Provide a written report stating conditions that are non-compliant or deemed unacceptable by the Contractor before starting work.
- .2 Delay work until surface conditions are acceptable.

3.8 MIXING

- .1 Mix materials in strict compliance with manufacturer's instructions.
- .2 Components must be well prepared and mixed by qualified personnel.

3.9 COATING MATURATION

- .1 Allow coatings to mature according to manufacturer's recommendations.
- .2 Do not cover materials before maturation is complete.

3.10 INSPECTION OF WORK

- .1 Inform the Departmental Representative when work is ready for inspection. work shall not yet be covered by fireproofing, control materials, or any other services traversing fire-resistant partitions.
- .2 Inspect penetrations in fire-stop systems in accordance with ASTM E2174.

3.11 CLEANING

- .1 Once installation and performance monitoring are finished, remove extra materials, rubbish, and tools from site.
- .2 Take off temporary safety restraints once initial setting is complete.

3.12 TESTS

- .1 Perform smoke penetration simulation tests.
- .2 If joint finishing, gaps, or openings described in this Section show clear smoke emission during tests, correct all defects, and start smoke test again at no additional costs to the Departmental Representative.
- .3 Smoke simulation product must not be toxic nor staining and must provide fog density of 80 mg/m³ (0.00008 oz/in³) with acceptable air concentration levels of 50 ppm.
- .4 Create smoke at a rate of 4 seconds/2.8 m³ (4 seconds/100 in³) and maintain fog density until inspection is complete.

3.13 FIRE-STOP SYSTEM LOCATION

- .1 Ensure fire-stop and smoke barrier protection to building elements that are fire resistant, including the following places:
 - .1 Penetrations through partitions, masonry walls, concrete, and gypsum that are fire resistant;
 - .2 Penetrations through floor slabs, ceilings, and roofs that are fire resistant;
 - .3 Access openings and penetrations made in fire-resistant partitions for further use;
 - .4 Around pipes and other mechanical and electrical material that penetrate fire-resistant partitions;
 - .5 Rigid conduits with sections above 129 cm² (20 in.²): Fire protection by means of a fire-resistant joint located between angle bracket and fire-resistant partition, as well as between angle bracket and conduit on each side of the fire-resistant partition.

END OF SECTION

DIVISION 10

Part 1 General**1.1 RÉFÉRENCES**

- .1 National Research Council Canada (NRCC).
 - .1 National Fire Prevention Code (NFPC) 2015.
- .2 Underwriters Laboratory of Canada (ULC).
 - .1 CAN/ULC-S503, Standard for Carbon Dioxide Fire Extinguishers.
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 10-2013, Standard for Portable Fire Extinguishers.
 - .2 NFPA 170-2018, Standard for Fire Safety and Emergency Symbols.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 City of Rigaud.
 - .1 Bylaw 332-2015: Fire Prevention.

1.2 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications, and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Technical Specifications:
 - .1 Submit technical specifications and documentation from manufacturer. Shop drawings must provide the following information: Product characteristics, performance criterion, dimensions, constraints, and finish.
 - .2 Submit two copies of Materials Safety Data Sheets required as per WHMIS (Workplace Hazardous Materials Information System), and in accordance with Section 01 33 00.
- .3 Submit required shop drawings.

1.3 CLOSEOUT SUBMITTALS

- .1 Specs sheets and operation and maintenance literature, which will be appended to the manual mentioned in the Section 01 78 00 - Closeout Submittals.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Sort waste in order to re-use and recycle in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Collect packaging materials from site and send to appropriate recycling facilities.

- .3 Collect and sort plastic, paper, polystyrene and corrugated cardboard wrappings, and dispose them in appropriate designated bins in accordance with Waste Management Plan.
- .4 Sort iron waste, metal and plastic for reuse or recycling and deposited them in designated containers in accordance with Waste Management Plan.
- .5 Manipulate and eliminate hazardous materials in accordance with the Canadian Environmental Protection Act, Transportation of Dangerous Goods Act, and provincial and municipal regulations.
- .6 Transport unused metal elements to a recycling facility approved by the Departmental Representative.

1.5 QUALITY CONTROL

- .1 Health and Safety:
 - .1 Take necessary measures to ensure health and safety on construction site, in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 TRANSPORT, STORAGE, AND HANDLING

- .1 Conditioning, Transport, Handling, and Unloading:
 - .1 Transport, handle, and deliver materials and equipment as per manufacturers written instructions.
 - .2 Deliver materials and equipment in good condition to the construction site and in their closed original packaging which must bear the manufacturer's name, address and ULC approval.
- .2 Storage and Protection:
 - .1 Store materials and equipment as per manufacturers' recommendations, in a clean, dry, and well-ventilated place.
 - .2 Replace all defective materials and equipment with new materials and equipment.

1.7 ACCEPTABLE PRODUCTS OR MATERIALS

- .1 Where acceptable materials or products are prescribed by their trade-mark, refer to the Instructions to Bidders for instructions on the application for approval of materials or substitutes.

Part 2 Products

2.1 ALL-PURPOSE POWDER EXTINGUISHERS (EP-01)

- .1 All-purpose, refillable powder extinguishers, equipped with hose, fitting with shut-off valve and pressure gauge.

.2 Specification:

- .1 Certification: CAN/ULC-S504 and UL-299.
- .2 Fire types: A, B and C.
- .3 Minimum UL/ULC rating: 4A 80B-C.
- .4 Minimum extinguisher capacity : 4,54 kg (10 lb).
- .5 Actuation: Permanent pressure.

.3 Acceptable Products:

- .1 Ansul, model Sentry 10 - AA10S.
- .2 Amerex, model B456.
- .3 Strike First, model WBDL-ABC10.
- .4 Replacement product approved by addendum in accordance with the Instructions to Bidder.

2.2 CARBON DIOXIDE EXTINGUISHER (EP-02)

- .1 Fully charged carbon dioxide extinguisher, aluminum tank, equipped with isolated handle, flexible hose kit and spray nozzle, triggered by automatic lever type faucet or pressed lever, fully charged.

.2 Characteristics:

- .1 Approval: CAN/ULC-S503 and UL-154.
- .2 Fire types: B and C.
- .3 Minimum UL/ULC Class: 20B -C.
- .4 Minimum capacity: 9 kg (20 lb).
- .5 Actuation: Permanent pressure.

.3 Acceptable Products:

- .1 Strike First, model SF-20CO2.
- .2 Ansul, model Sentry 20 – CD10A-1.
- .3 Amerex, model 332.
- .4 Replacement product approved by addendum in accordance with the Instructions to Bidder.

2.3 EXTINGUISHER BRACKETS

- .1 Brackets as recommended by extinguishers manufacturer.

2.4 FIRE EXTINGUISHER CABINETS

- .1 Cabinets for semi-recessed installation as per specifications, made of 1.6 mm thick steel, with 2.5 mm thick steel door opening 180°.

- .2 Cabinets having a fire resistance rating equivalent to that of the structure on which they will be installed.
- .3 Cabinet door with piano hinge as per the following characteristics:
 - .1 5 mm thick solid glass, Duolite type, with closing latch.
- .4 Finition coating:
 - .1 Cabinet: primed.
- .5 Door and frame: 304 stainless steel, satin finish #4.
- .6 Acceptable Products:
 - .1 10 lb (4.5 kg) portable dry chemical fire extinguisher:
 - .1 Semi-recessed Cabinets: National Fire Equipment Ltd. model CE-950-3-2; Guardian model 1845.

2.5 LABELLING

- .1 Extinguishers must be labelled in accordance with NFPA 10 and CAN/ULC-S508 Standard.
- .2 Attach, stick, or affix label on extinguishers with bilingual inscription, showing year, month, and day of installation. Space must be provided to indicate periodic inspection dates.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Conformity: 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 or assemble extinguishers on brackets or in fire hose cabinets, as specified, while complying with NFPA 10 Standard and other indications.
 - .1 Install portable extinguishers so that his top is at most 1.53 m above ground and his bottom at least 102 mm above ground.
 - .2 Install portable extinguishers so that they are visible from anywhere.
 - .3 Install a visible label to indicate portable extinguisher presence in accordance to the requirements of the Architect.

3.3 FIELD QUALITY CONTROL

- .1 Ensure that all portable extinguishers are filled before installing.

.2 Field quality control from manufacturer:

- .1 The manufacturer must state his recommendations regarding the operation of the products and carry out periodical visits to verify that implementation is achieved as per recommendations.

3.4 CLEANING

- .1 Clean up as per Section 01 74 00 - Cleaning.

END OF SECTION

DIVISION 21

Part 1 General**1.1 RELATED SECTIONS**

- .1 Section 23 05 19.13 - Thermometers and Pressure Gauges - Piping Systems.
- .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .3 Section 23 05 48.16 - Seismic Restraint Systems (SRS).
- .4 Section 23 05 53 - Identification for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 Unless otherwise indicated, execute all works in accordance with the 2015 National Building Code of Canada as well as local bylaws and regulations.
- .2 Moreover, execute all work in compliance with all applicable Codes or Standards, current Editions, including namely the following, but not restricted to:
 - .1 American National Standards Institute (ANSI)/American Petroleum Institute (API).
 - .1 ANSI/API Spec 5L, Specification for Line Pipe.
 - .2 American Society for Testing and Material (ASTM).
 - .2 ASTM A-47M, Standard Specification for Ferritic Malleable Iron Castings.
 - .3 ASTM A-53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - .4 ASTM A-135, Standard Specification for Electric-Resistance-Welded Steel Pipe.
 - .2 Canadian Standard Association (CSA)/CSA International.
 - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
 - .3 City of Rigaud:
 - .1 Bylaw 332-2015: Fire Prevention.
 - .4 National Fire Protection Association (NFPA).
 - .1 ANSINFPA 13 (2019), Installation of Sprinkler Systems.
 - .2 NFPA 25 (2017), Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
 - .3 NFPA 170 (2018), Standard for Fire Safety and Emergency Symbols.
 - .5 National Research Council Canada (NRC).
 - .1 National Building Code 2015.
 - .2 National Fire Code of Canada (NFC) 2015.
 - .6 Underwriter's Laboratories of Canada (ULC).
 - .1 CAN/ULC S543, Internal Lug Quick Connect Coupling for Fire Hose.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit data sheets as per 01 33 00 - Submittal Procedures. Submit the required data sheets and manufacturer's documentation for the relevant equipment and systems, Series or models. Data sheets shall include product characteristics, performance criteria, dimensions, limitations, and finish.
- .2 Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures and in accordance with NFPA 13 Standard.
 - .2 Submit erection drawing in accordance with execution drawing and prescribed criteria in NFPA 13 Standard.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit all required documents and items after completion of work for incorporation into manual such as specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance Data Sheets.
 - .1 Maintenance data sheets must include the following elements:
 - .1 Technical data from catalogs and product literature, including the model number, type, and size for the items mentioned below:
 - .1 Piping and fittings;
 - .1 Sprinklers;
 - .2 Alarm check valves;
 - .3 Valves, including gate valves, check valves, and globe valves;
 - .4 Pipes, hangers, and suspension;
 - .5 Couplings;
 - .6 Monitoring switches;
 - .2 Fire department connection.
 - .1 Relevant details concerning operation, maintenance, and servicing.
 - .2 A list of recommended spare parts.
- .3 Provide a copy of NFPA 25 "Inspection, Testing, and Maintenance of Water Based Fire Protection Systems" and incorporate it into the "Operation and Maintenance Manual".

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Sort waste in order to re-use and recycle in compliance with Section 01 74 19 - Waste Management and Disposal.
- .2 Collect packaging materials and send to appropriate recycling facilities.

- .3 Collect and sort plastic, paper, and corrugated cardboard wrappings, and dispose them in appropriate designated bins in compliance with the Waste Management Plan.
- .4 Fold up metal banding, flatten, and place in designated area for recycling.
- .5 Eliminate hazardous materials in compliance with the Canadian Environmental Protection Act, Transportation of Dangerous Goods Act, and provincial and municipal regulations.
- .6 Transport unused metal elements to a recycling facility approved by the Departmental Representative.

1.6 DIAGRAM

- .1 Submit diagram complying with requirements.
- .2 Submitted diagram must include following items:
 - .1 A key localisation plan at 1: 500 scale.
- .3 Once approved, provide two (2) laminated copies of the diagram, plasticized, glued on plywood, and inserted in a solid wooden frame.
- .4 Install one (1) diagram in the alarm valve room and deliver the other one to the Owner.

1.7 QUALITY CONTROL

- .1 Qualifications:
 - .1 Experienced person or company specializing in the installation of wet pipe sprinkler systems, with references to support claim.
- .2 Health and Safety:
 - .1 Take necessary measures to ensure health and safety on construction site, in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Submit the following documents in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Test reports:
 - .1 Submit test reports issued by recognized independent laboratories, certifying that automatic wet pipe sprinkler systems comply with requirements regarding physical characteristics and performance criteria.
 - .2 Submit documents signed by manufacturer certifying that products, materials and equipment meet requirements regarding physical characteristics and performance criteria.
 - .3 Instructions: Submit installation instructions provided by manufacturer.
 - .4 Manufacturer on-site checks: Submit required report.

1.8 SPARE PARTS AND MAINTENANCE

- .1 Provide spare sprinklers and tools as required by ANSI/NFPA 13 Standard.

1.9 TRANSPORT, STORAGE, AND HANDLING

- .1 Conditioning, transport, handling, and unloading:
 - .1 Transport, store, and handle materials and equipment as per manufacturer's written instructions.
 - .2 Deliver materials and equipment to the project site in good condition and in their original packaging which must bear the manufacturer's name, make, and ULC approval.
- .2 Storage and Protection:
 - .1 Store materials and equipment inside as per manufacturers' instruction, in a dry, well-ventilated, and clean area.
 - .2 Replace defective or damaged materials and equipment by new materials and equipment.

1.10 ACCEPTABLE PRODUCTS OR MATERIALS

- .1 Where acceptable materials or products are prescribed by their trademark, refer to the Instructions to Bidders for instructions on the application for approval of materials or substitutes.

Part 2 Products**2.1 GENERAL**

- .1 All products used in fire safety installations must be "cUL" or "ULC" listed and must be labelled as such.
- .2 Provide accessories that can withstand the normal pressure exerted in the fire protection network.

2.2 PIPES AND FITTINGS

- .1 Pipes:
 - .1 Pipes up to NPS 50:
 - .1 Black steel, Schedule 40, threaded, complying with ANSI/NFPA 13 and ASTM A-53 or ASTM A-135 Standards.
 - .2 Pipes NPS 65 and over:
 - .1 Black steel, Schedule 40, grooved or threaded, complying with ANSI/NFPA 13 and ASTM A-53 or ASTM A-135 Standards.
 - .3 Acceptable products: Allied; Bull Moose; Wheatland.
- .2 Fittings and couplings as per NFPA 13 Standard:
 - .1 Fittings and couplings up to NPS 50:
 - .1 Couplings and fittings, rigid type, from the same manufacturer.

- .2 Fittings and couplings NPS 65 and over:
 - .1 Couplings and fittings, rigid type, from the same manufacturer.
 - .2 Grooved-end pipe couplings, in compliance with CSA B242 and ANSI B-3620 (API-5L) Standards.
 - .3 Grooved-end fittings in compliance with ASTM-A-536, grade 65-45-12.
- .3 Acceptable Products:
 - .1 Fittings: Victaulic, Firelock or EZ Firelock; Gruvlock, Rigidilite 7400 Series; Viking.
 - .2 Couplings: Victaulic Vic-plus or "Flushseal"; Gruvlock.

2.3 VALVES

- .1 All valves to be listed for fire protection service.
- .2 Valves, NPS 50 and less, threaded:
 - .1 Bronze gate valves, with outside screw and yoke (OS&Y):
 - .1 Acceptable products: Maximum service pressure of 1.2 MPa (175 psi): Nibco.
 - .2 Bronze ball valves:
 - .1 Acceptable products: Maximum service pressure of 1.7 MPa (250 psi) Victaulic S/728 Firelock supervise contact; Victaulic; Anvil; Nibco.
- .3 Gate valves, NPS 65 and over, grooved:
 - .1 Ductile iron gate valve with outside screw and yoke (OS&Y).
 - .1 Acceptable products: Maximum service pressure of 1.2 MPa (175 psi): Victaulic.
- .4 Butterfly valves, NPS 65 and over with monitoring switch:
 - .1 Ductile iron butterfly valves, with indicating yoke, grooved ends:
 - .1 Acceptable products: Maximum service pressure of 1.2 MPa (175 psi): Nibco.
 - .2 Acceptable products: Maximum service pressure of 1.7 MPa (250 psi): Victaulic S/705W Firelock; Tyco, models BFV-N, TFP1510 and TFP1515; Gruvlok, models GN722-FP, GN7722-6D, and AE7722-3A.
- .5 Swing check valves with composite material disc:
 - .1 Flanged ends:
 - .1 Acceptable products: Maximum service pressure of 1.2 MPa (175 psi): Nibco F908W.
 - .2 Acceptable products: Maximum service pressure of 1.7 MPa (250 psi): Viking D-1 and G-1 flanged.
 - .2 Grooved ends:
 - .1 Acceptable products: Maximum service pressure of 1.2 MPa (175 psi): Globe CV-1-S.
 - .2 Acceptable products: Maximum service pressure of 1.7 MPa (250 psi): Victaulic S/717 Firelock; Gruvlok 78FP and 7800 Series; Viking D-1 and G-1 grooved.

- .3 Quiet type, adapted for flanged ends:
 - .1 Acceptable products: Maximum service pressure of 1.7 MPa (250 psi): Rite, model 212.

2.4 SPRINKLERS

- .1 General Requirements: Sprinkler heads complying with ANSI/NFPA 13 Standard and approved for fire protection service.
- .2 Sprinkler guard for sprinkler exposed to mechanical shock, with zinc coated steel rod.
 - .1 Guards must be approved for sprinkler head.
- .3 For tender, provide an additional amount for a 3% extra quantity for each type of sprinkler, including labor for the installation.
- .4 Upright Sprinkler:
 - .1 Upright sprinkler, quick-response, standard coverage, with frangible bulb, "K" factor of $80.6 \text{ L/min}/(\text{Bar})^{1/2}$ (5.6 US gal/min/(psi)^{1/2}) (G-05):
 - .1 Acceptable products:
 - .1 Fast response sprinklers: Viking; Victaulic; Globe.
 - .2 Temperature ratings: 68°C (155°F).
 - .3 Finish: Bronze.
- .5 Pendant Sprinkler:
 - .1 Semi-recessed type pendant sprinklers, with escutcheon, quick-response, standard coverage, with frangible bulb, "K" factor of $80.6 \text{ L/min}/(\text{Bar})^{1/2}$ (5.6 gal US/min/(psi)^{1/2}) (G-06).
 - .1 Acceptable products:
 - .1 Fast response sprinklers: Viking; Victaulic; Globe.
 - .2 Temperature ratings: 68°C (155°F).
 - .3 Finish: Chrome.

2.5 WET PIPE ALARM CHECK VALVE

- .1 Wet pipe alarm check valve complying with ANSI/NFPA 13, for fire protection use, including an excess pressure pump 120/1/60, pump pressure switch, relief valve, high and low pressure switches, flow detector, supervised control valve, pressure gauges, and all accessories and piping required for proper check valve assembly.
 - .1 Acceptable products: Viking, model J-1; Victaulic, style 759 or 751; Tyco, model AV-1-300.

2.6 PIPE HANGERS

- .1 Hangers for fire protection service must be ULC approved, in compliance with ANSI/NFPA 13 standard.

- .2 Refer to Sections 23 05 29, Hangers and Supports for HVAC Piping and Equipment and 23 05 48.16, Seismic Restraint Systems.

2.7 MONITORING SWITCHES

- .1 General: Switches approved for fire protection service, complying with ANSI/NFPA 13 prescriptions.
- .2 Valves:
 - .1 Mechanically attached to valve body, with normally open and normally closed contacts, and with monitoring capability.
 - .2 Add monitoring contacts on non-supervised valves, as indicated on site.
 - .3 Acceptable products:
 - .1 OS&Y valves: System Sensor.
 - .2 Pluggable valves: System Sensor.
- .3 Flow Switch:
 - .1 Designed to ensure monitoring of the system.
 - .1 Acceptable products: System Sensor; Potter.
- .4 Pressure Switches:
 - .1 Designed to ensure monitoring of the system.
 - .2 Acceptable products, high and low pressure:
 - .1 System Sensor; Potter.
 - .3 Acceptable products, pressure alarm switch: System Sensor; Potter.

2.8 FIRE PROTECTION GONG

- .1 Hydraulic gong complying with ANSI/NFPA 13, for fire protection use. Hydraulic gong shall be installed in the indicated location.
 - .1 Acceptable products: Victaulic, style 760; Viking; Tyco.

2.9 TEST AND DRAIN VALVE

- .1 Combined valve for test and drain, including one (1) ball valve.
 - .1 Acceptable products: Victaulic; Tyco.

2.10 FIRE DEPARTMENT CONNECTION

- .1 Siamese connection, comply with ANSI/NFPA 13, installed where indicated, with threaded metal cap and chain and threaded corresponding to the one of the local fire department.

- .2 Connection with the following characteristics: Bronze, polish finish, for wall mounted, with chrome indicating plate, threaded cap, and bronze metal chain.

- .1 Acceptable products: Giacomini A95.

2.11 PRESSURE GAUGES

- .1 Pressure gauges in compliance with Section 23 05 19.13 - Thermometers and Pressure Gauge - Piping Systems.
- .2 Maximum limit of not less than twice normal working pressure at point where installed.

2.12 IDENTIFICATION

- .1 Metal nameplate for test/drain valves: To ANSI/NFPA 13 Standard.
- .2 Provide a hydraulic design information sign for each hydraulic calculation. It shall be permanently installed at the base of riser and shall include the following information:
 - .1 Location of the design area;
 - .2 Discharge density over the design area;
 - .3 System flows and residual pressures requirements at the base of riser;
 - .4 Occupancy classification;
 - .5 Hose stream allowance included.
- .3 Fire protection equipment identification to NFPA 170, Standard for Fire Safety and Emergency Symbols.
- .4 Refer to Section 23 05 53 - Identification for HVAC Piping and Equipment.

2.13 SPARE PARTS CABINETS IDENTIFICATION

- .1 Cabinet for maintenance material, special tools, and spare sprinklers, including sprinkler wrench.
- .2 The cabinet must be installed nearby the sprinkler systems alarm check valve.
- .3 There must be a minimum of one (1) spare sprinkler for each type of sprinkler installed. The stock of spare sprinklers must comply with NFPA 13 Standard.
- .4 Cabinets must be constructed as per sprinkler system manufacturer's standards.
- .5 Acceptable Products: Victaulic; Grinnell; Viking.

2.14 EXCESS PRESSURE PUMP

- .1 Pump: Positive displacement, close coupled, direct drive, complete with cut-off valve.

- .2 Motor: Single phase, induction, squirrel cage, 120 V, 60 Hz, 1 phase, 0.25 kW, 1,725 RPM, open drip proof motor, ball bearings, Class B, complying with EEMAC, continuous duty, and capable of resisting a 50°C temperature raise.
- .3 Flow: 7,6 L/min (2 gal US/min).
- .4 Contact for excess pressure pump, set for a 103 kPa pressure difference.
- .5 Electrical Connections: As per Division 26.
- .6 Pump suction complete with control valve, strainer and flexible coupling; pump discharge complete with cut-off valve, check valve, control valve, and flexible coupling.
- .7 Acceptable products:
 - .1 Pump: Albany, model CEP-93-3.
 - .2 Control contactor: Allen-Bradley, 836T.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install, inspect, and perform acceptance tests in accordance with ANSI/NFPA 13 Standard.
- .2 Execute installation in accordance with established Standards and Laws, Regulations, and current Codes and Standards requirements.
- .3 Proper operation and installation coordination of the system, including automatic sprinkler system, system's monitoring points as well as the systems commissioning are all under the Fire Protection Contractor's responsibility.
- .4 Install excess pressure pump and connect it to the alarm check valve, as per manufacturer's instructions.
- .5 Clearly identify main shut-off valves, drain valves and all auxiliary valves.
- .6 Install sprinkler system test drains to open drains.
- .7 Install hydraulic calculations information placard at alarm valve.

3.3 TRAINING

- .1 Contractor shall organize a 4-hour training session for the building's operation and maintenance staff, in presence of the Departmental Representative.
- .2 Staff training shall cover normal sprinkler system operation, emergency procedure, and system maintenance, as per NFPA 25 Standard.

3.4 TESTS AND VERIFICATIONS

- .1 Carry out the following tests on the sprinkler system, complying with NFPA 13 Standard:
 - .1 Execute complete hydrostatic testing on the automatic sprinkler systems piping and appurtenances at a pressure of 1,380 kPa (200 psi) for 2 hours;
 - .2 Complete a flow test through the test connection in order to confirm flow switches operation. The alarm signals must be transmitted to the alarm panel within one-minute maximum starting at test connection opening and during test flow;
 - .3 Complete a flow test through the test connections fully opened to ensure that no pressure build-up occurs in the drainage piping, that could affect the proper operation of the system.
- .2 Conduct tests in presence of the representative of the Departmental Representative and supply test certificates, as required by ANSI/NFPA 13.

3.5 REPORT AND CERTIFICATE

- .1 Provide both inspection report and inspection attestation to the Departmental Representative at the end of the project, in addition to the properly completed and signed contractor materials and tests certificate. Record all tests results in a notebook appended to the report.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Once installation and performance control work done, remove surplus material, waste, tools, and equipment from the work site.

END OF SECTION

Part 1 General**1.1 RELATED SECTIONS**

- .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .2 Section 23 05 48.16 - Seismic Restraint Systems (SRS) - Type 2 Buildings.
- .3 Section 23 05 53 - Identification for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 Unless otherwise indicated, execute all works in accordance with the 2015 Edition of National Building Code of Canada and local bylaws and regulations.
- .2 Moreover, execute all work in compliance with all applicable Codes or Standards, current editions, including namely the following, but not restricted to:
 - .1 American National Standards Institute (ANSI)/American Petroleum Institute (API).
 - .1 ANSI/API Spec 5L, Specification for Line Pipe.
 - .2 American Society for Testing and Material (ASTM).
 - .1 ASTM A-47M, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A-53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - .3 ASTM A-135, Standard Specification for Electric-Resistance-Welded Steel Pipe.
 - .3 Canadian Standard Association (CSA)/CSA International.
 - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
 - .4 City of Rigaud.
 - .1 Fire Prevention By-law No. 332-2015.
 - .5 National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 13 (2019), Installation of Sprinkler Systems.
 - .2 NFPA 25 (2017), Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.
 - .3 NFPA 170 (2018), Standard for Fire Safety and Emergency Symbols.
 - .6 National Research Council Canada (NRC).
 - .1 National Building Code (NBC) 2015
 - .2 National Fire Code of Canada (NFC) 2015.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit data sheets as per 01 33 00 - Submittal Procedures. Submit the required data sheets and manufacturer's documentation for the relevant equipment and systems, Series or models. Data sheets shall include product characteristics, performance criteria, dimensions, limitations and finish.
- .2 Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures and in accordance with NFPA 13 Standard.
 - .2 Submit erection drawing in accordance with execution drawing and prescribed criteria in NFPA 13 Standard.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit all required documents and items after completion of work for incorporation into manual such as specified in Section 01 78 00 - Closeout Submittals.
- .2 Maintenance Data Sheets:
 - .1 Maintenance data sheets must include the following elements:
 - .1 Technical data from catalogs and product literature, including the model number, type and size for the items mentioned below:
 - .1 Piping and fittings;
 - .2 Valves;
 - .3 Hangers and suspension;
 - .4 Couplings;
 - .5 Sprinklers.
 - .2 Relevant details concerning operation, maintenance, and servicing.
 - .3 A list of recommended spare parts.
- .3 Provide a copy of NFPA 25 "Inspection, Testing, and Maintenance of Water Based Fire Protection Systems" and incorporate it into the "Operation and Maintenance Manual".

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Sort waste in order to re-use and recycle in compliance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Collect packaging materials and send to appropriate recycling facilities.
- .3 Collect and sort plastic, paper, and corrugated cardboard wrappings, and dispose them in appropriate designated bins in compliance with the Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

- .5 Eliminate hazardous materials in compliance with the Canadian Environmental Protection Act, Transportation of Dangerous Goods Act, and provincial and municipal regulations.
- .6 Transport unused metal elements to a recycling facility approved by the Departmental Representative.

1.6 DIAGRAM

- .1 Submit diagram complying with requirements.
- .2 Submitted diagram must include following items:
 - .1 A key localisation plan at 1: 500 scale.
- .3 Once approved, provide two (2) laminated copies of the diagram, plasticized, glued on plywood, and inserted in a solid wooden frame.
- .4 Install one (1) diagram in the alarm valve room and deliver the other one to the Departmental Representative.

1.7 QUALITY CONTROL

- .1 Qualifications:
 - .1 Installer: Experienced person or company specializing in installation of dry pipe sprinkler systems, with references to support claim.
- .2 Health and Safety:
 - .1 Take necessary measures to ensure health and safety on construction site, in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Submit the following documents in accordance with Section 01 33 00 - Submittal Procedures:
 - .1 Test reports:
 - .1 Submit test reports issued by recognized independent laboratories, certifying that automatic wet pipe sprinkler systems comply with requirements regarding physical characteristics and performance criteria;
 - .2 Certificates: Submit documents signed by manufacturer certifying that products, materials, and equipment meet requirements regarding physical characteristics and performance criteria;
 - .3 Instructions: Submit installation instructions provided by manufacturer;
 - .4 Manufacturer on-site checks: Submit required report.

1.8 SPARE PARTS AND MAINTENANCE

- .1 Provide extra material spare parts for maintenance as required by Section 01 78 00 - Closeout Submittals.
- .2 Provide spare sprinklers and tools as required by NFPA 13 Standard.

1.9 TRANSPORT, STORAGE AND HANDLING

- .1 Conditioning, transport, handling, and unloading:
 - .1 Transport, store, and handle materials and equipment as per manufacturer's written instructions.
 - .2 Deliver materials and equipment to the project site in good condition and in their original packaging which must bear the manufacturer's name, make, and ULC approval.
- .2 Storage and Protection:
 - .1 Store materials and equipment inside as per manufacturers' instruction, in a dry, well-ventilated, and clean area.
 - .2 Replace defective or damaged materials and equipment by new materials and equipment.

1.10 ACCEPTABLE PRODUCTS OR MATERIALS

- .1 Where acceptable materials or products are prescribed by their trademark, refer to the Instructions to Bidders for instructions on the application for approval of materials or substitutes.

Part 2 Products**2.1 GENERAL**

- .1 All products used in fire safety installations must be "cUL" or "ULC" listed and must be labelled as such.
- .2 Provide accessories that can withstand the normal pressure exerted in the fire protection network.

2.2 PIPES AND FITTINGS

- .1 Pipes:
 - .1 Pipes up to NPS 50:
 - .1 Galvanized steel, Schedule 40, threaded, complying with NFPA 13 and ASTM A-53 or ASTM A-135 Standards.
 - .2 Pipes NPS 65 and over:
 - .1 Galvanized steel, Schedule 10, grooved or threaded, complying with NFPA 13 and ASTM A-53 or ASTM A-135 Standards.
 - .3 Acceptable products: Allied; Bull Moose; Wheatland.
- .2 Fittings and couplings as per NFPA 13 Standard:
 - .1 Use fitting and joints with galvanized finish when using galvanized piping.
 - .2 Fittings and couplings up to NPS 50:
 - .1 Couplings and fittings, threaded, rigid type, from the same manufacturer.
 - .3 Fittings and couplings NPS 65 and over:
 - .1 Couplings and fittings, rigid type, from the same manufacturer.

- .2 Grooved-end pipe couplings, in compliance with CSA B242 and ANSI B-3650 (API-5L) Standards.
- .3 Grooved-end fittings in compliance with ASTM-A-536, grade 65-45-12.
- .4 Acceptable products:
 - .1 Fittings: Victaulic, Firelock or EZ Firelock; Gruvlock, Rigidilite 7400 Series; Viking.
 - .2 Couplings: Victaulic Vic-plus or "Flushseal"; Gruvlock.

2.3 VALVES

- .1 All valves to be listed for fire protection service.
 - .1 Valves, NPS 50 and less, threaded:
 - .1 Acceptable products: Maximum service pressure of 1.7 MPa (250 psi) Victaulic S/728 Firelock supervise contact; Victaulic; Anvil; Jenkins.
 - .2 Ball drip:
 - .1 Acceptable products: Maximum service pressure of 1.7 MPa (250 psi): Victaulic; Viking.

2.4 SPRINKLERS

- .1 General Requirements: Sprinkler heads complying with NFPA 13 Standard and approved for fire protection service.
- .2 For tender, provide an additional amount for a 3% extra quantity for each type of sprinkler, including labor for the installation.
- .3 Dry-type Pendant Sprinklers:
 - .1 Recessed pendant sprinkler, dry-type, with escutcheon, quick response, standard coverage, with frangible bulb, "K" factor of $80.6 \text{ L/min}/(\text{Bar})^{1/2}$ ($5.6 \text{ US gal/min}/(\text{psi})^{1/2}$) (G-01):
 - .1 Acceptable products:
 - .1 Quick response sprinklers: Viking; Victaulic; Globe.
 - .2 Temperature rating: 68°C (155°F), 93°C (200°F), 141°C (286°F), as required.
 - .3 Finish: Chrome.
- .4 Attic Sprinklers:
 - .1 Specific application sprinklers for attics, "back-to-back" type, extended coverage in combustible construction, with frangible bulb, "K" factor of $115.5 \text{ L/min}/(\text{Bar})^{1/2}$ ($8.0 \text{ US gal/min}/(\text{psi})^{1/2}$) (G-02):
 - .1 Acceptable products:
 - .1 Attic sprinklers: Tyco, model BB1 TY4180.

- .2 Specific application sprinklers for protecting attics, "single directional" type, extended coverage in combustible construction, with frangible bulb, "K" factor of $80.6 \text{ L/min}/(\text{Bar})^{1/2}$ ($5.6 \text{ US gal/min}/(\text{psi})^{1/2}$) (G-03):
 - .1 Acceptable products:
 - .1 Attics sprinklers: Tyco, model SD1 TY3183.
- .3 Specific application sprinklers for protecting attics, "attic plus" type, extended coverage in combustible construction, with frangible bulb, "K" factor of $80.6 \text{ L/min}/(\text{Bar})^{1/2}$ ($5.6 \text{ US gal/min}/(\text{psi})^{1/2}$) (G-04):
 - .1 Acceptable products:
 - .1 Attics sprinklers: Tyco, model AP TY3190.
- .4 Temperature rating: 93°C (200°F).
- .5 Finish: Brass.

2.5 PIPE HANGERS

- .1 Hangers for fire protection service, in compliance with NFPA 13 Standard.
- .2 Refer to Sections 23 05 29 - Hangers and Supports for HVAC Piping and Equipment and 23 05 48.16 - Seismic Restraint Systems (SRS) - Type 2 Buildings.

2.6 SPARE PARTS

- .1 Provide maintenance equipment, such as special tools and replacement sprinkler heads, including a sprinkler key.
- .2 Store maintenance/replacement equipment inside maintenance/replacement equipment cabinet. There must be at least one (1) model of each type of sprinkler head. Number of replacement sprinkler heads must be in accordance with ANSI/NFPA 13.

2.7 IDENTIFICATION

- .1 Fire protection equipment identification to NFPA 170, Standard for Fire Safety and Emergency Symbols.
- .2 Refer to Section 23 05 53 - Identification for HVAC Piping and Equipment.

2.8 MAINTENANCE EQUIPMENT AND SPARE PARTS CABINETS

- .1 Storage cabinets for maintenance equipment, special tools, and replacement sprinklers.
- .2 Cabinets installed near the alarm valves.
- .3 There must be at least one model of each sprinkler head. The quantity of sprinkler heads to comply with NFPA 13 Standard.
- .4 Cabinets built as per manufacturer's sprinkler systems standards.

- .5 Acceptable Products: Victaulic; Grinnell; Viking.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Execute installation in accordance with established Standards and Laws, Regulations, and current Codes and Standards requirements.
- .2 Proper operation and installation coordination of the system, including automatic sprinkler system, detection system, system's monitoring points as well as the systems commissioning, are all under the Fire Protection Contractor's responsibility.
- .3 Clearly identify drain valves, and all auxiliary valves.
- .4 Install hydraulic calculations information placard at alarm valve.
- .5 Install pre-action piping network with a slope to drain the system thru the lowest point. Slope of 0.4% on secondary branch and 0.2% on main branch.
- .6 Drain network at the end of tests.

3.3 TRAINING

- .1 Contractor shall organize a 4-hour training session for the building's operation and maintenance staff, in presence of the Departmental Representative.
- .2 Staff training shall cover normal sprinkler system operation, emergency procedure, and system maintenance, as per NFPA 25 Standard.

3.4 TESTS AND VERIFICATIONS

- .1 Carry out the following tests on the sprinkler system, complying with ANSI/NFPA 13 and NFPA 25 Standards:
 - .1 Perform an airtightness test on the piping network at 275 kPa (40 psi), during a period of 24 hours. Correct every air leaking who allow a loss of pressure of more than 10 kPa (1.5 psi) during the 24 hours test.
 - .2 Complete a flow test through the test connection of each zones in order to confirm flow switches operation. The alarm signals must be transmitted to the alarm panel within one-minute maximum starting at test connection opening and during test flow.

- .3 Perform a test to demonstrate that the air pressure can be recovered in the piping network in less than 30 minutes.
- .2 Provide an attestation certificate in accordance with CAN/ULC-S537 Standards.
- .3 Conduct tests in presence of the Departmental Representative, and supply test certificates, as required by NFPA 13.

3.5 REPORT AND CERTIFICATE

- .1 Provide both inspection report and inspection attestation to the Departmental Representative at the end of the project, in addition to the properly completed and signed Contractor materials and tests certificate. Record all tests results in a notebook appended to the report.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Once installation and performance control work done, remove surplus material, waste, tools, and equipment from the work site.

END OF SECTION

DIVISION 22

Part 1 General**1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance (O&M) clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data of systems and apparatuses, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable Codes.
 - .3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: Use MCAC Shop Drawing Submittal Title Sheet. Identify section and paragraph number.
- .4 Erection Drawings:
 - .1 Prepare and submit erection drawings to coordinate the work of the various construction sub-trades. Construction drawings are required for the following work:
 - .1 Ventilation-climatization work of all the building;
 - .2 Plumbing (Domestic water and drainage);
 - .3 Fire protection work.
 - .2 All erection drawings shall be prepared with the latest AutoCAD version, presented as DWG and PDF files. Drawings shall be an appropriate scale, but no smaller than 1:50.
 - .3 The erection drawings shall consist of plans to scale, indicating the position of equipment, ducts, piping, valves, and other fittings with required Sections and details, including the dimensions of piping and ducts, openings, anchors, and supports, relative positions with framework, architectural works, and other mechanical and electrical works.
 - .4 Preparation:
 - .1 Each discipline shall do its own erection drawing and coordinate it with other disciplines.
 - .2 The General Contractor shall be responsible for the coordination of the erection drawings of all mechanical and electrical trades which shall provide all data, schematics, drawings, and diagrams necessary for this coordination work.

- .3 The Ventilation-Climatization Contractor shall prepare a design of its own work with all necessary data and dimensions, and incorporate all information provided by the other trades.
- .4 All erection drawings shall be submitted for review simultaneously.
- .5 Mechanical and Electrical Contractors shall work in close collaboration to determine the location of their respective works to avoid clashes.
- .5 Responsibilities:
 - .1 Each subcontractor is directly responsible for the location and exact dimensions of the openings, bases, perforations, the location of its equipment, piping and ducts, whether dimensions figure in the structural, architectural, or engineering drawings or not.
 - .2 The Ventilation-Climatization Contractor shall ensure the perfect coordination of erection drawings.
 - .3 No compensation shall be awarded for modifications to the work, for coordination and integration purposes of mechanical and electrical systems with each other.
 - .4 The Departmental Representative's verification of the erection drawings is limited to ensuring that the technical requirements appear to be met (FD, grilles, insulation, etc.). The Departmental Representative does not verify the quality of the coordination carried out by contractors.

1.2 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data:
 - .1 Operation and Maintenance Manual shall be approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems, including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation, and troubleshooting instructions for each component.
 - .2 Data to include schedules of tasks, frequency, tools required, and task time.

- .4 Performance data to include:
 - .1 Equipment manufacturer's performance data sheets with point of operation, as left after commissioning is complete.
 - .2 Device/equipment performance test results.
 - .3 Other particular performance data as specified elsewhere in Contract Documents.
 - .4 Testing, adjusting, and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit one (1) copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted, unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into Operation and Maintenance Manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide one set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and changes occur.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make drawings available for reference purposes and inspection.
- .8 "As-built" drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of "As-built" drawings.
 - .2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: - AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting, and balancing for HVAC using "As-built" drawings.
 - .5 Submit completed reproducible "As-built" drawings with the Operating and Maintenance Manual.
 - .6 Print plumbing single-line diagrams on an A1 size sheet, to be installed underneath a plastic type plexiglass. Install drawings at locations indicated by BGIS on site.
- .9 Submit copies of "As-built" drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Supply spare parts as follows:
 - .1 One set of packing for each pump;
 - .2 One casing joint gasket for each size pump;
 - .3 One head gasket set for each heat exchanger;
 - .4 One glass for each gauge glass;
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment/apparatus as recommended by manufacturers.
- .4 Supply one commercial quality grease gun, grease, and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, 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.

Part 2 Products**2.1 NOT USED**

- .1 Not used.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: Prior to installation:
 - .1 Visually inspect surfaces/supports in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch-up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

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

3.4 FIELD QUALITY CONTROL

- .1 Site Tests: Conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 DEMONSTRATION

- .1 Departmental Representative will use equipment, apparatus, and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment, and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting, and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use Operation and Maintenance Manual, "As-built" drawings, and audiovisual aids as part of training materials.
- .4 Training duration time requirements as specified in appropriate Sections.
- .5 Departmental Representative will record these demonstrations on video tape for future reference.

3.6 CLEANING

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

3.7 PROTECTION

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 00 - Common Work Results for Plumbing.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM).
 - .1 ASTM A126-04 (2009), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA).
 - .1 ANSI/AWWA C700-09, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
 - .2 ANSI/AWWA C701-12, Standard for Cold Water Meters-Turbine Type for Customer Service.
 - .3 ANSI/AWWA C702-10, Standard for Cold Water Meters-Compound Type.
- .3 CSA Group (CSA).Good!
 - .1 CSA-B64 Series-11, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B79-08, Commercial and Residential Drains and Cleanouts.
 - .3 CAN/CSA-B356-10, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Efficiency Valuation Organization (EVO).
 - .1 International Performance Measurement and Verification Protocol (IPMVP).
 - .1 IPMVP 2007 Version.
- .5 National Research Council Canada (NRC).
 - .1 National Plumbing Code of Canada - 2015 (NPC).
- .6 Plumbing and Drainage Institute (PDI).
 - .1 PDI-G101-R2010, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.
 - .2 PDI-WH201-R2010, Water Hammer Arresters Standard.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for plumbing products, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit two (2) copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOCs.
- .3 Shop Drawings:
 - .1 Indicate on drawings to indicate accessories, number of anchors, construction and assembly details, finishes, method of anchorage, dimensions of the materials, and equipment.
- .4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: Submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: Manufacturers' field reports specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year, and capacity.
 - .2 Details of operation, servicing, and maintenance.
 - .3 Recommended spare parts list.

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 FLOOR DRAINS

- .1 Floor Drains and Trench Drains: To CSA B79.

- .2 AS-1: General duty; cast-iron round body, adjustable head, nickel-bronze strainer, integral seepage pan, clamping collar, and with vandal-proof secured top option included.
 - .1 Acceptable products:
 - .1 Concrete floor: Zurn, ZZN-415-A; Watts-Drainage, FD100-C-5-1; Jay R. Smith, fig. 2005-AHD.
 - .2 Ceramic floor: Zurn, ZZN-415-H (square); Watts-Drainage, FD100-C-L5-1; Jay R. Smith, fig. 2005-BHD.
 - .3 Linoleum floor: Zurn, ZZN-415-R6; Watts, FD-200-FC; Jay R. Smith.
- .3 AS-2 (vehicle passage): sturdy cast iron body, sturdy grid with galvanized finish, designed for dog traffic, incorporated catch basin with sediment basket, sealing collar, and clamp, all covered with "acid-resistant" epoxy paint.
- .4 ASE-1 (funnel type): Cast-iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral funnel.
 - .1 Acceptable products: Zurn, ZN-415-BF; Watts-Drainage, FD100-C-EG-1; Jay R. Smith, fig. 2005-AHD-B.
- .5 Siphons: All floor drains must be equipped with a siphon.

2.2 TRENCH DRAIN

- .1 CD-1: Monolithic trench drain of polymer concrete composed of aggregate and polyester resin. Resin tested to ASTM C579, C580, C307, C140, C267, and C666.
 - .1 Trench drain capable of withstanding a compressive force of 96,530 kPa (14,000 psi), and capable of withstanding a flexural force of 27,580 kPa (4,000 psi). The trench drain is resistant to frost, salt, acids, and alkalis.
 - .2 Drains manufactured with a semi-circular bottom, 0.5% slope, having a nominal outside width of 130 mm (5 in.) and an internal width of 100 mm (4 in.). The trench drain sections must fit together using male and female junctions.
 - .3 Trench drain sections sealed with flexible polyurethane sealant.
 - .4 Black polypropylene grilles specially design for dog traffic. Grids certified NF EN 1433 load A (1,588 kg (3,500 lbs)). Grilles from the same manufacturer as the trench drain. The grilles are boltless and fit into the trench drain and remain securely fixed there, while not preventing their removal for maintenance. Grilles are resistant to UV rays, are anti-slip, and ADA certified.
 - .5 400 mm (16 in.) deep by 500 mm (20 in.) long catch basin provided with a removable basket allowing to collect sediments and dogs' hair, to facilitate their removal from the catch basin.
 - .6 Acceptable Products: ABT; ACO.

2.3 CLEANOUTS

- .1 Plugs: Heavy cast-iron male ferrule with brass screws, threaded cast-iron plug, and neoprene gasket.
 - .1 Acceptable products: Zurn, Z-1445; Watts-Drainage, CO460; Jay R. Smith, 4510.

.2 Access Covers:

- .1 Wall Access: Square covers, stainless steel or polished nickel-bronze, face or wall type, with flush-head securing screws, beveled edge frame, complete with anchoring lugs.
 - .1 Acceptable products: Zurn, ZANB-1460; Watts-Drainage, CO460-S-3; Jay R. Smith, 4735.
- .2 Floor access: Fusotec 300 cast-iron male ferrule or baked epoxy finish with threaded plug. Cover adjustable to floor finish.
 - .1 For unfinished concrete floors: Anti-skid, polished nickel-bronze, round.
 - .1 Acceptable products: Zurn, ZX-1612; Watts-Drainage, CO200-RX-1-34G; Jay R. Smith, 4220.
 - .2 Cover for terrazzo finish: Polished nickel-bronze, with recessed cover for terrazzo infill, complete with vandal-proof locking screws.
 - .1 Acceptable products: Zurn, ZN1400-Z-VP; Watts-Drainage, CO200-U-1-6-34G; Jay R. Smith, 4180-U.
 - .3 Covers for tile and linoleum floors: Polished nickel-bronze, with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
 - .1 Acceptable products: Zurn, ZN1400-X-VP; Watts-Drainage, CO200-T-1-6-34G; Jay R. Smith, 4140-U.
 - .4 Cover for carpeted floors: Polished nickel-bronze, having a carpet marker and vandal-proof locking screws.
 - .1 Acceptable products: Zurn, ZN-1400-CM-VP; Watts-Drainage, CO200-RC-1-6-34G; Jay R. Smith, 4020-Y-U.

2.4 FROST-FREE EXTERIOR HOSE BIBS

- .1 RAE-1: Recessed type, without enclosure, with integral vacuum breaker, NPS ¾ hose outlet, and removable operating key, stainless-steel finish, and vandal-proof. Hose bib is equipped with a programmable timer using a battery, timer can limit the flow time of the water. The timer device is installed inside the building.

2.5 WATER HAMMER ARRESTORS

- .1 Stainless Steel or Copper, Bellows Type: To ANSI/ASSE 1010, Water Hammer Arrestors.
 - .1 Acceptable products: Zurn, Z-1700; Sioux Chief 650/660; Watts SG Series.

2.6 BACKFLOW PREVENTERS

- .1 To CAN/CSA B-64 Series. The Contractor must obtain a test certificate for each device.
- .2 Device selection must be to CAN/CSA B64 Series or the most restrictive requirements.
- .3 Lead-free.
- .4 DARPR: Reduced pressure backflow preventers of NPS ¼ to NPS 10.
 - .1 High risk.

- .2 Device with bronze or cast-iron body, epoxy coating, two (2) check valves, intermediary release valve, test valves, and two (2) isolating valves, for 1,210 kPa (175 psi) operating pressure at 43°C (110°F) water temperature.
- .3 Integral strainer and drain connector with air gap.
- .4 Acceptable products: Apollo, RP-4AL Series; Zurn Wilkins, model 375XL/375A; Watts.
- .5 DAR2CR: Double check valve backflow preventers of NPS ½ to NPS 10.
 - .1 Low to moderate risk.
 - .2 Device with bronze, stainless-steel or cast-iron body, epoxy coating, two (2) check valves and two (2) isolating valves, for 1,210 kPa (175 psi) operating pressure at 43°C (110°F) water temperature.
 - .3 Integral strainer.
 - .4 Acceptable products: Apollo, DC-4ALF Series; Zurn Wilkins, model 350XL/350; Watts.

2.7 VACUUM BREAKER

- .1 To CAN/ CSA-B64 Series.
- .2 Lead-free.
- .3 Atmospheric Vacuum Breaker.
 - .1 Acceptable products: Zurn Wilkins, 35XL; Apollo, AVB1 38-LF-100/200 Series; Watts.

2.8 VACUUM BREAKER (DOMESTIC WATER HEATERS)

- .1 To ANSI Z-21.22 and CSA 4.4.
- .2 Bronze body and stainless-steel spring.
- .3 Capacity: 7 L/s (15 cfm).

2.9 EXPANSION TANK (DOMESTIC WATER)

- .1 Steel continuous-flow thermal expansion tank with fixed ANSI/NSF 61-certified butyl bladder.
- .2 Tank fitted with colored structural integrity indicator for bladder leaks, stainless-steel connector with NPT thread, and a refill valve extension.
- .3 Tank prefilled with air at factory at 515 kPa (75 psi) and adjustable onsite.
- .4 Accessories:
 - .1 Vertical earthquake-proof supports.
- .5 Performance Data: Indicated in the Expansion Tanks Schedule in drawings.

2.10 INDOOR HOSE BIBS

- .1 RAI-1: Bronze construction complete with check valve, hose thread spout, replaceable composite disc.

2.11 DRAIN VALVES

- .1 Unless otherwise indicated, valves must be bronze, diameter NPS $\frac{3}{4}$ with cover, chain, and threaded end for connecting flexible pipe.

2.12 STRAINERS

- .1 "Y" type mesh, 860 kPa (125 psi) pressure gauge, with Monel, bronze, or stainless-steel removable screen.
- .2 For lines up to NPS 2:
 - .1 Bronze bodies: to ASTM B62 or cast iron to ASTM A-278M, Class 30.
 - .2 Screw fittings.
 - .3 Stainless-steel strainer with 0.8 mm (0.032 in.) perforations.
 - .4 Purge connection, rated diameter suitable for strainer, with ball valve and cap.
- .3 For lines NPS 2½ and over:
 - .1 Epoxy coated cast-iron bodies.
 - .2 Flanged fittings: To ASME/ANSI 16.1, Class 125.
 - .3 Strainer: Stainless steel, with 3.2 mm (0.125 in.) perforations.
 - .4 Purge connection, diameter suitable for screen, with cap and ball valve.

2.13 DRAIN TRAP PRIMER

- .1 Equipment working with pressure differential principle with integrated backflow preventer and test ports.
- .2 Supply floor drains to priming devices as follows:
 - .1 Above ground: Rigid copper, as prescribed.
 - .2 Underground: Soft copper type "K" or seamless flexible tube, composed of cross-linked polyethylene (PEX).
 - .1 Provide a dielectric connection in accordance with the requirements, for the passage from the underground to the above ground.

2.14 TRAP GUARD

- .1 Elastomeric device that automatically shuts after allowing drained fluid passing through. System resistant to scaling and microbiological growth.

2.15 ROOF VENT SLEEVE (MULTILAYER MEMBRANE OR MODIFIED BITUMEN)

- .1 Insulated, caulked, 1100 Series, aluminum casing, 1.662 mm (1.64 in.), 340 mm (13.4 in.) in height, factory-made in one piece with cap assorted aluminum premoulded. Sleeve insulated from the inside of a polyurethane-foam weather-strip injected at the factory.

2.16 HOSE REEL 18M-30M

- .1 Reel and hose assembly including:
 - .1 Manual rewinder in painted steel.

- .2 NPS 20 connector hose with a length of 1.5 m and NPT 20 connectors.
- .3 Hose length as indicated on drawings. NPS 15 industrial quality hose able to withstand a pressure of 1,034 kPa.
- .4 Spray gun with swivel connection.
- .5 Acceptable products: Charland Thermojet; Hannay Reels; Green Line.

2.17 OIL INTERCEPTOR

- .1 Oil interceptor for installation into the ground. The oil interceptor is made of steel and coated with an anti-rust enameled paint, including a flow regulator, a NPS 50 vent at the inlet and outlet, and a non-slip cover with gasket. The cover is robust to allow vehicle traffic. An alarm is mounted in a ULC and CSA certified PVC box, which is fixed to the garage wall and is connected to the oil interceptor using a teck cable of at least 4 m, supplied with the oil interceptor. The oil interceptor has the following characteristics:
 - .1 Flow: 3.78 L/s;
 - .2 Nominal diameter of drainage pipes: NPS 100;
 - .3 Volume of used oil that can be stored in the tank: 90 L;
 - .4 Weight of the oil interceptor: 134 kg;
 - .5 Dimensions:
 - .1 Height: 1,040 mm.
 - .2 Length: 810 mm.
 - .3 Width: 610 mm.

2.18 HIGH PRESSURE MACHINE (KENNEL)

- .1 Stationary industrial washer system, equipped with a pump, stainless steel pressurized water distribution network, manual rewinding station, hoses, and lances with variable spray gun.
- .2 All equipment and materials must be designed to withstand a maximum pressure of 27,579 kPa (4,000 psi) and a maximum temperature of 149°C (300°F).
- .3 All equipment and materials must come from the same supplier.
- .4 Characteristics of the high-pressure kennel machine:
 - .1 Flow: 11.4 L / min (3 US gal/min);
 - .2 Discharge pressure: 10,342 kPa (1,500 psi);
 - .3 Suction line: NPS $\frac{3}{4}$;
 - .4 Discharge pipe: NPS $\frac{1}{2}$;
 - .5 Motors: 3 HP;
 - .6 Power: 600 V / 3 phases / 60 Hz;
 - .7 Protection with pressure switch;
 - .8 Automatic start and stop.

- .5 Pump specification for stationary industrial washer system:
 - .1 Triplex pump with three pistons, forged-brass frame and manifolds, 304SS steel valve assembly, ceramic piston, standard Buna-N seals.
- .6 Characteristics of kennel reel (hoses 9 m long):
 - .1 Reel in painted steel, manual rewinding, equipped with a reel, with NPS 15 (NPS ½) hose length of 9 m, and variable jet gun.
- .7 Pipes of the pressurized water network:
 - .1 The piping and accessories must be supplied by the same distributor as the industrial washer system.
 - .2 Stainless-steel pipe, grade 304/304L, in accordance with ASTM A312 and NSF/ANSI-61 standards.
 - .3 Wall thickness of the piping is 0.025 in.
 - .4 Stainless-steel compression fittings.
 - .5 Robust piping support designed for high-pressure water networks.

2.19 WATER METERS

- .1 Turbine meters: To AWWA C701.
- .2 Characteristics: Peak flow of 14.5 L/s, pressure drop of 17 kPa, nominal diameter of DN-80 connections.
- .3 Accessories: Remote reading device, analog output to allow connection to the automatic building control system.

2.20 PITS AND SUMPS

- .1 Basins built on site as indicated on drawings. Galvanized-steel frame and lid. Basin, frame, and cover provided by the General Contractor.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with the manufacturer's written requirements, recommendations, and specifications, including every available technical bulletin, instructions for the handling, storage and installation of products, and specifications from the technical sheets.

3.2 INSTALLATION

- .1 Install in accordance with National Plumbing Code of Canada (NPC) and with local Authorities Having Jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

- .1 Install cleanouts at base of wastewater drop pipes, and rainwater leaders, at locations required Code, or as indicated.
- .2 Bring cleanouts to wall or finished floor, unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: Line size to maximum NPS 4.

3.4 FROST-FREE EXTERIOR HOSE BIBS

- .1 Install 900 mm (36 in.) above finished grade, unless otherwise indicated.
- .2 Exterior hose bibs have safety shut-off installed on the branch line inside building and flush-mounted in wall, with wall plate firmly supported against outside face of masonry. Space around hose bib must be sealed with sprayed moisture-proof insulation.

3.5 WATER HAMMER ARRESTORS

- .1 Mount water hammer arrestor on supply lines connected to each sanitary fixture or group of sanitary fixtures upstream of all quick shut-off valves, such as solenoid valves, automatic washing machines, etc., as well as other specified locations.

3.6 BACKFLOW PREVENTERS

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere, as required by Code.
- .2 Connect the drainage of each backflow preventor to the drain or nearest service sink or as specified.

3.7 DRAIN TRAP PRIMER

- .1 Install and connect siphon priming devices to all floor drains, all open drains, and all locations indicated on the drawings, as specified in the National Plumbing Code - Canada.
- .2 Install priming devices in accessible locations.

3.8 DRAIN VALVES

- .1 Unless otherwise indicated, mount drain valves on low points, near isolating valves, and at bottom of all plumbing and hydronic risers, as well as in other specified locations.

3.9 INTERIOR HOSE BIBS

- .1 Unless otherwise indicated, install interior hose bibs 900 mm (36 in.) above finished grade.

3.10 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.11 EXPANSION TANKS

- .1 Adjust expansion tank pressure as indicated.
- .2 Install at indicated locations and according to manufacturers' instructions.

3.12 DRAINS

- .1 Clean and prime floor drain traps and sediment baskets.
- .2 Clean roof drains.
- .3 Rectify start-up deficiencies.
- .4 All floor drains must be fitted with a siphon.

3.13 TRAP GUARD

- .1 All floor and open drains must be equipped with a trap guard.

3.14 TESTING AND ADJUSTING

- .1 Test and adjust special equipment once deficiencies identified at start-up have been rectified and certificate of completion issued by Authorities Having Jurisdiction.
- .2 Tolerances:
 - .1 Pressure at fixtures: Allowable deviation ± 70 kPa (10 psi).
 - .2 Flow rate at fixtures: Allowable deviation $\pm 20\%$.
- .3 Adjustments:
 - .1 Ensured that measured flow rate and pressure meet Design Criteria.
 - .2 Adjust while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .4 For the purposes of this clause, “check” a characteristic or “ensure” a condition or action also means “demonstrate” to Departmental Representative, upon request.
- .5 Commissioning:
 - .1 Floor drains:
 - .1 Check operation of prime devices and ensure that flushing is carried out properly.
 - .2 Ensure sediment baskets are firmly installed with sufficient clearance for maintenance purposes.
 - .3 Check operation of trap primer and trap guard.
 - .4 Prime trap.
 - .5 Check security, accessibility, removability of strainer.
 - .6 Clean out baskets.
 - .2 Roof drains:
 - .1 Check location, at low points in roof.
 - .2 Check security, removability of dome.
 - .3 Adjust weirs to suit actual roof slopes, meet requirements of design.
 - .4 Verify provisions for movement of roof system.
 - .5 Clean out sumps.
 - .3 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.

- .2 Verify cleanout rods can easily probe as far as next cleanout.
- .4 Wall-mounted and ground frost-free hose bibs:
 - .1 Verify complete drainage and freeze protection.
 - .2 Verify operation of vacuum breakers.
- .5 Water hammer arrestors:
 - .1 Ensure ease of access to water hammer arrestors.
 - .2 Verify proper installation of correct type of water hammer arrester.
- .6 Vacuum breakers and backflow preventers:
 - .1 Ensure appropriate equipment has been installed.
 - .2 Adjust as needed.
 - .3 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers and backflow preventers.
 - .4 Verify visibility of discharge from open ports.
- .7 Drain trap primer.
 - .1 Verify operation of equipment.
 - .2 Adjust the flow of each according to existing conditions.
- .8 Strainers:
 - .1 Verify accessibility.
 - .2 Clean out repeatedly until clear.
 - .3 Verify accessibility of cleanout plug and basket.
 - .4 Verify that cleanout plug does not leak.
- .6 Access Doors:
 - .1 Verify size and location relative to items to be accessed.
- .7 Commissioning Reports:
 - .1 Record all data collected at time of commissioning on forms provided for this purpose.
 - .2 Have reports signed by test technician and the site supervisor.
 - .3 Have reports countersigned by Departmental Representative.
- .8 Checking tests and test reports:
 - .1 Provide Departmental Representative with 24-hour advance notice prior to commencement of tests.
 - .2 Tests and other similar activities must be carried out with Departmental Representative present.
 - .3 Test reports must be checked by commissioning technician.
- .9 Training of personnel:
 - .1 Ensure O&M personnel are trained in starting up, operating, monitoring, maintaining, and decommissioning the equipment.
 - .2 Demonstrate full compliance with Design Criteria.

- .10 Demonstration of Compliance:
 - .1 Quality of O&M personnel training must be evaluated during compliance demonstrations.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 00 - Common Work Results for Plumbing.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (SDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and data sheets for fixtures and equipment.
 - .2 Submit WHMIS SDS in accordance with sustainable requirements and hazardous materials. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Shop Drawings.
 - .1 Submit shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies, and ancillaries. Identify whether factory or field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.
- .4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: Submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: Manufacturers' field reports specified.
- .7 Closeout Submittals: Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:
 - .1 Manufacturer's name, type, model year, capacity, and serial number.
 - .2 Details of operation, servicing, and maintenance.
 - .3 Recommended spare parts list with supplier's names and addresses.

Part 2 Products**2.1 DOMESTIC HOT WATER CIRCULATING PUMPS**

- .1 Centrifugal in-line pump, direct drive, mounted directly on-line (in-line).

- .2 With stainless-steel body NSF 372 certified.
- .3 Cast-bronze rotor, dynamically balanced, with minimum clearance.
- .4 Stainless-steel shaft with stainless-steel or bronze shaft sleeve, bronze bushing, and built-in thrust ring. Extra-long, oil-lubricated shaft (feed nozzle required).
- .5 Sealing consisting of a ceramic and carbon mechanical seal suitable for hot water up to 105°C (221°F).
- .6 Self-aligning spring-mounted flexible coupling.
- .7 Motor of type housed and provided with thermal overload protection.
- .8 Brackets of the type recommended by manufacturer.
- .9 Pump capable of operating at a pressure of 860 kPa (125 psi) at a temperature of 105°C (221°F).
- .10 Performance Data: As indicated on drawings.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 In each case, make piping and electrical connections between pump, motor assembly, and controls, as indicated.
- .2 Ensure pump and motor assembly does not support piping.
- .3 Align submerged vertical pump assembly after mounting and securing cover plate.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Check power supply.
 - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of "Manual-Off-Auto" selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature, and other protective devices.
- .4 Adjust flow from water-cooled bearings.
- .5 Adjust stuffing boxes assembly and packing glands on impeller shaft.

3.4 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified herein.
 - .2 Procedures:
 - .1 Check power supply.
 - .2 Check starter O/L heater sizes.
 - .3 Start pumps, check impeller rotation.
 - .4 Check for safe and proper operation.
 - .5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, and other protective devices.
 - .6 Test operation of "Manual-On-Auto" switch.
 - .7 Test operation of alternator.
 - .8 Adjust leakage through water-cooled bearings.
 - .9 Adjust shaft stuffing box assembly.
 - .10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
 - .11 Check base for free-floating, no obstructions under base.
 - .12 Run-in pumps for 12 continuous hours.
 - .13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .14 Adjust alignment of piping and conduit to ensure full flexibility.
 - .15 Eliminate causes of cavitation, flashing, air entrainment in pump.
 - .16 Measure pressure drop across strainer when clean and with flow rates as finally set.
 - .17 Replace seals if pump used to degrease system or if pump used for temporary heat.
 - .18 Verify lubricating oil levels.

3.5 REPORTS

- .1 In accordance with Section 01 91 13 - General Commissioning Requirements, supplemented as specified herein.
- .2 Include:
 - .1 PV results on approved PV Report Forms.
 - .2 Product Information report forms.
 - .3 Pump performance curves (family of curves) with final point of actual performance.

3.6 TRAINING

- .1 In accordance with Section 01 91 13 - General Commissioning Requirements, supplemented as specified.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 00 - Common Work Results for Plumbing.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI)/(AWWA).
 - .1 ANSI/AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .2 ANSI/AWWA C151/A21.51-09, Ductile Iron Pipe, Centrifugally Cast, for Water.
- .2 American Society of Mechanical Engineers International (ASME).
 - .1 ANSI/ASME B16.15-13, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-11, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .5 ASME B16.26-13, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .6 ASME B31.9-14, Building Services Piping.
 - .7 ASME B36.19M-04, Stainless Steel Pipe.
- .3 ASTM International (ASTM).
 - .1 ASTM A182/A 182M-16, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - .2 ASTM A269-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A312/A312M-16, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - .5 ASTM A351/A351M-16, Castings, Austenitic, for Pressure Containing Parts.
 - .6 ASTM A403/A403M-16, Wrought Austenitic Stainless Steel Piping Fittings.
 - .7 ASTM A536-84(2014), Standard Specification for Ductile Iron Castings.
 - .8 ASTM B32-08(2014), Standard Specification for Solder Metal.
 - .9 ASTM B42-15a, Seamless Copper Tube, Standard Sizes.
 - .10 ASTM B88M-14, Standard Specification for Seamless Copper Water Tube (Metric).
 - .11 ASTM F876-15, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

- .12 ASTM F877-11, Standard Specification for Crosslinked Polyethylene (PEX) Hot and Cold Water Distribution System.
- .4 CSA Group (CSA).
 - .1 CSA B137.5-13, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
- .5 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (SDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-02a, Butterfly Valves.
 - .2 MSS-SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC).
 - .1 National Plumbing Code of Canada (NPC) 2015.
- .9 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).
- .10 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC S101-07, Fire Endurance Tests of Buildings Construction and Materials.
 - .2 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
 - .3 CAN/ULC S115-11, Standard Method of Fire Tests of Firestop.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with manufacturer's written instruction.
- .2 Product Data.
 - .1 Provide manufacturer's printed product literature and data sheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish, and limitations.

1.4 DELIVERY, STORAGE, AND HANDLING

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

- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect the equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.5 LEAD-FREE PRODUCTS

- .1 The maximum permissible level of lead in the surfaces of distribution products for drinking water is 0.25%, to CSA and NSF Standards.

Part 2 Products

2.1 PIPING

- .1 Hot and cold-water systems (distribution, supply, and recirculation), within building.
 - .1 Aboveground installation: Copper tube, hard drawn, type L: To ASTM B88M and NSF/ANSI-61.
 - .2 Aboveground installation (NPS 4 and over): Stainless-steel pipes, Schedule 10S, grade 304L, to ASTM A312 and NSF/ANSI-61.
 - .3 Buried or walnut (DN 2 and below): Annealed copper "K" type tubing, to ASTM B88M, in long lengths and with no joints in the part to be buried.
 - .4 Aboveground installation, DN 2 and less: Cross-linked polyethylene pipes (XLPE), manufactured by peroxide method (XLPE-A).
 - .1 XLPE pipes must be manufactured in accordance with ASTM F876, ASTM F877 and CAN / CSA-B137.5 Standards. The pipes must be approved according to ASTM by an independent third party.
 - .2 XLPE pipes must have a hydrostatic design and standard pressure capacities of 93°C (551 kPa), 82°C (689 kPa) and 23°C (1,102 kPa). Pressure and temperature capabilities must be established by the Plastic Pipe Institute (PPI), a division of the Society of the Plastic Industry (SPI).
 - .3 Minimum bend radius for cold bending of XLPE pipes must not be less than six (6) times the outside diameter. Use a bending bracket supplied by the pipe manufacturer in the case of any bending whose radius is less than that indicated.

2.2 FITTINGS

- .1 Copper Piping:
 - .1 Bronze pipe flanges and flanged fittings, Classes 150 and 300: To ANSI/ASME B16.24.
 - .2 Cast bronze threaded fittings, Classes 125 and 250: To ANSI/ASME B16.15.
 - .3 Cast copper, solder type: To ANSI/ASME B16.18 and NSF/ANSI-61.
 - .4 Wrought copper and copper alloy, solder type: To ANSI/ASME 16.22.

- .2 Stainless-Steel Piping:
 - .1 Welded assembly:
 - .1 Stainless-steel fittings, Schedule 10S, grade 304/304L, butt-weld ends, in accordance with ASTM A403, grade WP and ANSI B16.9 Standards.
 - .2 Flanges, Class 150, forged stainless steel, weld neck, butt-weld ends, in accordance with ASTM A182 and ASME/ANSI B16.5, grade 304/304L Standards.
 - .1 Bolts: Stainless steel, grade 304, to ASTM A193.
 - .2 Nuts: Stainless steel, grade 304, to ASTM A194.
 - .3 Flange seals: Gore-Tex PTFE, 3-mm thick.
 - .2 Crosslinked polyethylene (XLPE) piping.
 - .1 Polymer or brass fittings.
 - .2 The fittings are XLPE-A cold expansion type.

2.3 JOINTS

- .1 Copper Piping:
 - .1 Rubber gaskets, 1.6-mm thick: To ANSI/AWWA C111/A21.11.
 - .2 Hex heads, nuts, and washers: To ASTM A307, Heavy Series.
 - .3 Solder, tin-antimony 95/5, to ASTM B32, maximum lead content 0.2%.
 - .1 Equivalent: Aquasol (Sb 1%, Cu 3%, Ag 0.25%, Sn 95.75%).
 - .2 Water-soluble soldering paste, non-corrosive and lead-free: To ASTM B813 and NSF-61.
 - .4 Silver solder, Sil-Foss, for buried and above-ground piping, NPS 2½ and over.
 - .1 Alloys to comply with AWS-A5.8/A5.8 M.
 - .5 Teflon tape for screw joints.
 - .6 Dielectric connections between dissimilar metals: Dielectric fittings to ASTM 492, complete with thermoplastic liner.
- .2 XLPE Piping:
 - .1 XLPE-A cold expansion type fittings shall include an insert and an XLPE-A cold expansion ring.

2.4 ACCESSORIES - XLPE PIPING

- .1 All penetration supports: Supports designed to penetrate walls must be supplied by the XLPE pipe manufacturer.

2.5 GLOBE VALVES (COPPER)

- .1 Globe valves, NPS 2½ and under, welded:
 - .1 To MSS-SP-80, Type 1, Class 125, 860 kPa (125 lb/in²), bronze body, renewable composition disc, screwed over bonnet.
 - .2 Lockshield handles: As indicated.

- .3 Acceptable products: Milwaukee, UP1502; Kitz, fig. 812; Red & White, fig. 212A-LF.
- .2 Globe valves, NPS 2½ and under, screwed:
 - .1 To MSS-SP-80, Type 2, Class 150, 1 MPa (150 lb/in²), bronze body, screwed over bonnet, renewable composition disc.
 - .2 Lockshield handles: As indicated.
 - .3 Acceptable products: Milwaukee, UP502; Kitz, fig. 811; Red & White, fig. 211-LF.

2.6 SWING CHECK VALVES (COPPER)

- .1 Check valves, NPS 2 and under, welded:
 - .1 To MSS-SP-80, Type 4, Class 150, 1,034 kPa (150 lb/in²), bronze body, bronze swing disc, screw in cap, regrindable seat.
 - .2 Acceptable products: Apollo, 161S-LF Series; Milwaukee, UP1509; Kitz, fig. 823; Red & White, fig. 237A-LF.
- .2 Check valves, NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Type 3, Class 125, 860 kPa (125 lb/in²), bronze body, bronze swing disc, screw in cap, regrindable seat.
 - .2 Acceptable products: Apollo, 161T-LF Series; Milwaukee, UP509; Kitz, fig. 822; Red & White, fig. 236A-LF.
- .3 Check valves, NPS 2½ and over, flanged:
 - .1 To MSS-SP-71, Type 1, Class 125, 860 kPa (125 lb/in²), cast-iron body, flat flange faces, renewable or regrindable seat, bronze disc, bolted cap.

2.7 BALL VALVES (COPPER)

- .1 Ball valves, NPS 2½ and under, screwed:
 - .1 Class 150.
 - .2 B283 forged brass or bronze body, chrome-plated brass ball, PTFE adjustable packing, brass gland or Viton double "O-ring" and PTFE seat, steel lever handle.
 - .3 Acceptable products: Apollo, 70-LF Series; Jenkins, model LF-201J; Milwaukee, UPBA100; Kitz, fig. 858; Red & White, fig. 5044A-LF; MAS B-3-LF.
- .2 Ball valves, NPS 2½ and under, welded:
 - .1 To ANSI B16.18, Class 150.
 - .2 B283 forged brass or bronze body, chrome-plated brass ball, PTFE adjustable packing, brass gland or Viton double "O-ring" and PTFE seat, steel lever handle.
 - .3 Acceptable products: Jenkins, model LF-202J; Kitz, fig. 859; Red & White, fig. 5049A-LF; MAS B-4-LF.

2.8 BALL VALVES (STAINLESS STEEL AND COPPER)

- .1 Ball valves, NPS 2½ and over, flanged:
 - .1 Class 150, stainless-steel body, stem and disc, flanged ends, regular passage, Teflon seats and fittings.
 - .2 Acceptable products: Velan No. FB-150; MAS No. F150-SS-F-N; Kitz No. 150UTBZM-N; American Valve No. 4001.
- .2 Ball valves, NPS 2½ and over, flanged:
 - .1 Class 125/150, epoxy-covered ductile iron body, stainless-steel disc and stem, Teflon seat, gear controls for valves larger than NPS 6.

2.9 BUTTERFLY VALVES (COPPER AND STAINLESS STEEL)

- .1 Butterfly valves, NPS 2½ and over, model without flange and with lug:
 - .1 In accordance with MSS-SP-67, NSF, Class 125, ductile-iron body, stainless-steel disc and stem, EPDM seat, lever and key, and gear controls for valves larger than NPS 6.
 - .1 Acceptable products: Milwaukee, models ML133E/ML233E/ML333E; Kitz 5141EL and 5141EG; MAS W-D-4-S-E-LH and W-D-4-S-E-G.

2.10 BALANCING VALVES

- .1 General:
 - .1 "Y" -type globe valve, designed for precise flow measurement and control, with tap sockets for differential pressure gauges.
 - .2 Accuracy: Measured and displayed flow shall be within 2% of the actual flow rate under nominal design conditions.
 - .3 Globe valve.
 - .1 NPS 2 and under.
 - .1 Die-cast bronze/copper body, threaded ends, Teflon seat and copper disc, threaded and screwed bonnet; capable of withstanding a maximum effective pressure of 1.7 MPa and a maximum temperature of 121°C.
 - .2 Flow control: At least four complete turns of the handwheel (numeric indicator and mechanical memory concealed and tamperproof).
 - .2 NPS 2½ and over.
 - .1 Cast-iron body coated with epoxy resins, zinc-resistant internal copper alloy housing, Class 125, and flanged ends to ANSI; capable of withstanding a maximum effective pressure of 1.7 MPa and a maximum temperature of 121°C.
 - .2 Flow control: At least eight complete turns of the handwheel with vernier-calibrated adjusting ring and mechanical memory concealed and tamperproof.
 - .3 R5.4 prefabricated polyurethane insulation of packing/delivery type.
- .2 Maximum permissible pressure drop: 15 kPa (2,2 psi).

2.11 SUSPENSION

- .1 Refer to Sections 23 05 29 - Hangers and Supports for HVAC Piping and Equipment and 23 05 48 - Vibration and Seismic Controls for HVAC.

Part 3 Execution**3.1 PIPING INSTALLATION**

- .1 Install in accordance with local Authority Having Jurisdiction and the National Plumbing Code of Canada.
- .2 Piping cut square, free of foreign material, deburr and clean ends, clean recesses of fittings, and assemble joints without binding.
- .3 Assemble piping using fittings manufactured to ANSI Standards.
- .4 Install piping close to building structure to conserve headroom and space. Group exposed piping and run parallel to walls.
- .5 Connect to fixtures and equipment in accordance with manufacturer's instructions, unless otherwise indicated.
- .6 Underground Piping:
 - .1 Lay in well compacted, washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.
 - .3 Domestic water piping to be located at minimum 300 mm above and 300 mm horizontally from sewage mains.
 - .4 All water piping to be at minimum 3 m from any petroleum product piping or tanks.

3.2 XLPE DRINKING WATER DISTRIBUTION SYSTEM

- .1 Install XLPE pipes in accordance with manufacturer's recommendations.
- .2 Collectors must be isolated by ball valves.
- .3 XLPE pipes must not be exposed to direct sunlight for more than 30 days.
- .4 Cover the XLPE pipes with insulation if they are directly exposed to a source of UV rays, such as fluorescent lamps.
- .5 Ensure that the following products never come in contact with pipes without the manufacturer's approval: Glues, adhesives, solvent, sealants, or chemicals.
- .6 Pipes through metal studs will use grommets or ducts at penetration points.
- .7 Use protective devices in cases where pipes can be pierced with screws or nails.
- .8 Manufacturer's bending supports must be used when bends are less than six times the outside diameter of the pipes.
- .9 Penetration supports must be used for all penetration of walls.

- .10 Pressurize the drinking water distribution system with air or potable water in accordance with the applicable Codes or, in the absence of these Codes, at a pressure of 173 kPa above the operating pressure of the system.
- .11 Comply with safety precautions during pressure tests, including use of compressed air, if applicable. Water should not be used to pressurize the system if the ambient temperature may fall below 0°C.

3.3 STAINLESS STEEL

- .1 Thoroughly clean cross-sections and rolled grooves to ensure that there is no black steel residue on the stainless steel.

3.4 VALVES

- .1 Isolate equipment, fixtures, and branches with cut-off valve.
- .2 Balance circulation system using lockshield globe valves. Mark settings and record on "As-built" drawings on completion.

3.5 PRESSURE TESTS

- .1 Test pressure shall be the greater of 860 kPa or maximum system operating pressure, without loss of pressure for 2 hours.

3.6 PRE-START-UP INSPECTIONS

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

3.7 FLUSHING AND DISINFECTING

- .1 Use sodium hypochlorite to ANSI/AWWA B300 Standard, to disinfect water distribution system.
- .2 Disinfect the water distribution system, to ANSI/AWWA C651.
- .3 Flushing and disinfecting must be done by a specialist contractor in the presence of the Departmental Representative. At least four (4) days before beginning the work, advise the Departmental Representative.
- .4 Flush water mains through available outlets with enough flow of potable water to produce velocity of 1.5 m/s within pipe for minimum 10 minutes or until foreign materials have been removed and flushed water is clear.
- .5 Provide connections and pumps for flushing, as required.
- .6 Open main water valves and connections to ensure thorough flushing; close them when the operation is complete.

- .7 When flushing has been completed to the Departmental Representative approval, introduce strong solution of chlorine, as approved by the Departmental Representative, into water main and ensure that it is distributed throughout entire system.
- .8 Rate of chlorine application to be proportional to rate of water entering pipe.
- .9 Chlorine application to be close to the point of filling water main and to occur at same time.
- .10 Operate valves and related accessories while main contains chlorine solution.
- .11 Flush line to remove chlorine solution after 24 hours.
- .12 Measure chlorine residuals at extreme end of pipeline being tested.
- .13 Perform bacteriological tests, specific metal tests, and physical chemistry on water main after chlorine solution has been flushed out according to the following protocol:
 - .1 Sampling the water inlet for the following parameters after purging the water for 5 minutes:
 - .1 E. coli, total coliforms, atypical bacteria, turbidity, pH, nitrite / nitrate, metals (aluminum, antimony, arsenic, barium, boron, cadmium, chromium, copper, iron, manganese, mercury, lead, selenium, uranium, zinc).
 - .2 End-of-pipe sampling for total lead, copper, and manganese, as well as E. coli, total coliforms and atypical bacteria (see "sampling protocol for water points" below).
 - .3 Sampling the end of the network for the following parameters after purging the water for 5 minutes:
 - .1 E. coli, total coliforms, atypical bacteria, turbidity, pH, nitrite / nitrate, metals (aluminum, antimony, arsenic, barium, boron, cadmium, chromium, copper, iron, manganese, mercury, lead, selenium, uranium, zinc).
 - .4 Sampling of the three water points located in the ground floor offices (two bathrooms and a multifunctional room) for total lead, copper, and manganese, as well as E. coli, total coliforms and atypical bacteria (see "sampling protocol for water points" below).
 - .5 Sampling of 20% of cell valves distributed evenly over two floors for total lead, copper, and manganese, as well as E. coli, total coliforms and atypical bacteria (see "sampling protocol for water points" below).
 - .6 Sampling of four taps in common areas for lead, total copper and manganese, as well as E. coli, total coliforms and atypical bacteria (see "sampling protocol for water points" below).
 - .7 Sampling protocol for water points (except water inlet):
 - .1 Total lead, copper, and manganese: The sampling protocol and test method for the verification of lead, copper, and manganese in drinking water must be in accordance with Health Canada recommendations issued in the lead technical document. (<https://www.canada.ca/fr/sante-canada/services/publications/vie-saine/recommandations-pour-qualite-eau-potable-canada-document-technique-plomb.html>). This protocol is detailed as follows:
 - .1 Leave the aerators in place;
 - .2 250-ml bottle;

- .3 Sampling without prior purging, first-time, and opening the tap at maximum flow.
 - .2 E. coli, total coliforms, atypical bacteria:
 - .1 Average flow.
 - .2 Sampling after completing that of lead, total copper and manganese.
 - .3 Free chlorine level measurement.
 - .3 Prior to the laboratory determination of lead, copper, and manganese (all water points except water inlet), the laboratory selected should apply the following treatment method:
 - .1 Acidification of samples with nitric acid 2% upon receipt at the laboratory;
 - .2 Waiting time 48 hrs. before lead determination;
 - .3 Samples must be taken by qualified personnel in accordance with Section 44 of "Le Règlement sur la qualité de l'eau potable du Québec";
 - .4 Analyzes must be carried out by a laboratory accredited by the Quebec Center of Expertise in Environmental Analysis, for areas including the parameters cited for drinking water;
 - .5 Sampling should be done once all construction is completed and before occupying the offices and cells.
 - .4 If contamination persists or reappears, disinfect the system again until the water is of potable quality;
 - .5 The specialized contractor shall submit a certified copy of the results of the analysis.
- .14 Take water samples at service connections regularly to test for chlorine residual.
- .15 After adequate chlorine residual of not less than 50 ppm has been obtained, leave system charged with chlorine solution for 24 hours.
 - .1 After 24 hours, take further samples to ensure that there is not less than 10 ppm of chlorine residual remaining throughout system.

3.8 START-UP

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

- .3 Bring HWS storage tank up to design temperature slowly.
- .4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
- .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.9 PERFORMANCE VERIFICATION

- .1 Perform hydronic network performance verification:
 - .1 After pressure and leakage tests and disinfection are completed, and Certificate of Completion and Compliance has been issued by Authority Having Jurisdiction.
- .2 Test Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 TAB HWC in accordance with Section 01 91 13 - General Commissioning (CX) requirements.
 - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .4 Sterilize HWS and HWC systems for Legionella control.
 - .5 Verify performance of temperature controls.
 - .6 Verify compliance with health and safety requirements.
 - .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
 - .8 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and cleaning.
- .3 Reports:
 - .1 Submit required reports in accordance with Section 01 91 13.
 - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 00 - Common Work Results for Plumbing.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM).
 - .1 ASTM B32-08, Standard Specification for Solder Metal.
 - .2 ASTM B306-02, Standard Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C564-03a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 CSA Group (CSA).
 - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125.3-05, Plumbing Fittings.
- .3 Green Seal Environmental Standards (GSES).
 - .1 Standard GS-36-00, Commercial Adhesives.
- .4 National Research Council Canada (NRC).
 - .1 National Plumbing Code of Canada 2015 (NPC).
- .5 South Coast Air Quality Management District (SCAQMD), California State.
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect the equipment from nicks, scratches, and blemishes.

June 30, 2020

- .3 Replace defective or damaged materials with new.

1.5 QUALITY CONTROL

- .1 An ISO 9000 Quality Control Certificate for gray cast-iron parts must be provided on demand.
- .2 An ISO 14001 Environmental Management Certificate for gray cast-iron parts must be provided on demand.
- .3 Ferrous materials used in the production of the gray cast-iron parts to be installed must be subjected to a radiation detection test in accordance with CSA B70, Clause 4.1.1. The documentation stipulated in this Clause must be provided on demand.
- .4 All certificates and approvals must be kept by the parts manufacturer to substantiate both their exact origin and their certification.
- .5 All assembled parts, such as gray cast-iron piping and fittings, must come from the same manufacturer to simplify liability and warranty requirements.
- .6 All products or materials to be installed, such as stainless-steel sheath couplings (MJ joint), must come from the same manufacturer to simplify liability and warranty requirements.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

- .1 Sanitary, storm, and vent pipes, under NPS 3, for above-ground installation, as well as their fittings, must be Type DWV to ASTM B306.
 - .1 Fittings:
 - .1 Cast brass fittings: To CAN/CSA B125 and CAN/CSA B158.1.
 - .2 Forged copper fittings: To CAN/CSA B125.
 - .2 Solder: lead free, tin-antimony 95:5: To ASTM B32.
 - .1 Equivalent products: Aquasol (Sb 1%, Cu 3%, Ag 0.25%, Sn 95.75%).

2.2 CAST-IRON PIPING AND FITTINGS

- .1 Sanitary, vent piping and storm drainage for above-ground installation, NPS 3 and above, as well as their fittings, shall be Class 4000 gray cast iron, to CAN/CSA B70, and have a bituminous coating.
- .2 The DWV copper piping described above may be replaced by cast-iron piping under NPS 3, depending on the Contractor's preference.
- .3 The trademark, diameter, and the CSA and ASTM labels must be stamped, throughout the entire length of the pipes, to CAN/CSA B70.
- .4 The fittings must be notched to indicate the position of the couplings.

June 30, 2020

.5 Couplings:

- .1 Standard couplings for gray cast-iron fittings with plain ends (MJ), both under- and above-ground, and piping NPS 6 and under.
 - .1 Mechanical joints with neoprene gaskets, reinforced with stainless-steel sheaths 0.2 mm thick (0.008 in) and fitted with T-304 stainless-steel clamps. Joints in accordance with CAN/CSA B70-M, CSA B602, and CAN/ULC S102 or CAN/ULC S102.2. Mechanical joints shall be Warnock Hersey-certified in the "Listed Pipe Coupling" category.
- .2 Couplings between gray cast-iron piping with plain ends (MJ) and above-ground DWV copper piping.
 - .1 Mechanical joints with neoprene gaskets, reinforced with stainless-steel sheaths 0.2 mm thick (0.008 in) and fitted with T-304 stainless-steel clamps. Joints in accordance with CAN/CSA B70-M, CSA B602, and CAN/ULC S102 or CAN/ULC S102.2. Mechanical joints shall be Warnock Hersey-certified in the "Listed Pipe Coupling" category.
 - .2 Cast-iron fittings threaded for brass male adaptors. Use an approved pipe-joint compound or 100% Teflon tape.
- .3 Couplings for gray cast-iron fittings with plain ends (MJ), both below- and above-ground; piping NPS 6 and under; and all piping installed below street level.
 - .1 Mechanical joints with neoprene gaskets, reinforced with corrugated stainless-steel sheaths 0.4 mm thick (0.016 in) equipped with T-304 stainless-steel clamps fitted with a 9.5 mm (³/₈ in) hexagonal bolt, tightened to 550 kPa (80 psi). Joints in accordance with CAN/CSA B70-M, CSA B602, ASTM C1277, UPC-IAPMO, FM, and CAN/ULC S102 or CAN/ULC S102.2.

.6 Fasteners:

- .1 Carbon steel clamps.

2.3 SUSPENSION

- .1 Refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment and Section 23 05 48 - Vibration and Seismic Controls for HVAC.

Part 3 Execution**3.1 INSTALLATION**

- .1 Unless otherwise indicated, install piping and accessories in accordance with National Plumbing Code of Canada and local Authority Having Jurisdiction.
- .2 Install piping to be buried on a clean, washed sand bed, 150 mm (6 in) thick, shaped so as to be able to match the shape of the fittings and female ends of the interlocking pipes. Respect the slope, lines, and levels indicated. Backfill with a 150 mm (6 in) layer of washed sand.
- .3 Install the above-ground piping parallel with and close to walls and ceilings to conserve headroom and space. Follow the slope and levels indicated.

June 30, 2020

- .4 Perform tests in accordance with both the National Plumbing Code of Canada and the local Authority Having Jurisdiction.
- .5 Lay copper drainage piping, NPS 1¼, to connect the drain fittings (with deep seal P trap) of the coil drip pans, air intakes, duct humidifiers, and drain pans to the nearest floor drain.
- .6 Storm drainage, NPS 10 and above:
 - .1 Install clamps at all changes of direction.
- .7 Storm and Sanitary Drainage, NPS 10 and over:
 - .1 Install clamps to all couplings on sub-grade networks.
- .8 Storm and Sanitary Drainage, NPS 6 and over:
 - .1 Install clamps on all plugs.
- .9 Rain and Sanitary Drainage:
 - .1 Anchor and block the legs of the column.

3.2 VENT

- .1 Extend vents without decreasing size to minimum 450 mm (18 in) under roof and increase the diameter at that point to minimum NPS 4 and above. Use a tapered reducing pipe fitting to change diameter size.

3.3 TESTS

- .1 All openings of the storm and sanitary piping must be completely plugged, including connections, mains, vent upflows, and horizontal drains. The piping must be filled with water to the highest level possible. The water must be maintained at this level for minimum two hours. If it is not possible to test the entire installation in a single operation, the testing can be divided up into several sections with each section tested as described above. However, the water column must be at least 3 m higher than the tested part of the system.
- .2 The piping must be tested up to roof level.
- .3 These tests, which are in accordance with or are more demanding than the National Plumbing Code of Canada, must be performed in the presence of plumbing inspectors or the Departmental Representative.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessibility and that access doors are correctly located.
 - .2 Open, cover with linseed oil, and re-seal.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm Water Drainage:
 - .1 Verify domes are secure.

- .2 Ensure weirs are correctly sized and installed correctly.
- .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system, and effectively vented.
- .5 Affix applicable identification label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 00 - Common Work Results for Plumbing.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM).
 - .1 ASTM D2564-04e1, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 CSA Group (CSA).
 - .1 CAN/CSA-Series B1800-06, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Green Seal Environmental Standards (GSES).
 - .1 Standard GS-36- 00, Commercial Adhesives.
- .4 National Research Council Canada (NRC).
 - .1 National Plumbing Code of Canada 2015 (NPC).
- .5 South Coast Air Quality Management District (SCAQMD), California State.
 - .1 SCAQMD Rule 1168- A2005, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Store at temperatures and conditions recommended by manufacturer.

June 30, 2020

Part 2 Products**2.1 PIPING AND FITTINGS**

- .1 Drainage piping dedicated to urinals until the first connection:
 - .1 Pipes that can be installed above ground, in return air plenums and in tall buildings:
 - .1 PVC pipes and fittings, type DWV, with a flame spread index of 0 and a smoke evolution index of 35, in accordance with the following Standards:
 - .1 CAN / CSA-B181.2;
 - .2 CAN / ULC-S102.2.
 - .2 For buried DWV piping to:
 - .1 CAN/CSA B1800.
 - .2 CAN/CSA-B181.2 (For PVC DWV piping, NPS 2 to NPS 24).
 - .3 CAN/CSA-B182.2 (For PVC DWV piping, type DR28 for NPS 4 to NPS 6, and type DR35 for NPS 8 to NPS 42).

2.2 JOINTS

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

Part 3 Execution**3.1 APPLICATION**

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

3.2 INSTALLATION

- .1 In accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.
- .2 Install in accordance with National Plumbing Code and local Authority Having Jurisdiction.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify if grade is appropriate and free from obstructions.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil, and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.

- .3 Storm Water Drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 00 - Common Work Results for Plumbing.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/CSA Group (ANSI/CSA).
 - .1 ANSI Z21.10.1A-2006/CSA 4.1A-2006, Addenda 1 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less.
 - .2 ANSI Z21.10.1b-2006/CSA 4.1b-2006, Addenda 2 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less.
- .2 CSA Group (CSA).
 - .1 CSA B51-03 (R2007), Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA-C309-M90 (R2003), Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.
- .3 National Research Council Canada (NRC).
 - .1 National Plumbing Code of Canada 2015 (NPC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, and data sheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.6 WARRANTY

- .1 For the Work of this Section, 12-month warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to number of years specified for each product.

Part 2 Products

2.1 INSTITUTIONAL TYPE ELECTRIC WATER HEATER

- .1 Electric water heater compliant with CAN / CSA C22.2 No. 110 and those of CAN / CSA C191 Series, fitted with immersion type heating elements and a thermostat with adjustable set temperature.
- .2 ASME certified device, Section 8, Division 1, for a maximum operating pressure of 860 kPa (125 psi).
- .3 Device fitted with a control panel and fully pre-factory installed.
- .4 Steel tank with 20 mm (0.787 in) thick cement lining.
- .5 50-mm (2-in.) exterior fiberglass insulation with enamelled metal jacket.
- .6 CEMA 1 control panel, as well as appropriate contactors, reversible step control, HRC fuses, control transformer and set of terminals.
- .7 Accessories:
 - .1 "High limit" thermal protection control.
 - .2 Low level control.
 - .3 Master disconnect.
 - .4 Stainless-steel diffuser at the water inlet.
- .8 Characteristics:
 - .1 Power: 27 kW.
 - .2 Capacity: 455 L (120 US gal.).
 - .3 Dimensions:
 - .1 Diameter: 720 mm (28-¹/₄ in.).
 - .2 Height: 1,710 mm (67-³/₈ in.).
 - .4 Power supply: 600 V, 3 phases, 60 Hz.
 - .5 3-year warranty certificate.

Part 3 Execution**3.1 INSTALLATION**

- .1 Install domestic water heater in accordance with manufacturer's recommendations, applicable codes and requirements of Authorities Having Jurisdiction.
- .2 Provide structural steel for mounted tanks and heaters.
- .3 Install all water heaters with pressure and temperature stop valve to ASME Code, with a test lever.
- .4 Provide drain valve connected to the nearest floor drain.
- .5 Provide vacuum breaker on cold-water inlet, installed in accordance with current Standards to prevent siphoning.
- .6 Adjust thermostats to 60°C (140°F).
- .7 Provide insulation between tank and supports.

3.2 FIELD QUALITY CONTROL

- .1 Start-up and commissioning of domestic water heaters must be performed by manufacturer or authorized representative.

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 00 - Common Work Results for Plumbing.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CAN/CSA-B45 Series-02(R2013), Plumbing Fixtures (Consists of B45.0, B45.1, B45.2, B45.3, B45.4, B45.5, B45.6, B45.7, B45.8 and B45.9).
 - .2 CSA B125.3-12, Plumbing Fittings.
 - .3 CSA B651-12, Accessible Design for the Built Environment.
- .2 Green Seal (GS).
 - .1 GS-36-2013, Adhesives for Commercial Use.
- .3 National Research Council Canada (NRC).
 - .1 National Building Code of Canada 2015 (NBC).
- .4 South Coast Air Quality Management District (SCAQMD).
 - .1 SCAQMD Rule 1168-A2011, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for washroom fixtures, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Indicate fixtures and trim:
 - .1 Dimensions, construction details, and roughing-in dimensions.
 - .2 Factory-set water consumption per flush at recommended pressure.
 - .3 For water closets, urinals: Minimum pressure required for flushing.

1.4 CLOSEOUT SUBMITTALS

- .1 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, and capacity.
 - .2 Details of operation, servicing, and maintenance.
 - .3 List of recommended spare parts.

June 30, 2020

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 MANUFACTURED UNITS**

- .1 Fixtures: Manufacture in accordance with CAN/CSA-B45 Series.
- .2 Trim, Fittings: Manufacture in accordance with CSA B125.3.
- .3 Exposed Brass Plumbing: Chrome plated.
- .4 Number and Locations: As indicated.
- .5 Fixtures in any one location: To be product of one manufacturer and of same type.
- .6 Trim in any one location: To be product of one manufacturer and of same type.
- .7 Water Closets (CA):

WC type Wall	Mounting	Bowl	Flush Valve	Type
CAH-1	Floor	Elong	Regular	Regular
CA-1	Floor	Elong	Regular	Regular
CA-2	Floor	Elong	Regular	Prison Unit

- .1 CAH-1: toilet for the disabled, for floor mounting, with visible manual flush valve and supply connection on top, with very low water consumption, at most 6 liters of water per flush. Height of cabinet of 410 mm.
 - .1 Backrest: 32-mm (1¼-in.) stainless-steel tube, satin finish, concealed fasteners and backing plate in antique white laminated plastic.
- .2 CA-1: Surface-mounted toilet, top-mounted faucet, with very low-water consumption, no more than 6 liters of water per flush.
 - .1 Bowl: Vitreous china, siphonic action, and elongated edge.
- .3 CA-2: Prison type toilet, floor mounted with wall drain, concealed flush valve, 6 liters of water per flush.
 - .1 Bowl: Vitreous china, siphonic action, and elongated edge.

June 30, 2020

- .8 CAH-1, CA-1, and CA-2 Water-Closet Flush Valves, Standard:
 - .1 Manual flush valve: Surface-mounted, brass chrome polished, externally adjustable, diaphragm, with NPS 1 screwdriver angle valve, oscillating control handle, flush coupling and coupling for NPS coupling. NPS 1½ on the top of the bowl, seat stop rosettes on the wall and on the unit, and vacuum breaker, very low flow per flush, meaning preset to 5.7 liters per flush, but adjustable between 3.8 and 17 liters per flush.
- .9 Water Closet Seats.
 - .1 Seat: Molded solid, white, elongated, open front, without flap and/or cover, with stainless-steel friction hinges, and stainless-steel mounting pin.
- .10 Washroom Lavatories:
 - .1 L-1: Wall-hung, prison type, integral back:
 - .1 Bowl: Vitreous china, with splashguard, integrated soap dishes, integral feed spout, cold water and hot water activation buttons, and prison type drinking tap, slow drain screen, power connection, antivandalism screw and wall mount included, overflow opening; dimensions of 356 mm x 324 mm x 362 mm.
- .11 LCH-1: countertop sink for the disabled.
 - .1 Oval sink, vitreous china, with integrated edge, overflow opening at the front, sealant, feed openings 100 mm (4 in.) apart.
 - .1 Dimensions: 533 mm (21 in.) W x 445 mm (17½ in.) D x 133 mm (5¼ in.) H.
 - .2 Acceptable products: American Standard, Cadet 9494.001; Toto; Zurn, Z 5134.
 - .2 Covering of cold water, hot water, and PVC drainage pipes, white color, in accordance with ASTM D-635, ASTM C-177 and ASTM G-21 Standards.
 - .1 Acceptable products: Truebro, Lav Guard; McGuire, PW2000WC; Zurn, Z 8946-3.
- .12 Standard faucets and accessories (LCH-1).
 - .1 Single-handle mixer tap, mixer nozzle without sealing washer, and chrome plated brass aerator.
 - .1 Devices to limit the feed rate to 4 L/min at a pressure of 413 kPa.
 - .2 Adjustable mixer with temperature control knob and dial thermometer to measure outlet temperature.
 - .3 Draining device: With stopper and chain.
 - .4 LCH-1 type lavatory faucets must be ADA certified.
- .13 Urinals.
 - .1 U-1: Urinal, for wall mounting with support, with visible manual flush valve and supply connection on top.
 - .1 Urinal: Vitrified porcelain, with siphonic action and integrated siphon.
 - .2 Exposed manual urinal flush valve: Chrome, self-closing, diaphragm, externally adjustable, with angle shut-off valve of NPS ¾ operated by screwdriver, oscillating handle, rosettes on wall and on the device, and integrated vacuum breaker; preset to 1.9 L (0.5 US gal.) per flush.

June 30, 2020

- .14 Fixture Piping:
 - .1 Hot and cold-water supplies to fixtures:
 - .1 Chrome-plated rigid supply pipes with screwdriver stop, reducers, and escutcheon.
 - .2 Waste:
 - .1 Brass "P" trap with clean out on fixtures not having integral trap.
 - .2 Chrome plated in exposed places.
- .15 Supports.
 - .1 Factory-built, floor-mounted brackets, for all wall drain fixtures.

Part 3 Execution**3.1 EXAMINATION**

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

3.2 INSTALLATION

- .1 Mounting Heights:
 - .1 Standard: To Manufacturer's recommendations.
 - .2 Wall-hung fixtures: As indicated.
 - .3 Barrier-free: To most stringent NBC.

3.3 ADJUSTING

- .1 Complying with water conservation requirements specified in this Section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Adjust flush valves to suit actual site conditions.
 - .4 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.
- .3 Checks:
 - .1 Water closets, urinals: Flushing action.

- .2 Aerators: Operation, cleanliness.
- .3 Vacuum breakers, backflow preventers: Operation under all conditions.
- .4 Thermostatic Controls:
 - .1 Verify temperature settings, operation, and safety controls.

3.4 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave work area clean at end of each day.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 00 - Common Work Results for Plumbing.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CAN/CSA-B45 Series-02(R2008), Plumbing Fixtures.
 - .2 CAN/CSA-B125.3-05, Plumbing Fittings.
 - .3 CAN/CSA-B651-04, Accessible Design for the Built Environment.
- .2 National Research Council Canada (NRC).
 - .1 National Building Code of Canada 2015 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, and capacity.
 - .2 Details of operation, servicing, and maintenance.
 - .3 List of recommended spare parts.

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 APPARATUSES AND ACCESSORIES**

- .1 Fixtures: Manufacture in accordance with CAN/CSA-B45 Series.
- .2 Trim, Fittings: Manufacture in accordance with CAN/CSA-B125.

- .3 Exposed Plumbing Brass: Chrome-plated.
- .4 Number, Locations: Architectural drawings to govern.
- .5 Fixtures: Product of one manufacturer.
- .6 Trim: Product of one manufacturer.
- .7 ES-1 (Service Sinks):
 - .1 Sink: Terrazzo composed of gray marble chips cast in white cement. Polished and sealed surface, dimensions of 610 mm x 610 mm x 254 mm.
 - .2 Fittings and accessories: Vacuum breakers, spigot handles, markings, robust cast-brass spout, bucket hook, aerator, wall bracket, integrated shut-off valves and devices to limit flow rate to 8.3 L/min at a pressure of 413 kPa, 914 mm long hose with chrome fittings of 19 mm diameter.
 - .3 Drain block: Cast-brass drain fitting with integrated stainless-steel strainer.
 - .4 Edge Guard: Stainless steel, continuous on three sides.
 - .5 Splash guards: Stainless steel, grade 304, thickness 20, on two (2) sides.
- .8 ES-2 (Service Sinks).
 - .1 304 Stainless-steel pedestals, 16-gauge, rounded flange, and adjustable legs.
 - .2 Dimensions: 691 mm x 691 mm x 356 mm deep, with rear splashguard of 225 mm height. Perforated panel for faucets.
 - .3 Wall-mounted tap with vacuum breaker, 200 mm centre-to-centre with threaded end for hose connection. It must withstand the disinfection temperature of 80°C (176°F).
 - .4 Drain block: Cast-brass drain fitting with integrated stainless-steel strainer.
- .9 ES-3 (Medical Service Sink).
 - .1 Vitrified porcelain medical service sink, with siphonic action, installed on the floor and with drain on the floor.
 - .2 Manual flush valve: Surface-mounted, in brass with polished chrome finish, externally adjustable, diaphragm, with NPS 1 angle valve to be operated by screwdriver, oscillating control handle, flush connector and coupling NPS 1½ on top of the bowl, rosette seat stop on the wall and on the appliance, and vacuum breaker. Flow rate of 24.6 L per flush.
- .10 Stainless-Steel Countertop Sinks.
 - .1 E-1: One-bowl sink, without a rear shelf.
 - .1 Tank: 1.0 mm thick stainless steel, grade 302, with built-in edge, underneath covered with a protective layer, for installation on a worktop using brackets; inner dimensions of 508 mm x 508 mm x 203 mm.
 - .2 Taps and fittings: Chrome-plated brass, including swivel spout, aerator, single lever, control cartridges without sealing washer, and devices to limit supply flow to 8.35 L/min at a pressure of 413 kPa.
 - .3 Drain block: Integrated stainless-steel plug/basket, drain connection, and molded brass "P" trap with bleed plug.

- .4 LY - 1: Emergency eye washer mounted on a column.
 - .1 Column-mounted emergency eyewash with 279 mm (11 in.) stainless-steel receptacle in shiny finish #2L; double anti-splash "Halo" sprinkler head with built-in 4.5 L/min (1.2 gpm) integrated flow regulator and dust caps with automatic release under water pressure; stainless-steel pictogram push-button control operating chrome-finish brass ball valve in open position, NPS ½ inlet; easy to clean in-line filter with 50 x 50 mesh screen.
 - .2 Stainless-steel hinged dust cover for receptacle, automatic opening by pushing the push plate.
 - .3 Mixer tap for eyewash, with a maximum capacity of 20 gpm, adjusted to 5 gpm, complete with check valve and thermometer, bronze construction.
- .11 FR-1: single wall-mounted, surface-mounted refrigerated fountain.
 - .1 Fountain: refrigerated drinking water fountain wall installation, 1.2-mm (18-gauge) type 304 stainless steel with brushed finish, lead-free brass drinking spout, self-closing valve activated with front push-button, automatic flow regulator for pressure varying between 138 and 725 kPa (20 and 105 psi), filter on the feed with 100 micron sieve. Drain and p-trap with integrated water guard, capacity of 30 L/H (8 gal/h), compressor with tank, storage of 2.25 L (0.59 gal) stainless steel, R134A refrigerant, finned cooler with fan hermetically sealed, 390 W, 4.6 A, 120 VAC one (1) phase with terminals for direct connection (to be connected to a circuit breaker with ground fault detector).
 - .1 Provide adequate support in the wall for the installation of the water fountain.
 - .2 Power supply: drinking water fountain supply, chrome finish, ¼ turn brass ball stop valve with removable handle/key combined with vandal-proof, rigid and integrated horizontal copper tube 13 mm (½ in.) ID x 127 mm (5 in.) long with brazing.
 - .3 P-trap: Provide a 1¼ in. diameter water trap. (included with the water fountain).
- .12 Fixture Piping:
 - .1 Hot and cold-water supply:
 - .1 Chrome-plated rigid supply pipes each with screwdriver stop, reducers, and rosette.
 - .2 Waste:
 - .1 Brass "P-trap" with clean out on each fixture not having integral trap.
 - .2 Chrome-plated in all exposed places.
- .13 Supports:
 - .1 Factory-built, floor mount brackets for all wall appliances.

Part 3 Execution**3.1 APPLICATION**

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

3.2 INSTALLATION

- .1 Mounting Heights:
 - .1 Standard: To comply with manufacturer's recommendations, unless otherwise indicated or specified in specifications or drawings.
 - .2 Wall-hung fixtures: As indicated.
 - .3 Physically handicapped: To comply with most stringent of either NBC or CAN/CSA-B651.

3.3 ADJUSTING

- .1 Complying with water conservation requirements specified in this Section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Verifications:
 - .1 Aerators: Operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: Operation under all conditions.
 - .3 Wash fountains: Operation of flow-actuating devices.
- .4 Thermostatic Controls:
 - .1 Verify temperature settings, operation, and safety controls.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 00 - Common Work Results for Plumbing.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CAN/CSA-B45 Series-02(R2008), Plumbing Fixtures.
 - .2 CAN/CSA-B125.3-05, Plumbing Fittings.
 - .3 CAN/CSA-B651-04, Accessible Design for the Built Environment.
- .2 National Research Council Canada (NRC).
 - .1 National Building Code of Canada 2015 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, and capacity.
 - .2 Details of operation, servicing, and maintenance.
 - .3 List of recommended spare parts.

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 APPARATUSES AND ACCESSORIES**

- .1 Fixtures: Manufacture in accordance with CAN/CSA-B45 Series.

- .2 Trim, Fittings: Manufacture in accordance with CAN/CSA-B125.3.
- .3 Exposed Plumbing Brass: Chrome-plated.
- .4 Number, Locations: Architectural drawings to govern.
- .5 Fixtures in any one location: Product of one manufacturer and of same type.
- .6 Trim in any one location: Product of one manufacturer and of same type.
- .7 Showers:
 - .1 DU-1: Shower head for individual shower, tamper proof.
 - .1 Standard 304 stainless steel shower head, 14-gauge, satin polished finish surface #4. Thermostatic and pressure balance, anti-scale, non-adjustable.
 - .2 One-handle pressure balance shower faucet with separate controls for water flow and temperature, including standard shower head.
 - .3 Type AS-1 drain in section 22 05 15 of the specifications is designed to accommodate a waterproofing membrane.
- .8 Fixture Piping:
 - .1 Hot and cold-water supply.
 - .1 Chrome-plated rigid supply pipes each with screwdriver stop, reducers, and rosette.
 - .2 Waste:
 - .1 Brass "P-trap" with cleanout on each fixture not having integral trap.
 - .2 Chrome-plated in all exposed places.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Mounting Heights:
 - .1 Standard: To comply with manufacturer's recommendations, unless otherwise indicated or specified.
 - .2 Physically handicapped: To comply with most stringent of either NBC or CAN/CSA B651.

3.3 ADJUSTING

- .1 Complying with water conservation requirements specified in this Section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.

- .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Checks:
 - .1 Aerators: Operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: Operation under all conditions.
 - .4 Thermostatic Controls:
 - .1 Verify temperature settings, operation, and safety controls.
- 3.4 CLEANING**
 - .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.
 - .2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

DIVISION 23

Part 1 General**1.1 USE OF SYSTEMS**

- .1 Use of existing, permanent, and new HVAC systems is not permitted.

Part 2 Products**2.1 NOT USED**

- .1 Not Used.

Part 3 Execution**3.1 NOT USED**

- .1 Not Used.

END OF SECTION

Part 1 General**1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable Codes.
 - .3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: Use "MCAC Shop Drawing Submittal Title Sheet". Identify Section and paragraph number.
- .4 Erection Drawings:
 - .1 Prepare and submit erection drawings to coordinate the work of the various construction sub-trades. Construction drawings are required for the following work:
 - .1 Ventilation-climatization work of all the building;
 - .2 Plumbing (Domestic water and drainage);
 - .3 Fire protection work.
 - .2 All erection drawings shall be prepared with the latest AutoCAD version, presented as DWG and PDF files. Drawings shall be an appropriate scale, but no smaller than 1:50.
 - .3 The erection drawings shall consist of drawings to scale, indicating the position of equipment, ducts, piping, valves, and other fittings with required sections and details, including the dimensions of piping and ducts, openings, anchors, and supports, relative positions with framework, architectural works, and other mechanical and electrical works.
 - .4 Preparation:
 - .1 Each discipline shall do its own erection drawing and coordinate it with other disciplines.
 - .2 The General Contractor shall be responsible for the coordination of all erection drawings of all mechanical and electrical disciplines which shall provide all the data, drawings, and diagrams necessary for this coordination work.

- .3 The Ventilation-Climatization Contractor shall prepare a design of its own work with all necessary data and dimensions, and incorporate all information provided by the other trades.
- .4 All erection drawings shall be submitted for review simultaneously.
- .5 Mechanical and electrical contractors shall work in close collaboration to determine the location of their respective works and to avoid clashes.
- .5 Responsibilities:
 - .1 Each subcontractor is directly responsible for the location and exact dimensions of the openings, bases, the location of its equipment, piping and ducts, whether dimensions figure in the structural, architectural, or engineering drawings or not.
 - .2 The Ventilation-Climatization Contractor shall ensure that no clashes are present in the erection drawings.
 - .3 No compensation shall be awarded for modifications to the work, for coordination and integration of mechanical and electrical systems with each other.
 - .4 The Departmental Representative's verification of the erection drawings is limited to ensuring that the technical requirements appear to be met (FD, grilles, insulation, etc.). Departmental Representative does not verify the quality of the coordination carried out by the contractors.

1.2 CLOSEOUT SUBMITTALS

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

- .2 Equipment performance test results.
- .3 Special performance data as specified elsewhere in Contract Documents.
- .4 Testing, adjusting, and balancing (TAB) reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approval:
 - .1 Submit one (1) copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted, unless otherwise directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into Operation and Maintenance Manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide one (1) set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 "As-built" drawings:
 - .1 Prior to start of testing, adjusting, and balancing for HVAC, finalize production of "As-built" drawings.
 - .2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: - AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform TAB for HVAC using "As-built" drawings.
 - .5 Submit completed reproducible "As-built" drawings with Operating and Maintenance Manuals.
 - .6 Print plumbing single-line diagrams on an A1 size sheet, to be installed underneath a plastic type plexiglass. Install drawings at locations indicated by BGIS on site.
- .9 Submit copies of "As-built" drawings for inclusion in final TAB report.

1.3**MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

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

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, 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.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Before proceeding with installation:
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch-up marred finished paintwork to match original.

- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

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

3.4 FIELD QUALITY CONTROL

- .1 Site Tests: Conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting, and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 DEMONSTRATION

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

3.6 CLEANING

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

3.7 PROTECTION

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 Green Seal Environmental Standards (GSES).
 - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .2 National Research Council Canada (NRC).
 - .1 National Fire Code of Canada 2015 (NFC).
- .3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards.
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 NOT USED**

- .1 Not used.

Part 3 Execution**3.1 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions, unless otherwise indicated.

June 30, 2020

- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance, and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components without interrupting operation of other system, equipment, and components. The dimension of the space shall comply to that shown in the drawings or shall be consistent with the manufacturer's recommendation, whichever is greater.

3.3 DRAINS

- .1 Install piping with grade in direction of flow, unless otherwise indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge must be visible.
- .4 Drain valves: NPS $\frac{3}{4}$ gate or globe valves, unless indicated otherwise, with hose end male thread, cap, and chain.

3.4 DIELECTRIC COUPLINGS

- .1 Use appropriate dielectric couplings compatible with system and pipework, to suit pressure rating of system.
- .2 Locations of dielectric couplings: Where dissimilar metals are joined.
- .3 NPS 2 and under: Isolating unions or bronze valves.
- .4 Over NPS 2: Isolating flanges.

3.5 PIPEWORK INSTALLATION

- .1 Screwed fittings covered and jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI Standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts, and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

June 30, 2020

- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly. Clean also after completion of installation work.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position or vertical upward, unless otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use butterfly or ball valves at branch take-offs for isolating purposes, unless otherwise specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .8 Use chain operators on valves NPS 2½ and larger where installed more than 2,400 mm (95 in.) above floor in mechanical rooms.

3.6 CHECK VALVES

- .1 Install silent check valves in vertical pipes with downward flow on discharge of pumps and as indicated.
- .2 Install swing check valves on discharge of pumps and as indicated.

3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: Schedule 40, black steel pipe.
- .3 Construction: Use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

June 30, 2020

- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire-retardant, waterproof non-hardening mastic.
 - .2 Elsewhere, provide space for firestopping and maintain fire rating integrity.
 - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one-piece type with set screws. Chrome or nickel-plated brass or type 302 stainless steel.
- .3 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRE-STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation, and adjacent fire separation in accordance with Section 07 84 00 - Fire-Stopping.
- .2 Uninsulated unheated pipes not subject to movement: No special protection.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapor barriers.

3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise the Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pework: Test as specified in relevant sections of Divisions 22 and 23.
- .3 Maintain specified test pressure without loss for 4 hours minimum, unless specified for longer period in relevant Sections of Divisions 22 and 23.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of the Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good.
- .7 Whether repair or replacement is appropriate is to be determined by the Departmental Representative.
- .8 Insulate or conceal work only after approval and certification of tests by the Departmental Representative.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).
 - .1 ANSI/ASME B31.1-2007, Power Piping.
 - .2 ANSI/ASME B31.3-2006, Process Piping.
 - .3 ANSI/ASME Boiler and Pressure Vessel Code 2007:
 - .1 BPVC 2007 Section I: Power Boilers.
 - .2 BPVC 2007 Section V: Nondestructive Examination.
 - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA).
 - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS).
 - .1 AWS C1.1M/C1.1-2000 (R2006), Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
 - .3 AWS W1-2000, Welding Inspection Handbook.
- .4 CSA Group (CSA).
 - .1 CSA W47.2-M1987 (R2008), Certification of Companies for Fusion Welding of Aluminum.
 - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
 - .3 CSA B51-03 (R2007), Boiler, Pressure Vessel and Pressure Piping Code.
 - .4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.
 - .5 CSA W178.1-2008, Certification of Welding Inspection Organizations.
 - .6 CSA W178.2-2008, Certification of Welding Inspectors.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Welders:
 - .1 Welding qualifications in accordance with CSA B51.

- .2 Use qualified and licensed welders possessing certificate for each procedure performed from Authority Having Jurisdiction.
- .3 Submit welder's qualification certificates to Departmental Representative.
- .4 Each welder to possess identification symbol issued by Authority Having Jurisdiction.
- .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
- .2 Inspectors:
 - .1 Inspectors' qualifications in accordance with CSA W178.2.
- .3 Certification:
 - .1 Registration of welding procedures in accordance with CSA B51.
 - .2 Copy of description of the welding procedures must be kept on site for reference purposes.
 - .3 Safety in welding, cutting, and related processes in accordance with CSA-W117.2.

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 FILLER METALS

- .1 Electrodes: In accordance with CSA W48 Series and ASME, Section IX, for arc welding.
- .2 Filler Metals: In accordance with ASME, Section IX.

Part 3 Execution

3.1 QUALITY OF WORK

- .1 Welding: In accordance with ANSI/ASME Boiler and Pressure Vessels Code, Sections I and IX, ANSI/ASME B31.1, B31.2, B31.3, and B31.4, and ANSI/AWWA C206, using procedures complying with AWS B3.0, AWS C1.1 and to applicable requirements of provincial Authorities Having Jurisdiction.

3.2 INSTALLATION REQUIREMENTS

- .1 Identify each weld with welder's identification symbol.
- .2 Backing Rings:
 - .1 Where used, fit to minimize gaps between ring and pipe bore.
 - .2 Do not install at orifice flanges.

- .3 Fittings:
 - .1 NPS 2 and smaller: Install welding type sockets.
 - .2 Bypass connections: Install welding tees or wrought connection.

3.3 SPECIAL REQUIREMENTS - STAINLESS STEEL WELDING

- .1 Special attention shall be paid to welding of stainless-steel piping both on site and in the workshop. Avoid welding and grinding of carbon steel near a stainless-steel weld to avoid contamination of the weld by the carbon-steel particles.
- .2 Welded pipe joints made of stainless-steel piping shall be at full penetration.
- .3 The first welding pass shall be carried out with the GTAW-GAS TUNGSTEN ARC (TIG) procedure. Foresee at least two (2) passes.
- .4 Usage of backing ring supports for butt welds of stainless-steel piping is not permitted.
- .5 Welding of stainless-steel piping shall be carried out using an inert gas purge (argon) welding process which includes the shielding gas around the welding rod and the supporting gas inside the piping.
- .6 Piping shall be pre-purged and purged at constant flow during welding.

3.4 INSPECTION AND TEST – GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits with applicable Codes and Standards with the Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with the Departmental Representative.
- .3 Do not conceal welds until they have been inspected, tested, and approved by inspector.
- .4 Allow inspector to visually inspect welds during early stages of welding procedures. As required, repair or replace defects as required by Codes and as specified in this Section.

3.5 SPECIALIST EXAMINATION AND TESTS

- .1 General:
 - .1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2, and ASME, Section IX, Standards, and approved by the Departmental Representative.
 - .2 Perform examinations and tests to ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 Standard, and requirements of Authorities Having Jurisdiction.
 - .3 Examine and test all welds in accordance with the "Inspection and Testing Plan", using non-destructive visual examinations: Include entire circumference of weld externally and wherever possible internally.

3.6 DEFECTS CAUSING REJECTION

- .1 General:
 - .1 In accordance with ANSI/ASME B31 and ANSI/ASME Boiler and Pressure Vessels Code.

- .2 Piping of less than 1,000 kPa (145 lb/in²) and inferior to 176°C (348°F):
 - .1 Undercutting greater than 0.8 mm (0.031 in.) deep, adjacent to cover bead outside of pipe.
 - .2 Undercutting greater than 0.8 mm (0.031 in.) deep, adjacent to root bead inside of pipe.
 - .3 Undercutting greater than 0.8 mm (0.031 in.) deep, considering internal and external surfaces of pipe.
 - .4 Incomplete penetration and fusion, greater than total length of 38 mm (1½ in.), in 1,500 mm (59 in.) length of weld depth of such defects being greater than 0.8 mm (0.031 in.).
 - .5 Repair cracks and defects exceeding more than of 0.8 mm (0.031 in.).
 - .6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiography tests.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds, at Contractor's expense.

3.8 SUBMITTED CLAIMS DUE TO DELAYS

- .1 Claims made due to delays in the completion of work shall not be accepted if these delays are attributable to welds rejected during examinations or tests.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self-Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- .3 Efficiency Valuation Organization (EVO).
 - .1 International Performance Measurement and Verification Protocol (IPMVP).
 - .1 IPMVP 2007 Version.
- .4 Green Seal Environmental Standards (GS).
 - .1 GS-11-11, Standard for Paints and Coatings.
 - .2 GS-36-11, Standard for Commercial Adhesives.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for thermometers and pressure gauges, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE, AND HANDLING

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

- .3 Storage and Handling Requirements:
 - .1 Store thermometers and pressure gauges off ground, in dry location, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid-point of scale or range.

2.2 DIRECT-READING THERMOMETERS

- .1 100-mm diameter dial-type industrial thermometers filled with liquid, in accordance with ANSI / ASME B40.100, category 1A, accurate to 1%.
- .2 With aluminum frame and adjustable angle.
- .3 Combined grading thermometers (°C and °F).
- .4 Scale: -40°C to 150°C (-40°F to 302°F).

2.3 THERMALLY CONDUCTIVE MATERIAL

- .1 Thermally conductive gel to fill gap between walls of thermowell and sensor.

2.4 THERMOWELLS

- .1 Copper or Plastic Pipes: Brass wells.
- .2 Steel Pipes: Brass or stainless-steel wells.

2.5 MANOMETERS

- .1 Dial manometers of 100 mm diameter, filled with liquid, in accordance with ANSI/ASME B40.100, Class 1A, accurate at 1%.
 - .1 Polished stainless-steel casing and ring, stainless-steel mechanism with adjustable needle (adjustable micrometer).
 - .2 Scaled to operate at central third of full range.
 - .3 Manometers built to resist a minimum pressure of 5,500 kPa (800 psi).
 - .4 Threaded joint NPS ¼ made of copper or bronze for copper or plastic piping and made of brass or stainless steel for steel piping.
 - .5 5-year warranty.
- .2 The following characteristics or elements must be considered for thermometer and manometer installed, depending which case:
 - .1 U-bend, if on a steam network;

June 30, 2020

- .2 Shock absorber, if the circuit undergoes pressure pulses;
- .3 Separating membrane, if the circuit contains corrosive fluids;
- .4 Bronze ball valve with drainage joint at every manometer.

2.6 PRESSURE TEMPERATURE GAUGES (PT)

- .1 Brass connection of NPS ¼, with valve-body connection and neoprene core designed to measure temperature and pressure, with threaded brass cap.
- .2 Temperature limits when cap is screwed: -40°C to 65.5°C (-40°F to 150°F).
- .3 Operating Temperatures: 7.2°C to 65.6°C (45°F to 150°F).
- .4 Pressure limits when cap installed: 3,450 kPa man. (500 psig.).
- .5 Operating Pressures: 2,760 kPa man. (400 psig.).
- .6 Thermometer for PT Gauge:
 - .1 Provide Departmental Representative with a dial thermometer, 25 mm in diameter, with stem 125 mm long, and graduated scales in degree Celsius (°C) and degree Fahrenheit (°F) (from -40°C to 70°C and -40°F to 160°F), which can be recalibrated.
- .7 Manometer for PT Gauge:
 - .1 Provide Departmental Representative with a dial pressure gauge, 63 mm in diameter, with steel case, aluminum dial, polycarbonate lens, NPS ¼ connection below dial, threaded brass stem for measurement and graduated pressure scales in kPa and psi from 0 to 415 kPa(0 to 60 psi).

Part 3 Execution

3.1 GENERAL

- .1 Install instruments so they can be easily read from floor or operating platform.
- .2 Install instruments between equipment and first fitting or valve element placed downstream or upstream, depending of case.

3.2 THERMOMETERS

- .1 Always set the thermometers in thermowells fitted with a thermally conductive material.
- .2 Install thermometers at the indicated locations as well as inlet and outlet of the following apparatuses:
 - .1 Heat exchangers;
 - .2 Heating and cooling coils;
 - .3 Hot water boilers;
 - .4 Heat pumps;
 - .5 Domestic water heaters.
- .3 Use extensions for thermometers installed on insulated piping.

June 30, 2020

- .4 Supply and install the thermowells necessary for the balancing of systems and regulation.

3.3 MANOMETERS

- .1 Install manometers in following locations:
 - .1 At suction and backflow of pumps;
 - .2 Upstream and downstream of pressure reducing valves;
 - .3 Upstream and downstream of regulation valves;
 - .4 Inlet and outlet, water side, of cooling and heating coils and heat exchangers;
 - .5 Outlet, water side, of boilers;
 - .6 At expansion tank;
 - .7 At each location indicated.
- .2 Use extensions when manometers are installed on insulated piping.
- .3 Install necessary connections where manometers shall be used for balancing purposes and regulation.

3.4 PRESSURE-TEMPERATURE GAUGES (PT)

- .1 Install PT gauges on the supply and return pipes of air-to-water and water-to-water heat pumps and fan coils.

3.5 NAMEPLATES

- .1 Install engraved Lamicoid nameplates, as specified in Section 23 05 53 - Identification for HVAC Piping and Equipment, to identify fluid carried.

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.
- .2 Section 23 05 48.16 - Seismic Restraint Systems (SRS) - Type 2 Buildings.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B31.1-07, Power Piping.
- .2 ASTM International (ASTM).
 - .1 ASTM A125-1996 (2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60.000 PSI Tensile Strength.
 - .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM).
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS).
 - .1 MSS SP58-2002. Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP69-2003. Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89-2003. Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 National Research Council Canada (NRC).
 - .1 National Plumbing Code of Canada 2015 (NPC).
- .6 Underwriters Laboratories of Canada (ULC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings for:
 - .1 Bases, hangers, and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.

June 30, 2020

- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions:
 - .1 Provide manufacturer's installation instructions.
 - .1 Departmental Representative will make available copy of systems supplier's installation instructions.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 DESCRIPTION OF SYSTEM

- .1 Design Requirements:
 - .1 Install pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's recommendations using current components, parts, and assemblies.
 - .2 Nominal maximum load ratings on eligible stresses prescribed by ASME B31.1 or MSS-SP-58.
 - .3 Ensure that supports, guides, and anchors do not transmit adverse quantities of heat or stress to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Total of adjustment in accordance with MSS-SP-58.
- .2 Performance Requirements:
 - .1 Design supports, platforms, catwalks, and hangers to withstand seismic events.

2.2 GENERAL

- .1 Fabricate hangers, supports, and sway braces in accordance with ANSI B31.1 and MSS-SP-58 Standards.

June 30, 2020

- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 Perforated metal straps are forbidden.
- .4 "Ramset" percussion and drop-in anchors are forbidden.

2.3 HANGERS

- .1 Finishes:
 - .1 Hangers and supports: Galvanized after manufacture.
 - .2 Use electro-plating galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper-plated or epoxy coated.
 - .4 Stainless-steel hangers for all stainless-steel pipework.
- .2 Suspension equipment from bottom flange of I-Beam:
 - .1 Piping NPS 2 or less and HVAC equipment: Malleable cast-iron, C-clamp with hardened steel cup point, set screw and locknut, UL, ULC, and FM approved, to MSS-SP-69.
 - .2 Piping NPS 2½ or greater: Malleable cast-iron beam clamp, eye rod, jaws and cast-iron extension with retaining clip, tie rod, carbon iron nuts and washers, UL, ULC, and FM approved, to MSS-SP-69.
- .3 Suspension equipment from top flange of I-Beam:
 - .1 Ductile cast-iron top-of-beam C-clamp, with hardened steel cup point set screw, locknut and carbon steel retaining clip, UL, ULC, and FM, approved to MSS-SP-69.
 - .2 Malleable cast-iron jaw, hook rod with nut, lock washer and plain washer, UL and FM, approved to MSS-SP-69.
- .4 Steel Joists:
 - .1 Pipes NPS 2 or less and HVAC equipment: Steel bearing plates with two (2) locknuts.
 - .2 Pipes NPS 2½ or greater and HVAC equipment: Steel bearing plates with two (2) locknuts, carbon steel welded attachment with malleable cast-iron eye nut.
 - .3 Carbon steel welded attachment with two (2) locknuts in accordance with MSS-SP-69, type 22.
- .5 Steel angles or channels (bottom flange):
 - .1 Ductile cast-iron top-of-beam, C-clamp with hardened steel cup point set screw, locknut and carbon steel retaining clip, UL, ULC, and FM, approved to MSS SP-69.
- .6 Steel angles or channels (top flange):
 - .1 Malleable cast-iron jaw, hook rod with nut, lock washer, and plain washer, UL and FM, approved to MSS-SP-69.
- .7 Wooden Work:
 - .1 Malleable cast-iron ceiling flange.
- .8 Shop and field-fabricated assemblies:
 - .1 Pipe rolls or roller supports.

June 30, 2020

- .2 Steel brackets.
- .3 Sway braces for seismic restraint systems: In accordance with Section 23 05 48.16 - Seismic Restraint Systems (SRS) - Type 2 Buildings.
- .9 Hanger Rods: Threaded, to MSS-SP-58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where vertical or horizontal movement of pipework is anticipated.
- .10 Supports and hangers installed on top of insulation (all diameters):
 - .1 Steel or copper piping, with longitudinal movement of less than 25 mm (1 in.): Adjustable clevis fastener, UL, ULC, and FM, in accordance with MSS-SP-69.
 - .2 Steel piping, with longitudinal movement of less than 25 mm (1 in.): Pipe roll in accordance with MSS-SP-69, type 43.
 - .3 Steel or copper hot piping supported underneath: Pipe roll stand in accordance with MSS-SP-69, type 44.
- .11 Supports and hangers installed directly on pipe (all diameters - Hot or tempered services only):
 - .1 Steel or plastic piping, with longitudinal movement of less than 25 mm (1 in.): Adjustable swivel ring, to MSS-SP-69, type 10, and UL and FM approved.
 - .2 Copper piping, with longitudinal movement of less than 25 mm (1 in.): Adjustable copper swivel ring, to MSS-SP-69, type 10.
 - .3 Steel or plastic piping, with longitudinal movement of less than 25 mm (1 in.): Pipe roll/roller support to MSS-SP-69, type 43.
 - .1 Plastic-coated for stainless-steel pipe.
 - .4 Steel or plastic piping supported underneath: Pipe roll in accordance with MSS-SP-69, type 44.
 - .1 Plastic-coated for stainless-steel pipe.
 - .5 Cast-iron drain piping and vent piping with steel mechanical joints, clamp on each side of the joint, (for NPS 2 to NPS 6) and cast-iron saddle (for NPS 8 and NPS 10).
 - .6 Stainless-steel pipe, with longitudinal movement of less than 25 mm: Grade 304 stainless steel adjustable clevis hanger, in accordance with ANSI/MSS-SP-69 and MSS-SP-58 (type 1).
- .12 Supports and hangers for fire protection piping.
 - .1 Plastic or steel fire protection piping: Adjustable clevis fastener, UL and FM approved, in accordance with MSS-SP-69, type 10, UL and FM approved.
 - .2 Copper fire protection piping: Adjustable brass stirrup, complying with MSS-SP-69, type 10.
- .13 Supports and hangers for refrigeration piping.
 - .1 Uninsulated copper refrigeration piping: Electro-galvanized channel and U-clamp, 41 mm x 41 mm (1.6 in. x 1.6 in.), 2.6 mm (0.1 in.) thick, assembly to ASTM B633, type III SC1, with plastic packing.
 - .2 Insulated copper refrigeration piping: Electro-galvanized channel and U-clamp, 41 mm x 41 mm (1.6 in. x 1.6 in.), 2.6 mm (0.1 in.) thick, assembly to ASTM B633, type III SC1.

June 30, 2020

- .14 U-bolts: Carbon steel, in accordance with MSS-SP-69, with two (2) nuts at each end, to ASTM A563.
 - .1 Galvanized finish for steel pipework.
 - .2 Black finish for copper, glass, brass, or aluminum piping, with formed portion plastic coated.
- .15 U-bolts: Grade 304 stainless steel, to ANSI/MSS-SP-69 and MSS-SP-58 (type 24).

2.4 RISER CLAMPS

- .1 Steel, Cast-iron, or Plastic Piping: Carbon steel clamp, UL and ULC approved, to MSS-SP-69, type 8.
- .2 Copper Pipe: Copper-plated carbon steel clamp, to MSS-SP-69, type 8.
- .3 Bolts: According to ASTM A307.
- .4 Nuts: According to ASTM A563.
- .5 Stainless-Steel Pipe: Grade 304 stainless-steel clamp, to ANSI/MSS-SP-69 and MSS-SP-58 (type 8).

2.5 PIPE SHIELDS AND SADDLES

- .1 Use high-density insulation with continuous vapor barrier for pipe shields.
- .2 Pipe shields and saddles for support of horizontal, insulated piping complying with the following characteristics:
 - .1 Rigid copper piping, NPS 1¼ or greater: Protective pipe shield;
 - .2 Ferrous metal piping:
 - .1 Chilled-water piping: Pipe shield and high-density insulation for all diameters;
 - .2 Hot-water pipes: Pipe shields for NPS up to 3 and saddles for NPS greater than 3;
 - .3 Steam and condensate piping: Saddles for all diameters.

2.6 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: Alloy steel, to ASTM A125, shot peened, magnetic particle inspected, with ±5% spring rate tolerance, tested for free height, spring rate, loaded height, and provided with Certified Mill Test Report (CMTR).
- .2 Load Adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel +20%. Difference between total travel and actual travel 25 mm (1 in.) minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

June 30, 2020

2.7 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical Movement between 13 mm (½ in.) minimum and 50 mm (2 in.) maximum: Use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm (2 in.): Use double-spring pre-compressed variable spring hanger with two (2) springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Alloy Steel Springs: To ASTM A125, shot peened, magnetic particle inspected, with ±5% spring rate tolerance, tested for free height, spring rate, loaded height, and provided with CMTR.

2.8 EQUIPMENT SUPPORTS

- .1 When not supplied by manufacturer, elements intended to support devices must be made of structural steel in accordance with Structural Documents. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.10 HOUSE-KEEPING PADS

- .1 Provide 100 mm (4 in.) high concrete housekeeping pads for base-mounted equipment; size pads 200 mm (8 in.) larger than equipment; chamfer pad edges.
- .2 Concrete: In accordance with Structural Specifications.

2.11 ROOF SUPPORTS

- .1 UV-resistant recycled rubber mounts and fastening accessories as specified.
- .2 U-clamp with bolted collars, galvanized-steel fastener and 12 mm (½ in.) dia. rod assembly.
- .3 Brackets installed on previously cleaned and swept roof, in accordance with manufacturer's instructions.

Part 3 Execution**3.1 MANUFACTURER'S INSTRUCTIONS**

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

3.2 INSTALLATION

- .1 Provide anti-vibration devices to pumps, boilers, refrigeration equipment, cooling towers, and other specified items.

June 30, 2020

- .2 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques.
 - .3 Steel pipes: Install below coupling or shear pins.
 - .4 Cast-iron pipes: Install below joint.
- .3 Anchorage components for hangers mounted on concrete structure:
 - .1 Attach elements as recommended by manufacturer.
- .4 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm (½ in.) or more.
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .5 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25% of total load.

3.3 SPACING BETWEEN SUPPORTS AND SUSPENSIONS

- .1 Plumbing Piping: To National Plumbing Code of Canada.
- .2 Comply with NFPA 13 and NFPA 14 for fire protection piping.
- .3 Install a support or hanger every 1.5 m (5 ft) for NPS ½ or smaller copper piping.
- .4 Install a support or hanger no more than 300 mm (12 in.) from each elbow.
- .5 Comply with MSS-SP-69 for pipe NPS 12 or greater.
- .6 Flexible joint roll grooved pipe: Install a support or hanger at each joint.
- .7 Support cast-iron piping at all connections and each telescoping joint. The distance between two supports shall not exceed 3 m (10 ft). Reduce this distance for piping with mechanical joints to 1 m (3.3 ft) when two adjacent connections are 300 mm (12 in.) or less apart.
- .8 Install supports at the base, at the high point, and at each floor of risers.
- .9 In addition to the above required supports, install supports and suspensions on the straight lengths of the piping as described in the tables below:

PLUMBING, COOLING, AND HEATING PIPING							
MAXIMUM SPACING ON HORIZONTAL PIPING, METRES (FEET)							
Ø PIPE (NPS)	Ø ROD mm (in.)	STEEL		COPPER	ASBESTOS- CIMENT	ABS PVC	CPVC
		SCHED. 10	SCHED. 40				
Up to ½	10 (¾)	---	2.1 (6.9)	1.5 (4.9)	----	0.9 (3.0)	0.8 (2.6)
¾	10 (¾)	2.1 (6.9)	2.1 (6.9)	1.5 (4.9)	---	1.0 (3.3)	0.9 (3.0)
1	10 (¾)	2.1 (6.9)	2.1 (6.9)	1.8 (5.9)	---	1.1 (3.6)	1.0 (3.3)
1¼	10 (¾)	2.1 (6.9)	2.1 (6.9)	2.1 (6.9)	2.0 (6.6)	1.2 (3.9)	1.2 (3.9)

June 30, 2020

PLUMBING, COOLING, AND HEATING PIPING							
MAXIMUM SPACING ON HORIZONTAL PIPING, METRES (FEET)							
Ø PIPE (NPS)	Ø ROD mm (in.)	STEEL		COPPER	ASBESTOS- CIMENT	ABS PVC	CPVC
		SCHED. 10	SCHED. 40				
1½	10 (¾)	2.7 (8.9)	2.7 (8.9)	2.4 (7.9)	2.0 (6.6)	1.3 (4.3)	1.3 (4.3)
2	10 (¾)	3.0 (9.8)	3.0 (9.8)	2.4 (7.9)	2.0 (6.6)	1.5 (4.9)	1.4 (4.6)
2½	13 (½)	3.4 (11.2)	3.4 (11.2)	2.7 (8.9)	2.0 (6.6)	---	1.7 (5.6)
3	13 (½)	3.6 (11.8)	3.6 (11.8)	3.0 (9.8)	2.0 (6.6)	1.9 (6.2)	1.8 (5.9)
3½	13 (½)	---	3.9 (12.8)	3.4 (11.2)	2.0 (6.6)	---	---
4	16 (⅝)	---	4.2 (13.8)	3.7 (12.1)	2.0 (6.6)	2.2 (7.2)	2.1 (6.9)
5	16 (⅝)	---	4.8 (15.7)	---	2.0 (6.6)	---	---
6	19 (¾)	---	5.1 (16.7)	---	2.0 (6.6)	2.6 (8.5)	2.6 (8.5)
8	19 (¾)	---	5.7 (18.7)	---	2.0 (6.6)	3.0 (9.8)	3.0 (9.8)
10	22 (⅞)	---	6.6 (21.7)	---	2.0 (6.6)	3.5 (11.5)	3.3 (10.8)
12	22 (⅞)	---	6.9 (22.6)	---	2.0 (6.6)	3.8 (12.5)	3.7 (12.1)
14	25 (1)	---	7.6 (24.9)	---	---	4.0 (13.1)	3.9 (12.8)
16	25 (1)	---	8.2 (26.9)	---	---	4.4 (14.4)	4.3 (14.1)
18	25 (1)	---	8.5 (27.9)	---	---	4.7 (15.4)	---
20	32 (1¼)	---	9.1 (29.9)	---	---	5.0 (16.4)	---
24	32 (1¼)	---	9.7 (31.8)	---	---	5.6 (18.3)	---

FIRE PROTECTION PIPING						
MAXIMUM SPACING ON HORIZONTAL PIPING, METRES (FEET)						
Ø PIPING (DN)	Ø ROD mm (po)	STEEL	COPPER	THIN- WALL STEEL	DUCTILE CAST- IRON	CPVC
¾	10 (¾)	---	2.4 (7.9)	---	---	1.3 (4.3)
1	10 (¾)	3.6 (11.8)	2.4 (7.9)	3.6 (11.8)	---	1.5 (4.9)
1¼	10 (¾)	3.6 (11.8)	3.0 (9.8)	3.6 (11.8)	---	1.6 (5.2)
1½	10 (¾)	4.5 (14.8)	3.0 (9.8)	3.6 (11.8)	---	1.7 (5.6)
2	10 (¾)	4.5 (14.8)	3.6 (11.8)	3.6 (11.8)	---	1.9 (6.2)
2½	10 (¾)	4.5 (14.8)	3.6 (11.8)	3.6 (11.8)	---	2.3 (7.5)
3	10 (¾)	4.5 (14.8)	3.6 (11.8)	3.6 (11.8)	4.5 (14.8)	2.5 (8.2)
3½	10 (¾)	4.5 (14.8)	4.5 (14.8)	---	---	---
4	10 (¾)	4.5 (14.8)	4.5 (14.8)	---	4.5 (14.8)	---
5	13 (½)	4.5 (14.8)	---	---	---	---
6	13 (½)	4.5 (14.8)	---	---	4.5 (14.8)	---
8	13 (½)	4.5 (14.8)	---	---	4.5 (14.8)	---

June 30, 2020

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Provide appropriate supports, hangers, guides, anchors, elbows, and thermal-expansion loops required to allow piping to expand due to temperature variations in a flexible manner.
- .5 Piping and equipment must be supported independently from each other.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4° from vertical.
- .2 Where horizontal pipe movement is less than 13 mm (½ in.), offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 PIPING ATTACHMENT TO METAL STRUCTURE

- .1 Support piping with diameter greater than NPS 4 to distribute load imposed on the structure on several structural elements.
- .2 When pipework is parallel to joists, install pipe in the center at equal distance between two girders and install supports or hangers to distribute load equally among those two (2) girders.

3.7 FINAL ADJUSTMENT

- .1 Hangers and Supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable Clevis:
 - .1 Tighten hanger load nut securely to optimize hanger performance.
 - .2 Tighten lock nut after adjustment done.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam Clamps:
 - .1 Hammer jaw firmly against bottom flange of beam.

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.
- .2 Section 23 05 48.16 - Seismic Restraint Systems (SRS) - Type 2 Buildings.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .2 National Fire Protection Association (NFPA).
 - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
- .3 National Research Council Canada (NRC).
 - .1 National Building Code of Canada 2015 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications, and data sheets in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec.
 - .2 Provide separate shop drawings for each isolated system and system shop drawings complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
- .3 Quality Assurance Submittals: Submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling, and unloading:
- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.

1.6 USE OF VIBRATION AND SEISMIC CONTROLS

- .1 Provide vibration controls for mechanical equipment as per the requirements in the table below:

Equipment	Power (HP) and Other	RPM	Equipment Location											
			Ground Slab			Slab - Span								
						Up to 6 m			Between 6 and 9 m			Between 9 and 12 m		
			Base	Isolator	Min. Flexion (mm)	Base	Isolator	Min. Flexion (mm)	Base	Isolator	Min. flexion (mm)	Base	Isolator	Min. Flexion (mm)
Ventilation Units	All	All	A	1.1	-	A	1.1	-	A	1.1	-	A	1.1	-
Axial Fans														
Diameter: Up to 560 mm	All	All	A	2	5	A	3	20	A	3	20	C	3	20
Diameter: 600 mm and over	P.S. ≤ 500 Pa	Up to 300	B	3	65	C	3	90	C	3	90	C	3	90
		301 to 500	B	3	20	B	3	40	C	3	65	C	3	65
		501 and over	B	3	20	B	3	40	B	3	40	B	3	40
	P.S. ≥ 501 Pa	Up to 300	C	3	65	C	3	90	C	3	90	C	3	90
		301 to 500	C	3	40	C	3	40	C	3	65	C	3	65
		501 and over	C	3	20	C	3	40	C	3	40	C	3	65
Centrifugal Fans														
Diameter: Up to 560 mm	All	All	B	2	5	B	3	20	B	3	20	C	3	40
Diameter: 600 mm and over	≤ 40	Up to 300	B	3	65	B	3	90	B	3	90	B	3	90
		301 to 500	B	3	40	B	3	40	B	3	65	B	3	65
		501 and over	B	3	20	B	3	20	B	3	20	B	3	40
	≥ 50	Up to 300	C	3	65	C	3	90	C	3	90	C	3	90
		301 to 500	C	3	40	C	3	40	C	3	65	C	3	65
		501 and over	C	3	25	C	3	40	C	3	40	C	3	65
Water-Water Heat Pumps	All	All	A	3	20	A	3	20	A	3	20	A/D	3	40
Condensing Units	All	All	A	1	5	A	4	20	A	4	40	A/D	4	40
Small Fans and Fan-Powered Terminal Boxes														
	≤ 285 L/s	All	A	3	15	A	3	15	A	3	15	A	3	15
	> 285 L/s	All	A	3	20	A	3	20	A	3	20	A	3	20

- Base types:
- A. No base; isolators attached directly to equipment.
- B. Base or structural steel rail (2.9).
- C. Inertia base, concrete (2.10).
- D. Roof curb isolation rails (2.11).

June 30, 2020

- Isolator types:
1. Elastomeric pads (2.2).
 - 1.1 Rubber / steel / rubber elastomeric pads (2.2, EP4).
 2. Floor or suspended elastomeric mounts (2.3, 2.6).
 3. Floor or suspended springs (2.6).
 4. Spring mount(s) (2.5).
 5. Thrust restraints (2.8).

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation shall comply with indications.
- .2 All products shall comply with Aseismic Standards.

2.2 ELASTOMERIC PADS

- .1 Type EP1: Neoprene waffled or ribbed, 12 mm (0.5 in.) minimum thick, 50 durometer, maximum load 621 kPa (90 psi).
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
- .2 Type EP2: Rubber waffled or ribbed, 30 durometer, 12 mm (0.5 in.) minimum thick, maximum load 345 kPa (50 psi).
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
- .3 Type EP3: Neoprene-steel-neoprene, comprising two (2) neoprene pads, waffled or ribbed, 50 durometer, 12 mm (0.5 in.) minimum thick, bonded to 1.71 mm (0.067 in.) steel plate, holes sleeved with isolation washers, maximum load 621 kPa (90 psi).
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
- .4 Type EP4: Rubber-steel-rubber, comprising two (2) natural rubber pads, waffled or ribbed, 30 durometer, 12 mm (0.5 in.) minimum thick, bonded to 1.71 mm (0.067 in.) steel plate, holes sleeved with isolation washers, maximum load 345 kPa (50 psi).
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".

2.3 ELASTOMERIC MOUNTS

- .1 Type M1: Color coded; neoprene in shear; maximum durometer of 60, ribbed top and bottom surfaces, threaded insert and two (2) bolt-down holes.
- .2 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".

2.4 SPRINGS

- .1 Design Stable Springs: Ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

June 30, 2020

- .3 Cadmium plated for all installations.
- .4 Color coded.

2.5 SPRING MOUNTS

- .1 Zinc or cadmium-plated hardware; housings coated with rust-resistant paint.
 - .1 Type M2: Stable open spring; support on bonded 6-mm (0.236 in.) minimum thick ribbed neoprene or rubber friction and soundproof pad.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
 - .2 Type M4: Restrained stable open spring; supported on bonded 12-mm (0.5 in.) minimum thick ribbed neoprene or rubber friction and soundproof pad; built-in resilient limit stops, removable spacer plates.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
 - .3 Type M5: Enclosed spring mounts with snubbers for isolation up to 950 kg (2,090 lbs) maximum.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
- .2 Performance: Minimum damping efficiency of 95%.

2.6 HANGERS

- .1 Color-coded springs, rust-resistant, painted box type hangers, arrange to allow hanger box or rod to move through a 30-degree arc, without metal-to-metal contact.
 - .1 Type H1: With neoprene washer, in-shear, molded with rod isolation bushing.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
 - .2 Type H2: Stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
 - .3 Type H3: Stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
 - .4 Type H4: Stable spring, elastomeric element with precompression washer and nut with deflection indicator.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
- .2 Performance: Minimum damping efficiency of 95%.

2.7 ACOUSTIC GASKETS FOR ANCHORS AND GUIDES

- .1 Acoustic Gaskets: Between pipe and support, consisting of 25 mm (1 in.) minimum thick heavy-duty duct and neoprene isolation material.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".

June 30, 2020

2.8 HORIZONTAL THRUST RESTRAINTS

- .1 Type L1: Horizontal thrust restraints, spring and elastomeric elements housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment. Provision for adjustment to limit maximum start and stop movement to 9 mm (0.354 in.).
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.
- .3 Acceptable Products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/ Booth".

2.9 STEEL BASES

- .1 Types:
 - .1 Type B1: Prefabricated steel base; integrally welded on sizes up to 2,400 mm (8 ft), for field welding on sizes over 2,400 mm (8 ft); reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
 - .2 Type B2: Steel base; structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
 - .1 Acceptable products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".
 - .3 Set bases to clear housekeeping pads by 25 mm (1 in.) minimum.

2.10 STEEL INERTIA BASES AND CONCRETE SLAB

- .1 Type:
 - .1 Type B3: Full-depth perimeter structural or formed channels, frames; welded in place reinforcing rods running in both directions; bottom (formwork); 1.3 mm (0.051 in.) thick frame-welded sheet for frame widths of up to 2,400 mm (8 ft), and bolted when the frame width exceeds 2,400 mm (8 ft); spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm (2 in.) minimum.
 - .2 Pump bases: "T" shaped, where applicable, to support elbows.
- .2 Concrete: As indicated.
- .3 Concrete base thickness to be one-tenth ($1/10$) of the maximum span between isolators, but no less than 150 mm and no more than 300 mm, unless otherwise indicated.
- .4 Acceptable Products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".

2.11 ROOF CURB ISOLATION RAILS

- .1 General: Type B4, complete factory assembled.
- .2 Lower Members: Rectangular steel tubes or extruded aluminum channels.

June 30, 2020

- .3 Upper Members: Continuous rectangular steel tubes or extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6-mm (0.236 in.) thick, to resist wind and seismic forces.
- .4 Springs: Steel, adjustable, removable, selected for 50-mm (2 in.) maximum static deflection plus 50% additional travel to solid, cadmium-plated, sized and positioned to ensure uniform deflection.
- .5 High-Frequency Isolation: Continuous gasket on top and bottom of complete assembly or pads on top and bottom of each spring. Material: 6 mm (0.236 in.) thick, closed cell neoprene.
- .6 Weatherproofing: Continuous flexible counterflashing to curb and providing access to springs. Material: Aluminum or neoprene.
- .7 Hardware: Cadmium-plated or galvanized.
- .8 Acceptable Products: Vibro-Acoustics; Vibra-Sil; Ingenia "Amber/Booth".

2.12 SEISMIC CONTROL MEASURES

- .1 General:
 - .1 The seismic protection equipment and / or systems shall meet requirements of the level of protection according to requirements of the NBC for the City of Rigaud.
 - .2 Seismic control systems and devices to work in all directions.
 - .3 Fasteners and attachment points to resist same maximum load as seismic restraints.
 - .4 Drilled or power-driven anchors and fasteners not permitted.
 - .5 No equipment, equipment supports, or mounts to fail before failure of structure.
 - .6 Supports of cast-iron or threaded pipe not permitted.
 - .7 Seismic control systems and devices shall not interfere with integrity of fire-stopping devices.
- .2 Static Equipment:
 - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
 - .2 Suspended equipment:
 - .1 Use one or more of following methods depending upon site conditions and as indicated:
 - .1 Install tight to structure;
 - .2 Cross-brace in every direction.
 - .3 Cross-brace to frame;
 - .4 Cable restraint system.
 - .3 Seismic restraints:
 - .1 Earthquake-resistant devices and systems shall provide cushioning action that is gentle and steady.
 - .2 Never reach metal-like stiffness.

June 30, 2020

- .3 Resilient Supporting Material (Vibration isolated):
 - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
 - .3 As indicated.
- .4 Piping Systems.
 - .1 Fire protection systems: To NFPA 13.
 - .2 Other piping systems: Hangers longer than 300 mm; brace at each hanger.
 - .3 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing Methods: As approved by Seismic Specialist Engineer.
 - .1 Structural steel angles or channels.
 - .2 Cable restraint system incorporating grommets, shackles, and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Seismic control measures: To meet National Code of Canada requirements.
- .2 Install vibration isolation equipment in accordance with manufacturers' instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting, and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduits, and ducts passing through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows. Comply with the following:
 - .1 Up to NPS 4: First three (3) points of support. NPS 5 to NPS 8: First four (4) points of support. NPS 10 and over: First six (6) points of support;
 - .2 First point of support: Static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor, use vibration isolation rubber washers.

June 30, 2020

- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.
- .7 Place ventilation units on elastomer pads selected for static deflection of 4 mm and spaced a maximum of 2,400 mm apart, centre-to-centre.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's field services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer to provide product use recommendations and carry out periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of products;
 - .2 After preparatory work and other preliminary work are complete, but before installation commences;
 - .3 Upon completion of installation.
 - .3 Submit manufacturer's reports to the Departmental Representative within three (3) days of manufacturer representative's site visit.
 - .4 Adjustments and corrections in accordance with manufacturer's written report.
- .2 Inspection and certification of seismic restraints.
 - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start-up and once TAB operations are completed.
 - .2 Take vibration measurements for indicated equipment.
 - .3 Provide Departmental Representative with 24-hour advance notice prior to commencement of tests.
 - .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
 - .5 Submit complete report of test results.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CAN/CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .3 National Research Council Canada (NRC).
 - .1 National Building Code of Canada 2015 (NBC).

1.3 SYSTEM DESCRIPTION

- .1 SRS fully integrated into, and compatible with:
 - .1 Noise and vibration controls prescribed.
 - .2 Structural, mechanical, and electrical design of Project.
- .2 Each Specialist Contractor is responsible for the seismic restraint measures related to its discipline.
- .3 During seismic event, SRS to withstand maximum relative movement of structure expected during building construction without damage and prevent mechanical and electrical systems from causing personal injury and from moving from normal position.
- .4 SRS to be designed by a specialist seismic engineer recognized in the Province of Quebec.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in the Province de Quebec, Canada.
- .3 Submit design data including the following:
 - .1 Full details of design criteria;
 - .2 Working drawings, prepared to same standard of quality and size as documents forming these Contract Documents, materials and equipment lists, schematics, and full specifications for all components of each SRS to be provided;
 - .3 Design calculations, including restraint loads resulting from seismic forces in accordance with Quebec Construction Code, detailed work sheets and tables;

June 30, 2020

- .4 Separate shop drawings for each SRS and devices for each system and equipment as well as each of their elements;
- .5 Identification of location of each device or system;
- .6 Schedules of types of SRS equipment or devices;
- .7 Details of fasteners and attachments to structure, anchorage loadings, and attachment methods;
- .8 Installation and instructions procedures.
- .4 Submit documents signed and sealed by a specialist engineer recognized in the Province of Quebec certifying that the products, materials, and equipment comply with specified performance characteristics and physical properties.
- .5 Submit manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide required closeout submittals and attach them to the Operations and Maintenance (O&M) Manual in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide maintenance data, including SRS monitoring requirements.
- .3 Submit a seismic system conformity report signed by a qualified engineer, stating that the installation complies with the regulations in force.

1.6 PROTECTION LEVEL

- .1 Install anchoring and seismic stabilization devices for ventilation ducts, equipment, tanks and piping, other than fire protection piping, in accordance with the ASHRAE Manual "A Practical Guide to Seismic Restraint" and with ANSI/SMACNA 001.
 - .1 Design criteria according to NBCC 2015, Kennel:
 - .1 City: Rigaud.
 - .2 Risk category: Normal ($I_e = 1.0$).
 - .3 Site class: Class D.
 - .4 Spectral acceleration at 0.2s: $S_a(0.2) = 0.570$ (Latitude 45.474737; Longitude -74.29292).
 - .2 Design criteria according to NBCC 2015, Shed:
 - .1 City: Rigaud.
 - .2 Risk category: Normal ($I_e = 1.0$).
 - .3 Site class: Class D.
 - .4 Spectral acceleration at 0.2s: $S_a(0.2) = 0.570$ (Latitude 45.474737; Longitude -74.29292).

Part 2 Products

2.1 SUPPLIER

- .1 SRS from sole manufacturer regularly engaged in SRS production.

June 30, 2020

2.2 GENERAL

- .1 SRS to prevent permanent displacement and damage caused by horizontal or vertical movement and overturning.
- .2 SRS to be fully compatible with electromechanical design. SRS must not hinder normal operation of electromechanical systems.
- .3 SRS to provide gentle and steady cushioning action in all directions and avoid high impact loads.
- .4 Fasteners and attachment points to resist same load as seismic restraints.
- .5 Impact-type "Ramset" anchors and drop-in anchors not permitted.
- .6 Attachments to reinforced concrete structure:
 - .1 Use high-strength mechanical expansion anchors.
- .7 No equipment, equipment supports, nor mounts to fail before failure of structure.
- .8 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .9 Seismic control measures not to interfere with operation or integrity of firestopping.
- .10 Brace all accessories, such as diffusers and light fixtures, installed in suspended ceilings.

2.3 STEEL ANGLES

- .1 Angles: Manufactured from cold-formed steel plate to AISI requirements, with a minimum tensile strength of $F_u = 410 \text{ MPa}$ (59 ksi) and an elastic limit of $F_y = 300 \text{ MPa}$ (43 ksi).

2.4 C CHANNELS

- .1 C channels: Constructed to ASTM A1011/A1011M GR 33 and CSA G40.20/G40.21.

2.5 STRUCTURAL PIPING

- .1 Structural Piping: Constructed to ASTM A53/A53M, E or S Type, Grade B.

2.6 CABLE

- .1 Cable: Constructed to ASTM A603 or ASTM A475 with minimum seven strands and a single Class A coating.
- .2 Connection Fittings: Constructed to ASCE 96 and able to support 110% of ultimate cable strength.

2.7 BOLTS

- .1 Bolts: Hex head constructed to ASTM A307, Grade A.

2.8 SRS FOR STATIC EQUIPMENT

- .1 Attach equipment to hangers that are fastened to the frame.
- .2 Install devices to prevent sway in horizontal plane, "rocking" in vertical plane, sliding, and buckling in axial direction.

June 30, 2020

- .3 Use buckle-resistant hanger rods.

2.9 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Attach equipment to hangers that are secured to the frame by rigid rods in all three axial directions.
- .2 Cushioning Action: Gentle and steady. by utilizing elastomeric material or other means in order to avoid high impact loads.
- .3 SRS not to jeopardize noise and vibration isolation systems. During normal operation, provide 6-mm (¼-in.)-12-mm (½-in.) clearance between seismic restraint devices and equipment.
- .4 If seismic isolators are used, design and install to withstand minimum acceleration forces.
- .5 Effectiveness of devices to withstand compressive loading.
- .6 SRS to resist complete isolator unloading.
- .7 Where standard isolators are used, incorporate seismic restraints into vibration isolation system to prevent overturning.

Part 3 Execution

3.1 GENERAL

- .1 Attachment Points and Fasteners:
 - .1 Check that anchor bolts, dowel pin diameters, recess depths in concrete, and weld lengths comply with drawings submitted for approval.
 - .2 Bolt equipment not isolated against vibration transmission to the frame or structure.
 - .3 Oblong openings for bolt adjustment not permitted.
 - .4 Small diameter pipes may be rigidly secured to larger pipes for seismic restraint purposes, but not the reverse.
 - .5 Distance of anchor points in concrete slabs from edges to comply with ASTM E-488 and manufacturer's recommendations.
 - .6 Anchors in concrete slabs to be driven to a depth at least eight times their diameter.
 - .7 Install restraining straps on all C-clamps used to support piping to restrain them at their anchor point during a seismic event. Choose fasteners manufactured by the same manufacturer as the clamps.
- .2 Slack Cable Restraint System (SCS):
 - .1 Connect to suspended equipment so that axial projection of cable passes through centre of gravity of protected equipment.
 - .2 Tighten cable attachments in accordance with manufacturer's recommendations.
 - .3 Use appropriate grommets, shackles, and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
 - .4 Orient restraint cables on ceiling-hung equipment at approximately 90° to each other (in drawing), tie back to structure at maximum of 45° to structure.

June 30, 2020

- .5 Adjust restraint cables so that they are not visibly slack, but permit vibration isolation system to function normally.
- .6 Tighten cables to reduce slack to 40 mm (1½ in.) under thumb pressure. Cables must not bear equipment weight during normal operation.
- .3 Tighten bolts to "C" channels using the following torques:
 - .1 NPS ½: 68 Nm (50 ft-lb);
 - .2 NPS ¾: 169 Nm (125 ft-lb).
- .4 Install SRS at least 25 mm (1 in.) from any other equipment, systems, and services.
- .5 Miscellaneous equipment not vibration-isolated:
 - .1 Bolt through house-keeping pad to structure.
- .6 Coordinate connections with other disciplines.
- .7 Vertical Tanks:
 - .1 Anchor through house-keeping pad to structure.
 - .2 Provide steel bands above centre of gravity.
- .8 Horizontal Tanks:
 - .1 Provide at least two (2) straps with anchor bolts fastened to structure.
- .9 Cross-brace equipment separate from ventilation ducts and pipes.
- .10 Never use two (2) types of cross-bracing in the same direction.
- .11 Do not stabilize systems or equipment if length of hanger rods is less than 300 mm (12 in.).
- .12 Do not install SRS at an angle greater than 60° or less than 45° from horizontal.
- .13 Install lateral SRS perpendicular to direction of piping or ductwork with a maximum angle variation of 2.5°.
- .14 Install longitudinal SRS parallel to direction of piping or ductwork with a maximum angle variation of 2.5°.
- .15 Install at least two (2) lateral SRS and two (2) longitudinal SRS for each straight section of piping or ductwork.
- .16 Install lateral and longitudinal SRS maximum distance 100 mm (4 in.) from a vertical support, which shall be reinforced as required.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 SERVICE UTILITIES ENTRANCE INTO BUILDING

- .1 Provide flexibility to prevent breakage in the event of seismic activity.

June 30, 2020

3.4 FIELD QUALITY CONTROL

- .1 Once the installation work is completed, seismic protection systems shall be inspected and certified by a specialist engineer recognized in the Province of Quebec.
- .2 Provide written report to Departmental Representative with certificate of compliance.
- .3 Where applicable, Contractor shall adjust and correct as recommended in the written report submitted by Specialist Engineer.

3.5 COMMISSIONING DOCUMENTATION

- .1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of Construction Documents, revised to show "As-Built" conditions.

3.6 INSTALLATION FOR FIRE PROTECTION PIPING

- .1 Perform installation and design of seismic systems per ANSI / NFPA 13.
- .2 Install mechanical flexible joints approved for grooved piping on pipes with a diameter greater than or equal to NPS 2½ at the following locations:
 - .1 Within 610 mm (24 in.) of the top slab of the supply columns if they are more than 0.9 m (3 ft) in length;
 - .2 Within 305 mm (12 in.) of the floor of the supply columns;
 - .3 Within 610 mm (24 in.) of the horizontal portion of the fitting on a supply column;
 - .4 Within 610 mm (24 in.) of building expansion joints;
 - .5 Within 610 mm (24 in.) of top of down supply columns;
 - .6 Within 610 mm (24 in.) above the highest support of the down supply columns attached to the structure, shelf, or mezzanine;
 - .7 Within 610 mm (24 in.) of the bottom of the down supply columns.
- .3 Install seismic separation assemblies where piping passes through seismic separation of building. Stabilize this assembly transversely, vertically and longitudinally within 1.83 m (6 ft) on each side of the partition.
- .4 At least every 12.2 m (40 ft) transversely stabilize all water mains irrespective of size and all branches DN 2½ and over.
- .5 The distance between the end of the piping to be stabilized and the device and the seismic cross-protection system shall not exceed 1.8 m (6 ft).
- .6 Stabilize transversely the last pipe length of a water main.
- .7 The transverse seismic protection device and system of a pipe section of NPS 2½ and greater may act as a longitudinal seismic protection device and system for a pipe section of the same dimensions connected perpendicular to the first, if the braces are located less than 600 mm (24 in.) from an elbow or "T" fitting.
- .8 Stabilize pipework within 610 mm (24 in.) of mechanical flexible joints other than the mechanical flexible joints required above.
- .9 At least every 24.4 m (80 ft) longitudinally stabilize all water mains.

June 30, 2020

- .10 The distance between the end of the piping to be stabilized and the longitudinal support must not exceed 12.2 m (40 ft).
- .11 Do not transversely stabilize suspended piping with supports located less than 150 mm (6 in.) From the structure. This exception does not apply to longitudinal stabilization.
- .12 Stabilize transversely, vertically and longitudinally the top of vertical columns more than 1 m (3 ft) in length, every 7.6 m (25 ft).
- .13 Stabilize end of distribution lines within 150 mm (6 in.) of last support.

3.7 INSTALLATION FOR PIPING OTHER THAN FIRE PROTECTION

- .1 Design and install SRS in accordance with ASHRAE Manual "A Practical Guide to Seismic Restraint" and ANSI/SMACNA 001.
- .2 Compatible with requirements for anchoring and guiding of piping systems.
- .3 Brace piping with a diameter of NPS 3 and greater.
- .4 Brace compressed air pipes with a diameter of NPS 1 and greater.
- .5 Install mechanical restraint devices for piping at the following minimum frequency:
 - .1 Lateral bracing:
 - .1 NPS 8 and less: 12.2 m (40 ft);
 - .2 NPS 10 and greater: 6.1 m (20 ft);
 - .3 Reduce these lengths by half for gas, non-ductile or screwed piping.
 - .2 Longitudinal bracing:
 - .1 NPS 5 and less: 24.4 m (80 ft);
 - .2 NPS 6 and NPS 8: 12.2 m (40 ft);
 - .3 NPS 10 and greater: 6.1 m (20 ft);
 - .4 Reduce these lengths by half for gas, non-ductile or screwed piping.
- .6 For plastic piping, install a standard support in accordance with manufacturer's recommendations at mid-points between joints.
- .7 The lateral SRS for a section of pipe may act as a longitudinal SRS for a same size section of pipe connected perpendicularly to the first, if the cross-bracing is located within 600 mm (24 in.) of an elbow or tee connection.
- .8 Install seismic separation assemblies in places where piping crosses a seismic separation in the building. Brace the assemblies laterally, vertically, and longitudinally within 1.83 m (6 ft) of either side of the separation.
- .9 Brace cast-iron and glass piping on each side of a 90° direction change.
- .10 Do not brace piping suspended by supports located within 300 mm (12 ft) of the structure.

3.8 INSTALLATION FOR VENTILATION DUCTS

- .1 Design and install SRS in accordance with ASHRAE Manual "A Practical Guide to Seismic Restraint" and ANSI/SMACNA 001.

June 30, 2020

- .2 Brace rectangular and oblong ventilation ducts with a surface area of 0.55 m² (6 ft²) or more and round ducts with a diameter of 700 mm (28 in.) or more.
- .3 A lateral SRS for a section of ductwork may also act as a longitudinal support for another section of perpendicular ductwork of the same or smaller size, if the support is installed within 600 mm (24 in.) of the intersection.
- .4 A wall (including a gypsum wall) may act as a lateral SRS if the duct is solidly attached to the wall all around the duct.
- .5 Install mechanical restraint devices at the following minimum frequency:
 - .1 Vertical bracing:
 - .1 Vertical bracing is provided by the regular supports.
 - .2 Lateral bracing: 9.1 m (30 ft).
 - .3 Longitudinal bracing: 18.3 m (60 ft).
- .6 Do not brace ducts suspended by supports located within 300 mm (12 in.) of the structure. Supports shall be fastened to ducts using at least two metal No. 10 screws installed at least 50 mm (2 in.) from the top of the duct.

3.9 RIGID RODS AND ATTACHMENT POINTS

- .1 Connect to suspended equipment so that axial projection of rod passes through centre of gravity of equipment.
- .2 Use appropriate diameter rods that comply with seismic support manufacturer's requirements.
- .3 Install vertical, lateral, and longitudinal rods in accordance with support manufacturer's recommendations.

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 Canadian Gas Association (CGA).
 - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product data to include paint color chips, as well as other products specified in this Section.
- .2 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, and lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality Assurance Submittals: Submit following in accordance with Section 01 33 00 - Submittal Procedures.

1.5 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 MANUFACTURER'S NAMEPLATES**

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: Voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM'S NAMEPLATES

- .1 Colors:
 - .1 Hazardous materials: Red letters, white background.
 - .2 Elsewhere: Black letters, white background (except where required otherwise by applicable Code).
- .2 Construction:
 - .1 3-mm thick, laminated or white anodized aluminum, matte finish, with square corners, letters accurately aligned, and machine engraved into core.
- .3 Sizes:
 - .1 Complying with following table:

Size #	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Identification for PWGSC Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
 - .2 Equipment in mechanical room:
 - .1 Main identifier: Size #9.
 - .2 Source and destination identifiers: Size #6.
 - .3 Terminal cabinets, control panels: Size #5.

June 30, 2020

- .3 Equipment elsewhere: Sizes as appropriate.

2.3 IDENTIFICATION OF EXISTING SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified in this Section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 SIGE IDENTIFICATION

- .1 Apply Standard, attached to this Section of Specifications, relating to nameplates used on site.

2.5 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Sprinklers: To NFPA 13.
 - .2 Standpipe and hose systems: To NFPA 14.

2.6 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background color marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3, except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) Regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colors listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background color marking:
 - .1 Height: To full circumference of pipe or insulation.
 - .2 Length: To accommodate pictogram, full length of legend, and arrows.
- .6 Materials for background color marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

June 30, 2020

.7 Background Colors and Legends:

- .1 Where not listed, obtain direction from Departmental Representative.
- .2 Colors for legends, arrows: To following table:

Background Color	Legend, Arrows
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background color marking and legends for piping systems:

Contents/Fluid Conveyed	Background Color Marking	Legend
** Add design temperature		
++ Add design temperature and pressure		
Domestic Hot Water Supply	Green	DOM. HW SUPPLY
Dom. HWS Recirculation	Green	DOM. HW CIRC
Domestic Cold Water Supply	Green	DOM. CWS
Waste Water	Green	WASTE WATER
Storm Water	Green	STORM
Plumbing Vent	Green	SAN. VENT
Fire Protection - Water	Red	FIRE PROT. WTR
Sprinklers - Water	Red	SPRINKLERS

2.7 IDENTIFICATION OF DUCTWORK SYSTEMS

- .1 50-mm high stenciled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colors: Black, or with color ensuring strong contrast.

2.8 IDENTIFICATION OF VALVES, CONTROLLERS

- .1 Brass tags with 12-mm stamped identification data, painted black.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.9 IDENTIFICATION OF SYSTEMS AND CONTROLS COMPONENTS

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this Section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.10 UNILINGUAL/BILINGUAL INSCRIPTIONS

- .1 Identification of systems and elements in French and in English.

June 30, 2020

- .2 Use one nameplate and label for both languages.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXECUTION TIME

- .1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3, unless otherwise indicated.
- .2 Provide ULC and CSA registration plates as required by respective agencies.
- .3 Identify systems and equipment complying with PWGSC PMSS.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Stand-offs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate, or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 17-m intervals, to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 At change of direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstructions or where run is difficult to follow.
- .5 On both sides of separations, such as walls, floors, or partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run, and at each piece of equipment.
- .8 At point immediately upstream of major manually operated or automatically controlled valves. Where this is not possible, preferably upstream.

June 30, 2020

- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 LOCATION OF IDENTIFICATION OF VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 FIELD QUALITY CONTROL

- .1 Verification requirements for Sustainable Design Reporting, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified wood.
 - .8 Low-emitting materials.

3.8 CLEANING

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

END OF SECTION

Section 23 05 53

"Normes pour plaques signalétiques"

Normes pour les PLAQUES SIGNALÉTIQUES

Il y a seulement 2 grandeurs de plaques signalétiques qui peuvent être utilisées pour l'identification SIGE. Il est recommandé d'utiliser la plus grande dimension pour la plupart des applications.

A black rectangular identification plaque with the white text "05-370-01".

05-370-01

Écriture blanche sur plaque indicatrice noire

20 mm x 50 mm Lettres de 10 mm de hauteur

A black rectangular identification plaque with the white text "05-370-01".

05-370-01

Écriture blanche sur plaque indicatrice noire

20 mm x 100 mm Lettres de 12 mm de hauteur

Grandeur pour les plaques relatives aux composantes.

(utilisés sur les schémas unifilaire)

Exemples: Sectionneurs, Démarreurs, Panneaux



Écriture blanche sur plaque indicatrice noire

25 mm X 75 mm Lettres 12 mm de hauteur

Plaques surdimensionnées pour panneaux distribution primaire

Exemple: 1-S1-D3H3 (cas spéciaux)

(utilisés sur les schémas unifilaire)

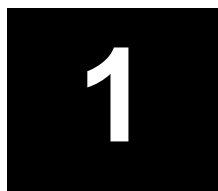
Écriture blanche sur plaque indicatrice noire



50 mm X 150 mm Lettres 25 mm de hauteur

Plaquettes identification position dans les panneaux de distribution primaire.

(utilisés sur les schémas unifilaire)



Écriture blanche sur plaque indicatrice noire

25 mm X 25 mm Lettres 15 mm de hauteur

June 30, 2020

Part 1 General**1.1 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Submit names of personnel to perform TAB to Departmental Representative within 90 days of award of Contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: Performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved.
 - .1 Associated Air Balance Council, (AABC), National Standards for Total System Balance, MN-1.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .4 Recommendations and prescribed practices contained in the TAB Standard: Mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this Contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures and requirements are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.2 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems to meet specified performance requirements, to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges. Provide pulleys and belts as needed to meet system performance.

June 30, 2020

1.3 SPECIAL STANDARDS AND CODES

- .1 TAB of systems and equipment regulated by Codes or Standards to satisfaction of Authorities Having Jurisdiction.

1.4 WORK COORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.5 PRE-TAB REVIEW

- .1 Review Contract Documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified Standards and report to Departmental Representative in writing proposed procedures which vary from Standards or reference documents.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports, and fittings.

1.6 EQUIPMENT AND SYSTEMS START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer, unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Contract Documents.

1.7 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.8 START OF TAB

- .1 Notify Departmental Representative seven (7) days prior to start TAB.
- .2 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, and other construction affecting TAB;
 - .2 Application of weather stripping, sealing, and caulking;
 - .3 Pressure, leakage, and other tests specified elsewhere;
 - .4 Provisions for TAB installed and operational;
 - .5 Start-up, verification for proper, normal, and safe operation of mechanical and associated electrical and control systems affecting TAB including, but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.

June 30, 2020

- .2 Ducts clean and free of debris.
- .3 Ducts, air shafts, and ceiling plenums are airtight to within specified tolerances.
- .4 Correct fan rotation.
- .5 Fire, smoke, and volume control dampers installed and open.
- .6 Coil fins combed, clean.
- .7 Access doors, installed and closed.
- .8 Outlets installed and volume control dampers open.

1.9 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values.
 - .1 Mechanical systems: Plus 5%, minus 5%.

1.10 APPLICATION TOLERANCES

- .1 Measured values accurate to within $\pm 2\%$ of actual values.

1.11 MEASURE INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or mechanical system submitted to TAB.
- .3 Calibrate within three (3) months of TAB. Provide a calibration certificate to the Departmental Representative.

1.12 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
 - .1 Proposed methodology and procedures for performing TAB if different from referenced Standard.

1.13 PRELIMINARY REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets:
 - .1 Include: Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.14 TAB REPORT

- .1 Format in accordance with referenced Standard or documents.

June 30, 2020

- .2 In the report, express results in units, as indicated on drawings, and include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit electronic document (.pdf) of TAB Report to Departmental Representative for verification and approval, in both official languages.

1.15 VERIFICATION OF RESULTS

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results as directed by Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.16 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings; must not be erased nor covered in any way.

1.17 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.18 AIR SYSTEMS

- .1 Standard: TAB to most stringent of this section or TAB Standards of AABC, ASHRAE, SMACNA, or NEBB.
- .2 Do TAB of systems, equipment, components, and controls as specified in Contract Documents.
- .3 Personnel performing TAB qualified to Standards of NEBB and current member in good standing of NEBB.
- .4 Perform TAB under direction of supervisor qualified to Standards of NEBB.
- .5 Measurements: To include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, and vibration.
- .6 Locations of equipment measurements: To include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, and other equipment causing changes in conditions.
 - .2 At controllers and controlled devices.
- .7 Locations of systems measurements to include as appropriate: Main ducts, main branch, sub-branch, run out (grille or diffuser).

June 30, 2020

1.19 HOT DOMESTIC WATER PRODUCTION SYSTEMS

- .1 Locations of equipment measurements: To include as appropriate: Inlet and outlet of water heaters, tanks, pumps, circulating pumps, regulators, and command/control devices.
- .2 Locations of systems measurements: To include as appropriate: Main ducts, main branch and sub-branch connections, supply ducts for terminal units, and inlet connections for make-up water circuits.

1.20 OTHER MECHANICAL SYSTEMS

- .1 Adjust flush valves to suit actual site conditions.
- .2 Pumped sanitary and storm water drainage systems: Perform necessary tests to verify that systems are working as intended in the drawings and specifications.
- .3 Backflow Preventers: Test and obtain certificates in accordance with CAN/CSA-B64.10.

1.21 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified in this paragraph:
 - .1 Qualifications of TAB personnel: As for air systems specified in this Section.
 - .2 Quality assurance: As for air systems specified in this Section.
- .2 Building Pressure Conditions:
 - .1 Adjust mechanical systems, equipment, and controls to always ensure specified pressure conditions.
- .3 Zone Pressure Differentials:
 - .1 Adjust mechanical systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combination of normal operating modes.
- .4 Measurement of vibration from equipment specified in Contract Documents.

1.22 POST-OCCUPANCY TAB

- .1 Measure DBT, WBT (or % RH), air velocity, air flow patterns, and NC levels in occupied zones.
- .2 Participate in systems checks twice during Warranty Period - #1 approximately three (3) months after acceptance and #2 during last month of Warranty Period.

Part 2 Products**2.1 NOT USED**

- .1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
 - .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
 - .1 Submit proposed report form and test report format to Departmental Representative at least one (1) month before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
 - .2 Prepare report of results and submit to Departmental Representative within 48 hours of completion of tests. Include:
 - .1 Schematic of entire system;
 - .2 Schematic of section under test showing test site;
 - .3 Required and achieved static pressures;
 - .4 Orifice differential pressure at test sites;
 - .5 Permissible and actual leakage flow rate (L/s) for test sites;
 - .6 Witnessed certification of results.
 - .3 Include test reports in final TAB report.
 - .4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: Submit manufacturer's installation instructions.
 - .1 Manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
 - .1 Verify project requirements.

- .2 Review installation conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer installation instructions and warranty requirements.

Part 2 Products

2.1 TEST INSTRUMENTS

- .1 Test apparatus to include the following:
 - .1 Fan capable of producing required static pressure;
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps;
 - .3 Flow measuring instrument compatible with the orifice plate;
 - .4 Calibration curves for orifice plates used;
 - .5 Flexible duct for connecting to ductwork under test;
 - .6 Smoke bombs for visual inspections.
- .2 Test Apparatuses: Accurate to within $\pm 3\%$ of flow rate and pressure.
- .3 Submit details of test instruments to be used to Departmental Representative at least one (1) month before anticipated start date.
- .4 Test Instruments: Calibrated and certificate of calibration deposited with Departmental Representative no later than 28 days before start of tests.
- .5 Re-calibrated every 6 months.

2.2 EQUIPMENT LEAKAGE TOLERANCES

- .1 Equipment and system components, such as VAV boxes, duct heating leakage: 1%.

Part 3 Execution

3.1 TEST PROCEDURES

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include: Fittings, branch ducts, and tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.2 SITE TOLERANCES RELATED TO SEALING OF AIR DUCTS

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.

- .2 Leakage tests on following systems not to exceed specified leakage rates:
 - .1 Small duct systems up to 250 Pa: Leakage 2%;
 - .2 VAV box and duct on downstream side of VAV box: Leakage 2%;
 - .3 Large low-pressure duct systems up to 500 Pa: Leakage 2%;
 - .4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: Leakage 1%.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.3 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals and gaskets.
- .4 Flexible connections to VAV boxes.

3.4 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Departmental Representative to witness tests and to verify reported results.
 - .2 To be certified by same TAB agency approved to undertake TAB on this Project.
 - .3 Provide personnel and instrumentation to verify up to 30% of reported results.

3.5 CLEANING

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM).
 - .1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB).
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Green Seal Environmental Standards (GSES).
 - .1 Standard GS-36-00, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State.
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

- .7 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 DEFINITIONS

- .1 For purposes of this Section, the following definitions shall apply:
 - .1 "Concealed": Insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces;
 - .2 "Exposed": Means "not concealed" as previously defined;
 - .3 "Insulation systems": Insulation material, fasteners, jackets, and other accessories;
 - .4 "Ductwork": Overall duct system including ducts, elbows, tees, and all related accessories.
- .2 Insulation thickness is the thickness required to cover every component of the insulated element, including reinforcements, angle irons, T-joints, flanges, etc.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Description of equipment giving manufacturer's name, type, model, year, and capacity.
 - .2 Details of operation, servicing, and maintenance.
 - .3 Recommended spare parts list.
- .3 Samples:
 - .1 Submit for approval: Complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
 - .2 Mount sample on 12-mm plywood board.
 - .3 Affix typewritten label beneath sample indicating service.
- .4 Manufacturers' Instructions:
 - .1 Provide manufacturer's written duct insulation jointing recommendations and special handling criteria, installation sequence, and cleaning procedures.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Specialist in performing work of this Section, and member of TIAC.

1.6 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 FIRE AND SMOKE RATING**

- .1 To CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75.20°F) mean temperature, when tested in accordance with ASTM C335.
- .2 **D-1** type thermal insulation: Rigid mineral fibre panels to ASTM C612, with factory-applied vapor retarder shield to ASTM E96.
 - .1 Maximum "K" factor of 0.0337 W/m•°C (0.234 Btu-in/h•ft²•°F) at 24°C (75°F) mean temperature.
 - .2 Temperature limits: 120°C (250°F).
 - .3 Density: 36 kg/m³ minimum (2.25 lb/ft³).
- .3 **D-2** type thermal insulation: Mineral fibre blanket to ASTM C553, with factory-applied vapor retarder jacket to ASTM E96.
 - .1 Mineral fibre: To ASTM C553.
 - .2 Vapor barrier: To ASTM E96.
 - .3 Maximum "K" factor of 0.035 W/m•°C (0.24 Btu-in/h•ft²•°F) at 24°C (75°F) mean temperature.
 - .4 Temperature limits: 120°C (250°F).
 - .5 Density: 24 kg/m³ (1.5 lb/ft³).
- .4 **D-3** type thermal insulation: Rigid mineral fibre, with factory-applied vapor retarder jacket.
 - .1 Mineral fibre: ASTM C547.
 - .2 Jacket: To ASTM E96.
 - .3 Maximum "K" factor of 0.037 W/m•°C (0.26 Btu-in/h•ft²•°F) at 38°C (100°F) mean temperature.
 - .4 Density: 40 kg/m³ (2.5 lb/ft³).
 - .5 Temperature limits: 454°C (850°F).

- .5 **D-4** type thermal insulation: Semi-rigid rock fibre panels.
 - .1 RSI: 0.72 m²K/W with a thickness of 25.4 mm at 24°C, mean temperature to ASTM C518.
 - .2 Humidity resistant, moisture absorption of -0.03 % according to ASTM C1104. Mushroom resistance according to ASTM C1338.
 - .3 Density: 64 kg/m^{3t} to ASTM C303.
 - .4 Maximum temperature: 650°C.
 - .5 Vapor-Barrier: Aluminum sheet reinforced with fiberglass (RFF).

2.3 JACKETS

- .1 Canvas Jacket:
 - .1 Cotton canvas with a surface mass of 220 g/m² (0.045 lb/ft²), plain weave, fire resistance approved by ULC, coated with heat-insulating and flame-retardant glue, diluted, according to ASTM C921 Standard.

2.4 ACCESSORIES

- .1 Vapor Barrier Lap Adhesive:
 - .1 Water-based, fire-retardant type, compatible with insulation.
- .2 Vapor barrier to be applied to the insulation:
 - .1 Vinyl emulsion acrylic type, compatible with insulation.
- .3 Insulating Cement: Hydraulic setting, on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 g/m² (0.045 lb/ft²) cotton, plain weave, treated with dilute fire-retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapor Barrier Mastic:
 - .1 Vinyl emulsion acrylic type, compatible with insulation.
 - .2 Reinforcing fabric: Fiber glass, untreated 305 g/m² (0.062 lb/ft²).
- .6 Tape: Self-adhesive, aluminum, reinforced, 75 mm (3 in.) wide minimum.
- .7 Contact Adhesive: Quick-setting.
- .8 Canvas Adhesive: Washable.
- .9 Tie Wire: 1.5 mm (0.06 in.) stainless-steel banding.
- .10 Bands: Stainless steel, 0.5 mm (0.02 in.) thick and 19 mm (¾ in.) wide.
- .11 Facing: 25 mm (1 in.) stainless-steel hexagonal wire mesh stitched on both faces of insulation or on one face of insulation with expanded metal lath on other face.
- .12 Fasteners: 4 mm (0.16 in.) diameter pins with 35 mm (1.4 in.) diameter clips, length to suit thickness of insulation.

Part 3 Execution**3.1 PREPARATORY WORK**

- .1 Pressure test ductwork systems complete, witnessed, and certified by authority.
- .2 Ensure surfaces are clean, dry, and free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Install materials in accordance with manufacturers' instructions and as indicated on drawings.
- .3 Use two (2) layers with staggered joints when required nominal thickness exceeds 75 mm (3 in.).
- .4 Secure any raised joints with an overlapping strip of flexible insulating material with an integrated vapor barrier.
- .5 Maintain uninterrupted continuity and integrity of vapor barrier jacket and finishes:
 - .1 Ensure hangers and supports are outside vapor barrier jacket.
- .6 Hangers and Supports: To Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment:
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .7 Fasteners: Install at 300 mm (12 in.) on centre in horizontal and vertical directions, minimum two (2) rows each side.

3.3 TABLE - THERMAL INSULATION OF AIR DUCTS

- .1 Insulate duct systems as indicated in the table below:

	SYSTEMS AND EQUIPMENT	THICKNESS OF INSULATION mm (in.)	TYPE OF INSULATION
.1	Exposed rectangular air conditioning supply ducts	38 (1½)	D-1
.2	Concealed rectangular air conditioning supply ducts whose greatest dimension does not exceed 1,000 mm (39 in.)	25 (1)	D-2
.3	Concealed rectangular air conditioning supply ducts whose greatest dimension exceeds 1,000 mm (39 in.)	38 (1½)	D-1
.4	Exposed round and oval air conditioning supply ducts (only metallic ducts), except in the office portion of the building	25 (1)	D-3
.5	Concealed round and oval air conditioning supply ducts	25 (1)	D-2

SYSTEMS AND EQUIPMENT	THICKNESS OF INSULATION mm (in.)	TYPE OF INSULATION
.6 Round and oval exhaust and return ducts on a 5 m (16 ft) length starting from the roof or exterior wall, to the main duct and branch lines	50 (2)	D-2
.7 Fresh air ducts, starting from the louvers to the heating coils and evacuation air ducts, from fan to air evacuation device	75 (3)	D-4
.8 The air supply, return air, and exhaust air ducts passing through a ventilated attic	75 (3)	D-4
.9 Rectangular exhaust and return air ducts whose greatest dimension does not exceed 1,000 mm (39 in.) over a length of 5 m (16 ft) from the roof or outside wall, on the main duct and branch lines	50 (2)	D-1
.10 Rectangular exhaust and return air ducts larger than 1,000 mm (39 in.) over a length of 5 m (16 ft) from the roof or outside wall, on the main duct and branch lines	75 (3)	D-1

3.4 FINISHING

- .1 Indoor Ducts: Canvas Jacket.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 ASTM International (ASTM).
 - .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
 - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB).
 - .1 CGSB 51-GP-52Ma-89, Vapor Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 33.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Safety Data Sheets (SDS).

- .6 Manufacturer's Trade Associations.
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

- .1 For purposes of this Section, the following definitions shall apply:
 - .1 "Concealed": Insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "Exposed": Will mean "not concealed" (as specified).
 - .3 "System": Piping, including all incorporated accessories, trim, etc., such as valves, elbows, pumps, tees, etc.
- .2 Insulation shall be thick enough to cover all components of element to be insulated, such as reinforcements, angle irons, supports, joints, etc.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and data sheets in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit for approval: Complete assembly of each proposed type of insulation system, insulation, coating, and adhesive. Mount sample on 12-mm plywood board. Affix label beneath sample indicating service.
- .5 Quality Assurance Submittals: Submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: Specialist in performing work of this Section, and member of TIAC.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store, and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic (staff, material, and vehicles).
 - .2 Protect against damage.
 - .3 Store material at temperatures and conditions required by manufacturer.

Part 2 Products**2.1 FIRE AND SMOKE RATING**

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.
- .2 Materials must be tested according to ASTM C411.

2.2 SEALANTS

- .1 Do not use sealants that emit strong odors, contain toxic chemicals, or are not certified as mold-resistant in air handling units.
- .2 When low-toxicity products are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

2.3 INSULATION

- .1 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C335.
- .2 Type **P-1** Thermal Insulation: Rigid molded mineral fibre with factory applied vapor barrier jacket.
 - .1 Mineral fibre: To ASTM C547.
 - .2 Jacket: To CGSB 51-GP-52Ma.

- .3 Maximum "K" factor: Of 0.033 W/m•°C (0.231 Btu-in/h•ft²•°F) at an average temperature of 24°C (75°F).
- .4 Temperature limits: -29°C (-20°F) to 454°C (850°F).
- .3 Type **P-2** Thermal Insulation: Rigid mineral fibre board faced with factory applied vapor barrier jacket.
 - .1 Mineral fibre: To ASTM C547.
 - .2 Jacket: To CGSB 51-GP-52Ma.
 - .3 Maximum "K" factor: Of 0.035 W/m•°C (0.24 Btu-in/h•ft²•°F) at an average temperature of 24°C (75°F).
 - .4 Temperature limits: 120°C (250°F).
 - .5 Density: 24 kg/m³ (1.5 lb/ft³).
- .4 Type **P-3** Thermal Insulation: Flexible unicellular tubular elastomer.
 - .1 Insulation: To CAN/CGSB-51.40.
 - .2 Maximum "K" factor: Of 0.039 W/m•°C (0.27 Btu-in/h•ft²•°F) at an average temperature of 24°C (75°F).
 - .3 Temperature limits: -57°C (-70°F) to 105°C (220°F).
 - .4 Certified by manufacturer: Free of potential stress corrosion cracking corrodents.
- .5 Type **P-5** Thermal Insulation: High density.
 - .1 Use: For installation with protective shield.
 - .2 Thickness: Equal to thickness of specified insulation.
 - .3 Material: Preformed stone wool, density of 180 kg/m³, fully water repellent.
 - .4 Maximum operating temperature: 760°C (1,400°F).
 - .5 Thermal Conductivity Coefficient "K" not exceeding 0.052 W/m•C (0.36 Btu-in/hr•ft²•°F) at an average temperature of 149°C (300°F).
 - .6 Cover the insulation with a completely waterproof jacket.

2.4 ADHESIVES, TAPE, AND FASTENERS

- .1 Accessories:
 - .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm (2 in.) wide minimum.
 - .2 Contact adhesive: Quick-setting.
 - .3 Canvas adhesive: Washable.
 - .4 Tie Wire: 1.5 mm (0.6 in.) diameter stainless steel.
 - .5 Banding: 19 mm (¾ in.) wide, 0.5 mm (0.02 in.) thick stainless steel.
- .2 For P-1 and P-2 Thermal Insulations:
 - .1 Tape: Aluminum, self-adhesive ULC listed for the following characteristics: Flame spread rating of not more than 25 and a smoke developed classification of not more than 50.

- .2 Quick-setting lap adhesive: Used to seal vapor barrier joints and overlaps.
- .3 Thermal insulation adhesive, fireproof coating.
- .3 P-3 Thermal Insulation:
 - .1 Contact adhesive: Quick-setting, air-drying adhesive used to seal transverse and longitudinal joints in thermal insulation.
 - .2 Tape: Self-adhesive PVC.
 - .3 Coating for Type P-3 thermal insulation: To be installed on all exposed piping, water-based, flexible semi-gloss finish, for interior and exterior application, white, can be brushed on or sprayed.

2.5 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece molded type and sheets to CAN/CGSB-51.53 with pre-formed shapes, as required.
 - .2 Colour: White.
 - .3 Minimum service temperatures: -20°C (-4°F).
 - .4 Maximum service temperature: 65°C (149°F).
 - .5 Moisture vapor transmission: 0.02 perm.
 - .6 Thickness: 0.5 mm (0.02 in.).
 - .7 Fastenings:
 - .1 Solvent adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Special requirements:
 - .1 Outdoor: UV rated material, at least 0.8 mm (0.03 in.) thick.

2.6 INSULATING CEMENT

- .1 Thermal insulating and finishing cement.
 - .1 Hydraulic setting or air drying, on mineral wool, to ASTM C449/C449M.

Part 3 Execution

3.1 INSTALLATION

- .1 Apply insulation after all tests have been completed and results approved by Departmental Representative.
- .2 Insulation and surfaces to be clean and dry during installation and during application of finishes.
- .3 Apply insulation, accessories, jackets, and finishes in accordance with manufacturer's recommendations and as specified herein. Apply at least two (2) finish coats.

- .4 Apply adhesive to entire surface (100%) of insulation installed on roof drain bodies to hold it in place.
- .5 Provide protection saddles and shields as per Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment:
 - .1 Cut insulation under piping over at least the length of the saddle or shell and one third the circumference of the piping.
 - .2 Replace insulation with high-density insulation.
 - .3 Cover vapor barrier to maintain continuity for cold pipes.
 - .4 Install protective shield.
- .6 Vapor barrier to have no openings or breaks in sleeves, connectors, and supports.
- .7 Provide grooved joints insulation for drainage piping and water loop of heat pumps.

3.2 THERMAL INSULATION

- .1 Install thermal insulation in compliance with ANSI/NFPA 90A and 90B.
- .2 Use shell insulation for piping up to NPS 12 and shell or sectional insulation for piping over NPS 12.
- .3 Multiple Thickness Insulation: Stagger joints of each insulation layer.
- .4 Vertical Pipe over NPS 3: Install insulation supports welded or bolted to pipes directly above lowest fitting, thereafter, at 4.5 m intervals.
- .5 Expansion joints in insulation: Terminate each layer in straight cut, as recommended by manufacturer, leaving space of 25 mm (1 in.) between successive sections, and fill with P-2 Type flexible mineral fibre insulation without packing.
- .6 Seal and finish exposed ends and other terminations of all insulation, visible or not, with insulating cement.
- .7 Piping Expansion Joints: Provide for adequate expansion and contraction of piping without damage to insulation or jacket.
- .8 Orifice plate mounting flanges, clamps, and unions on inlets and outlets, expansion joints, valves, and other elements requiring periodic maintenance: Install insulation and finishes to permit disassembly and reassembly without damage to adjacent insulation and finishes.
- .9 Connectors, cold application (5°C (41°F) to 15°C (59°F)): Insulate connectors with flexible, tight-fitting insulation covered with reinforcing membrane and vapor barrier coating. Alternatively, insulate connectors with flexible tight-fitting insulation covered with reinforcing membrane and vapor barrier coating and enclosed in PVC.
- .10 Do not insulate the following chrome-plated elements:
 - .1 Pipes, valves, and connectors.

3.3 FASTENINGS

- .1 Fasten each section of insulation with tape at a maximum of 900 mm (36 in.) center-to-center with at least one piece at each end and in its centre.

3.4 TABLE - PIPING INSULATION

- .1 Includes valves, valve bonnets, strainers and filters, flanges, and fittings, unless otherwise specified.
- .2 Do not insulate exposed chrome-plated runouts to chrome-plated piping, valves, fittings.
- .3 Insulate piping systems and equipment as indicated in the following table:

	SYSTEMS AND EQUIPMENT	FLUID TEMPERATURE °C (°F)	INSULATION TYPE
.1	Potable cold water systems	4 (39)	P-1
.2	Potable hot water systems	60 (140)	P-1
.3	Recirculated potable hot water	60 (140)	P-1
.4	Exposed storm drainage, thickness of insulation 25 mm (1 in.)	--	P-1
.5	Concealed storm drainage, thickness of insulation 40 mm (1½ in.)	--	P-2
.6	Exposed vent pipe over a length 5 m (16 ft) from the roof, on main and branch pipes	--	P-1
.7	Concealed vent pipe over a 5 m (16 ft) length from the roof, on main and branch pipes, thickness of insulation 25 mm (1 in.)	--	P-2
.8	Under roof drain bodies, thickness of insulation 50 mm (2 in.)	--	P-2
.9	Drainage piping of HVAC units and air plenum, thickness of insulation 25 mm (1 in.)	--	P-1
.10	Drain and purge piping for electric and natural gas humidifiers	118 (244)	P-1
.11	On insulation expansion joints, thickness of insulation 25 mm (1 in.)	--	P-2
.12	Strainer plugs for chilled water and cold potable water system (removable installation), thickness of insulation 25 mm (1 in.)	--	P-3
.13	Cold, soft, demineralized, distilled, and sterile water systems	4 (39)	P-1
.14	Any other piping system or equipment required to be insulated under Quebec's Regulation respecting energy conservation	--	--
.15	Refrigerant gas suction systems, thickness of insulation 19 mm (¾ in.)	--	P-3

.4 Thickness of thermal insulation.

FLUID TEMPERATURE °C (°F)	NOMINAL PIPE SIZE (NPS) OF LINES			
	1 and under	1¼ to 2	2½ to 4	5 and over
	Thickness in mm (in.)			
151-240 (303-464)	64 (2½)		76 (3)	89 (3½)
121-150 (249-302)	51 (2)	64 (2½)		76 (3)
96-120 (204-248)	38 (1½)		51 (2)	
50-95 (121-203)	25 (1)		38 (1½)	
14-49 (56-120)	25 (1)		38 (1½)	
5-13 (41-55)	25 (1)	38 (1½)		
Under 5 (41)	25 (1)	38 (1½)		
Ventilation	25 (1)			
Geothermal fluid	38 (1½)	51 (2)	51 (2)	51 (2)

3.5 FINISHES

- .1 Exposed Indoors: PVC jackets.
- .2 Exposed in Mechanical Rooms: PVC jackets.
- .3 Concealed, Indoors: PVC on valves and fittings. No further finish.
- .4 Fasteners: Bands and screws, at 150 mm (6 in.) centre-to-centre. Seals: Wing or closed.
- .5 Install: In accordance with TIAC recommendations.

3.6 REMOVABLE, PREFABRICATED INSULATION AND ENCLOSURES

- .1 Destination Applications: Pumps, access doors, expansion joints, valves, flow measuring elements, mechanical joints, flanges, unions, and other accessories.
- .2 Design: To permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation.
 - .1 Of type requested for piping concerned, shaped to suit form of components to be insulated.
 - .2 Thickness: Twice thickness requested for concerned device or piping.
 - .3 Vapor barrier added for water cooling installations and other cold surfaces.
- .4 Enclosures: In aluminum 1.3 mm (0.051 in.) thick or stainless steel 0.6 mm (0.24 in.) thick with exterior finish and quick-release belt.

3.7 SEALANTS

- .1 Complying with manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants, including special conditions governing use.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 15 - Plumbing - Specialties and Accessories.
- .2 Section 23 05 93 - Testing, Adjusting and Balancing.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM).
 - .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 POTABLE WATER SYSTEMS

- .1 When cleaning is completed and system filled, execute the following procedure:
 - .1 Verify performance of equipment and systems as specified elsewhere in Division 23 Sections;
 - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then promptly shut off water. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve;
 - .3 Confirm water quality consistent with Standards, verifying that no residuals remain resulting from flushing and/or cleaning.

1.4 WET AND DRY PIPE SPRINKLER SYSTEMS

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices as specified elsewhere in Division 23.
- .2 Verification of controls, detection and alarm devices as specified Division 26.
- .3 Demonstrate that fire hose will reach to most remote location regardless of partitions and obstructions.
- .4 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.5 SANITARY AND STORM DRAINAGE SYSTEMS

- .1 Buried Systems: Perform tests prior to backfilling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored and well connected to system.
- .4 Operate flush valves and tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: Refer to Section 22 05 15 - Plumbing - Specialties and Accessories.

1.6 REPORTS

- .1 In accordance with Section 01 91 13 - General Commissioning Requirements: Reports, supplemented as specified herein.

1.7 TRAINING

- .1 In accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel, supplemented as specified herein.

Part 2 Products**2.1 NOT USED**

- .1 Not Used.

Part 3 Execution**3.1 NOT USED**

- .1 Not Used.

END OF SECTION

Part 1 General**1.1 REFERENCE STANDARDS**

- .1 ASME.
 - .1 ASME B16.22-12, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-10, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International (ASTM).
 - .1 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - .2 ASTM B280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - .3 ASTM 210/240-17, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- .3 CSA Group (CSA).
 - .1 CSA B52-05 (R2009), B52 Package, Mechanical Refrigeration Code.
 - .2 CAN/CSA-C273.3-01, Performance Standard for Split-System Central Air-Conditioners and Heat Pumps.
- .4 Environment Canada (EC).
 - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- .5 National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 90A-18, Installation of Air Conditioning and Ventilating Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for refrigerant piping, fittings, equipment, and wall-mounted air conditioner, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit two copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOC's for adhesive and solvents during application and curing.

- .3 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals
- .2 Operation and Maintenance Data: Submit operation and maintenance data for refrigerant piping and wall-mounted air conditioner for incorporation into manual.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect refrigerant piping, fittings, equipment, and wall-mounted air conditioner from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 REFRIGERANT PIPING

- .1 Tubing.
 - .1 Processed for refrigeration installations, deoxidized, dehydrated, and sealed.
 - .1 Hard copper: To ASTM B280, type ACR.
 - .2 Annealed copper: To ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.
- .2 Fittings.
 - .1 Service: Design pressure 2,070 kPa and temperature 121°C.
 - .2 Brazed:
 - .1 Fittings: Wrought copper to ASME B16.22.
 - .2 Joints: Silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P, and non-corrosive flux.
 - .3 Flanged:
 - .1 Bronze or brass: To ASME B16.24, Class 150 and Class 300.

- .2 Gaskets: Suitable for service.
 - .3 Bolts, nuts, and washers: To ASTM A307, Heavy Series.
- .4 Flared:
 - .1 Bronze or brass, for refrigeration: To ASME B16.26.
- .3 Pipe Sleeves.
 - .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.
- .4 Valves.
 - .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
 - .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

2.2 WALL-MOUNTED AIR CONDITIONER

- .1 General.
 - .1 Air conditioners must meet the requirements of document 1 / RA / 1 published by the PES, be approved by CSA, and bear the AHRI or CSA certification seal.
- .2 Refrigerants.
 - .1 Only refrigerants approved by Environment Canada, complying with the spirit of the Montreal Protocol and all its amendments, must be used for the purposes of this work.
- .3 Condensate Drains.
 - .1 The condensate collection tanks to be placed under the interior coils must be designed and constructed to ensure perfect drainage of the recovered water, and they must be installed so that cleaning can be carried out easily.
- .4 Wall-Mounted Air Conditioner.
 - .1 General:
 - .1 Unit installed inside the building using air as a heat source and intended for continuous operation.
 - .2 Apparatuses assembled and tested in the factory, with a refrigerant charge and ready to be put into service.
 - .3 Devices approved by ULC and bearing the label of this organization.
 - .4 Appliances mounted on one-piece base.
 - .5 Appliances designed to operate with R410A refrigerant.
 - .2 Performance characteristics: According to the table on drawings.

- .3 Compressor:
 - .1 Hermetically welded device equipped with anti-vibration devices and a crankcase heater.
 - .2 Appliance equipped with a refrigerant accumulator and a device allowing to drown the condenser in order to allow an air conditioning operation down to -28°C (20°F) outside temperature.
 - .3 Integrated control / regulation and cooling systems.
 - .4 Outdoor unit must have a sound intensity equal to or less than 55 dB.
- .4 Coils: Aluminum fins mechanically attached to copper tubes without longitudinal joint, with brazed transverse joints.
- .5 Condensate drain pan; placed under the indoor battery.
- .6 Internal supply fan: Centrifugal type, with forward curved blades, statically and dynamically balanced, direct drive, permanently lubricated motor bearings.
- .7 External fan: Helical type, vertical air supply, statically and dynamically balanced, direct drive, motor bearings permanently lubricated with a sequential module with multiple fan speed.
- .8 Filters:
 - .1 Washable filter, easily removable for cleaning.
- .9 Enclosure: Galvanized steel, bonded and coated with oven-baked enamel paint, with easily removable panels and arranged so as to allow maintenance of all elements. Tilting vanes fitted with motorized deflectors ensure uniform air sweeping.
- .10 Refrigerant piping:
 - .1 Piping connecting the compressor, the external battery, and the internal battery, including all the valves and all the necessary refrigerant flow adjustment devices.
- .11 Mounting support: Supplied by the appliance manufacturer, at least 350 mm in height, meeting the requirements of the National Roofing Contractors Association (NRCA), comprising an insulated panel to be placed under the compressor as well as retaining bolts.
- .12 Control / regulation devices:
 - .1 Protection devices: High- and low-pressure switches with manual reset, protection device against pressure drop, frigistat for internal battery, protection devices against overcharges, reacting to heat and current intensity.
 - .2 External battery defrost control used to prevent the formation of frost on the coil.
- .13 Air conditioning control:
 - .1 The wall air conditioner will be controlled by a digital liquid crystal microprocessor.
 - .2 Control must include the following functions:
 - .1 Air conditioning, automatic mode;

- .2 Temperature adjustment;
- .3 Timer, start or stop, programmable 24 hours;
- .4 Self-diagnosis indicating the element at fault in the event of a malfunction;
- .5 Remote start and stop.

Part 3 Execution

3.1 EXAMINATION

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

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1, and ASME B31.5.

3.4 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

3.5 PIPING INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constriction or hard drawn copper tubing: Do not bend. Minimize use of fittings.
- .2 Hot Gas Lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

- .2 Provide trap at base of risers greater than 2,400 mm high and at each 7,600 mm thereafter.
- .3 Provide inverted deep trap at top of risers.
- .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: Install traps as specified.
 - .2 Small riser: Size for 5.1 m³/s at minimum load. Connect upstream of traps on large riser.

3.6 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides, respectively.
- .3 Test Procedure: Build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 hours.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 hours.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to Departmental Representative.
- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

- .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
- .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to Departmental Representative.
- .9 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection, and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, 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 Departmental Representative.

3.8 DEVICES START-UP AND COMMISSIONING

- .1 The quality of execution of installation work must be certified by the manufacturer.
- .2 The manufacturer must approve the installation as well as supervise its start-up and commissioning.

3.9 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- .2 ASTM International (ASTM).
 - .1 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Green Seal Environmental Standards (GS).
 - .1 GS-36-11, Standard for Adhesives for Commercial Use.
- .4 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .5 Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards.
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

June 30, 2020

- .3 Test and Evaluation Reports:
 - .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to Codes and Standards in force.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure	Seal Class
500 Pa	B (SMACNA)

- .2 Seal Classification:
 - .1 Class B: Longitudinal seams, transverse joints, and connections made airtight with sealant, tape, or combination thereof.
 - .2 In accordance with SMACNA "HVAC Air Duct Leakage Test Manual".

2.2 SEALANTS

- .1 General:
 - .1 Tapes and sealants shall comply with CAN/ULC-S109 (tape), NFPA 90A and 90B Standards, and have a maximum flame spread of 25 and a smoke index of not more than 50.
 - .2 All sealants must meet LEED criteria (IEQ 4.1) - Low Emitting Materials: Adhesives and Sealants.

June 30, 2020

- .2 Transverse Joints:
 - .1 Round and rectangular ducts with sliding or "S" joints. Operating temperature: -40°C to +116°C.
 - .1 ULC labeled self-adhesive kraft/canvas/aluminum laminated tape.
 - .2 "T" joints and flanged joints.
 - .1 Tape.
- .3 Longitudinal Seams:
 - .1 Round.
 - .1 ULC labeled self-adhesive kraft/canvas/aluminum laminated tape.
 - .2 Rectangular.
 - .1 Tube sealant.
- .4 Miscellaneous:
 - .1 Operating temperature above -7°C (19.4°F).
 - .1 Sealant: Water-based, ULC-certified watertight sealant with a flame spread of not more than 25 and a smoke index of not more than 50, which can be used in an operating temperature range from -7°C (19.4°F) to +93°C (199.4°F).
 - .2 Operating temperature at or below -7°C (19.4°F).
 - .1 Sealant: Water-based, flame retardant, oil-resistant sealant for air ducts that can withstand temperatures from -28°C (-20°F) to +82°C (190°F).

2.3 TAPE

- .1 Tape: Polyvinyl treated, open-weave fiberglass tape, 50 mm wide.

2.4 FITTINGS

- .1 Manufacture: To SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: Centreline radius equal the width of the duct.
 - .2 Round: Centreline radius 1.5 times the "manufacturers' standard" duct diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: With single thickness turning vanes.
 - .2 Over 400 mm: With double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch:
 - .1 90° entry branch: With balancing damper in the branch as close as possible to the main duct.
 - .2 45° entry branch: With a radius of curvature equal to the width of the duct and with a balancing damper in the branch as close as possible to the main duct.
 - .2 Round main ducts and branch: Enter main duct with conical connection.

June 30, 2020

- .5 Transitions:
 - .1 Diverging: 20° maximum included angle.
 - .2 Converging: 30° maximum included angle.
- .6 Offsets: Mitred elbows or radiused elbows, as indicated.
- .7 Obstruction Deflectors: Maintain full cross-sectional area. Maximum included angles: As for ordinary transitions.

2.5 FIRESTOPPING

- .1 Retaining angles around duct, on both sides of fire separation.
- .2 Firestopping material and installation must not distort duct.

2.6 GALVANIZED-STEEL AIR DUCTS

- .1 Galvanized-steel air ducts with G90 zinc coating, flexible, lock forming quality, to ASTM A653/A653M.
- .2 Design Criteria: Pressure of 500 Pa.
- .3 Thickness, fabrication, and reinforcement: To ASHRAE and SMACNA.
- .4 Joints:
 - .1 To ASHRAE and SMACNA, for the following uses:
 - .1 Greatest dimension is equal to or under 1,200 mm or diameter is 900 mm.
 - .2 Proprietary prefabricated flanged joints for air ducts, for the following uses:
 - .1 Greatest dimension is greater than 1,200 mm or a diameter of 900 mm.

2.7 HANGERS AND SUPPORTS

- .1 Hanger Straps: Of same material as duct, but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.
- .2 Hanger Configuration: To ASHRAE and SMACNA.
- .3 Angles and Hanger Rods: Galvanized-steel angles retained by galvanized-steel rods to ASHRAE and SMACNA, and the indications in following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
Up to 750	25 x 25 x 3	6
751 to 1,050	40 x 40 x 3	6
1,051 to 1,500	40 x 40 x 3	10
1,501 to 2,100	50 x 50 x 3	10
2,101 to 2,400	50 x 50 x 5	10
2,401 and greater	50 x 50 x 6	10

June 30, 2020

- .4 "Ramset" impact anchors and simply laid anchors ("drop-in" anchors) are prohibited.
- .5 Upper Hanger Attachments:
 - .1 Concrete:
 - .1 Zinc-plated steel anchor bolts with a hexagon head and internal threaded washer.
 - .1 Acceptable products: Hilti, Kwik HUS-EZI; Powers Vertigo+, without hex head: Powers Snake+.
 - .2 Zinc-coated steel expansion anchor (¼ in. to 1 in. diameter):
 - .2 Steel joist: Prefabricated steel joist hanger or steel plate.
 - .3 Steel beam: Prefabricated joist hanger.

2.8 STAINLESS-STEEL AIR DUCTS

- .1 Stainless-Steel Pipes: Grade 304, according to ASTM A480 / A480M Standard, brushed finish.
- .2 Thickness, Fabrication, and Reinforcement: According to ASHRAE and SMACNA, and as indicated below:
 - .1 Design criteria: For a pressure of 500 Pa.
- .3 Joints: Flanged (or continuously welded in an inert atmosphere).
- .4 Usage: Chemical hood exhaust ducts.

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with ASHRAE and SMACNA, as well as ANSI/NFPA 90A and ANSI/NFPA 90B Standards.
- .2 Do not break continuity of insulation vapor barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with ASHRAE and SMACNA, and as indicated.
- .4 Install breakaway joints in ductwork, on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints, of registered trademark, in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths to accommodate installation of acoustic duct lining.

3.2 HANGERS

- .1 Strap Hangers: Install in accordance with SMACNA.
- .2 Angle Hangers: Complete with locking nuts and washers.

June 30, 2020

.3 Hanger Spacing:

Duct Size (mm)	Spacing (mm)
To 1,500	3,000
1,501 and over	2,500

3.3 WATERTIGHT DUCT**.1 Provide watertight ducts for:**

- .1 Fresh air intake and exhaust.
- .2 Minimum 1,000 mm from duct-mounted humidifier in all directions.
- .3 As indicated.

.2 Form bottom of horizontal ducts without longitudinal seams. Solder or weld transverse joints of bottom and side sheets. Seal other joints with air duct sealer.**.3 Slope horizontal branch ductwork down towards extraction hoods served or their drainage point.****.4 Fit at base of main riser with 150 mm deep drip tray, solder or weld all joints.****.5 At the following locations, install a NPS 1¼ drain connected to a deep seal "P" trap; the water seal must be at least 1.5 times the static pressure measured at this location, but not less than 300 mm.**

- .1 At the bottom of fresh air intake and exhaust.
- .2 At the bottom of riser drip trays.
- .3 At the low point of horizontal watertight ducts.
- .4 As indicated.

3.4 SEALING**.1 Apply sealant to outside of joint, to manufacturer's recommendations.****.2 Bed tape in sealant and recoat with minimum of one coat of sealant, to manufacturer's recommendations.****.3 Seal all openings in air ducts, such as instrumentation openings, damper linkage, coils, etc., using neoprene or silicone sealant or jointing, while allowing the normal movement of the equipment installed in ducts.****3.5 AIR DUCT LEAKAGE TESTS****.1 Conduct leakage tests in accordance with Section 23 05 94 - Pressure Testing of Duct Air Systems.****.2 In accordance with SMACNA "HVAC Duct Leakage Test Manual".****.3 Do leakage tests in sections and provide report with results for approval.**

- .4 Make preliminary trial leakage tests (to detect air leakage) as instructed, to demonstrate quality of workmanship.
- .5 Install no additional ductwork until trial test are not satisfactory.
- .6 Test section of a minimum of 30 m long with not less than three-branch takeoffs and two (2) 90° elbows.
- .7 Do not insulate or conceal ducts before completing required tests and having the test report approved.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
- .2 ASTM International (ASTM).
 - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .3 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - .4 ASTM E477-06a, Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- .3 National Research Council Canada (NRC).
 - .1 National Building Code of Canada 2015 (NBC).
- .4 Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for acoustical air plenums, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit separate drawings for each piece of attenuation equipment complete with required product data.
- .4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE, AND HANDLING

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

- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location, off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect acoustical air plenums from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 ABSORPTION AND INSULATING MEDIA

- .1 Acoustical performance measurements to be done in accordance with ASTM E477, ASTM E90, and ASTM C423, except specified otherwise.
- .2 Acoustic quality fibreglass, smooth, uniform and odorless, bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements and meet requirements of the Quebec Construction Code or requirements of Authority Having Jurisdiction for duct lining.

2.2 SILENCERS

- .1 Factory-built, prime coated or galvanized steel, compatible with ductwork specified elsewhere and to ASHRAE and SMACNA Standards.
- .2 Silencer made of a double-wall casing, where the outer casing is 16-gauge galvanized steel, inner casing is galvanized steel with clean cut circular perforations, and space between outer and inner casings is used to enclose acoustic media. Inner casing to have pods or half-splitters running full length of silencer where any cross-sectional dimension exceeds 450 mm (18 in.). Protect media from erosion (disintegration or abrasion) with Tedlar between media and perforated metal.
- .3 Performance: As indicated in the Table of silencers.

Part 3 Execution

3.1 INSTALLATION

- .1 Install insulating media as per manufacturer's recommendations.
- .2 Noise Flanking: Where indicated, install in wall sleeve with uniform clearance around to ensure no contact of silencer with wall sleeve. Pack with flexible, non-hardening caulking on both sides of sleeves.
- .3 Instrument Test Ports: Install at inlet and outlet to permit measurement of insertion loss and pressure loss.
- .4 Suspension: To manufacturer's instructions.

3.2 SUPPLIER VERIFICATION OF INSTALLATION

- .1 The supplier shall go to the worksite to verify that installation complies with manufacturer's recommendations and provide a report of findings.

- .2 If required, adjust and correct in accordance with supplier's written report.
- .3 Provide the Departmental Representative with notice 24 hours prior to visit.

3.3 LEAKAGE TESTS

- .1 Conduct leakage test on acoustic plenums.
- .2 Carry out leakage tests in accordance with requirements for air duct testing in the SMACNA "HVAC Duct Leakage Test Manual".
- .3 Maximum permissible leakage rate is 2.5% of total flow when subjected to a test pressure of 2,500 Pa (10 in. of water).

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for air duct accessories, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Louvers.
 - .4 Instrument test ports.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 GENERAL**

- .1 Manufacture in accordance with the following Standards:
 - .1 CSA B228.1;
 - .2 SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Metal Components: 1.3 mm (0.05 in.) thick galvanized sheet, attached to flexible connections with double-clamp joints.
- .2 Material:
 - .1 Neoprene coated fibreglass, fireproof, auto-extinguishable, able to withstand temperatures between -40°C (-40°F) and 93°C (200°F), density of 1.0 kg/m², to NFPA 701, 90A, and 90B Standards.
 - .2 Acrylic-treated asbestos fiber fabric, non-combustible, complying with environmental Standards, capable of withstanding a nominal temperature of 480°C (896°F), compliant with ASTM Category AAAA, with a density of 0.920 kg/m², ULC listed (S109).

2.3 AIR DUCT ACCESS DOORS

- .1 Non-insulated Ducts: Sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (0.02 in.) thick, complete with sheet metal angle frame.
- .2 Insulated Ducts: Sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (0.02 in.) thick, complete with sheet metal angle frame and 25 mm (1 in.) thick rigid fibreglass insulation.
- .3 Gaskets: Neoprene, 20 mm x 10 mm (0.79 in. x 0.39 in.).
- .4 Hardware:
 - .1 Doors, up to 1,000 mm (39 in.): One (1) continuous piano type hinge and at least two (2) locks, Duro Dyne SL-1.
 - .2 Doors, over 1,000 mm (39 in.): One (1) continuous piano type hinge and three (3) handles operable, respectively, from both inside and outside.
 - .3 Door holder: Device to keep doors in open position.
- .5 For high-velocity ducts: Access door must open toward the inside.

2.4 LOUVERS

- .1 Factory or shop-fabricated, single or double thickness, to recommendations of SMACNA, and as indicated.

2.5 INSTRUMENT TEST

- .1 1.6 mm (0.06 in.) thick steel, zinc plated after manufacture.
- .2 Cam-lock handles with neoprene expansion plug and handle chain.
- .3 28 mm (1.1 in.) minimum inside diameter; length suitable to insulation thickness.
- .4 Neoprene mounting gasket.
- .5 Acceptable Products: Duro Dyne IP1 or IP2.

2.6 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

- .2 Sheet metal thickness shall correspond to round ducts.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets of fans.
 - .2 At specified locations.
 - .2 Length of connection: 150 mm (6 in.).
 - .3 Minimum distance between metal parts when system in operation: 75 mm (3 in.).
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Metallic elements at each end of flexible connections shall be in alignment.
 - .2 Connection must have a little slack.
 - .6 Use a #2/0 copper flat braid to ensure continuity of grounding throughout the flexible connections of air ducts. Fit the braid with lugs and bolt them to the ducts and equipment.
- .2 Air Duct Access Door:
 - .1 Sizes:
 - .1 450 mm x 1,000 mm (18 in. x 39 in.) for access door.
 - .2 300 mm x 300 mm (12 in. x 12 in.) for handhole.
 - .3 300 mm x 450 mm (12 in. x 18 in.) for viewing.
 - .4 As indicated.
 - .2 Locations:
 - .1 Required to access balancing dampers.
 - .2 Required to access devices requiring maintenance.
 - .3 Required by applicable Codes.
 - .4 Required to access each side of coils.
 - .5 As indicated.
- .3 Instrument Test Ports:
 - .1 General.
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.

- .3 Install insulation port extensions as required.
- .4 Locations.
 - .1 For traverse readings.
 - .1 Inlets and outlets of fans.
 - .2 Main and sub-main ducts.
 - .3 As indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 On mixing boxes, at locations approved by the Departmental Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 As indicated.
- .4 Louvers.
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible - 2013.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 GENERAL**

- .1 Manufacture to SMACNA Standards.

2.2 SINGLE-BLADE DAMPERS

- .1 Fabricated from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

- .2 Size and configuration complying with recommendations of SMACNA, except maximum height of 250 mm (10 in.).
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADE DAMPERS

- .1 Factory-manufactured of material compatible with duct.
- .2 Opposed Blades: Configuration to recommendations of SMACNA.
- .3 Maximum Blade Height: 100 mm (4 in.).
- .4 Bearings: Pin in bronze bushings.
- .5 Linkage: Shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 BACKDRAFT DAMPER

- .1 Gravity-operated, single or multi-blade, aluminum (or stainless steel), counterweight or counterspring, according to requirements.
- .2 Channel frame, extruded aluminum 2.3 mm (0.09 in.) thick.
- .3 Extruded aluminum blades, 1.2 mm (0.05 in.) thick with vinyl trim providing a good seal.
- .4 Bearings: Synthetic.
- .5 Connecting Flanges: Installation of inserted registers is not acceptable.

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 in accordance with recommendations of SMACNA and with manufacturer's instructions.
- .2 Install balancing dampers at all places where air balancing is required, and as indicated.
- .3 Install multi-blade dampers of opposite blade type at all secondary ducts that are greater than 250 mm (10 in.) in height, and in all main ducts.
- .4 Install single blade dampers in the secondary ducts that are less than 250 mm (10 in.) in height.
- .5 Install dampers, as close as possible to the main ducts, when installed in the secondary ducts.
- .6 Install controls for damper in accessible and visible locations.

- .7 Properly fix dampers, including the control shaft to prevent vibration.
- .8 Only install splitter dampers in wye branch ductwork.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM).
 - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 MULTI-BLADE DAMPERS**

- .1 Opposed blade type, except where dampers are located at the mixing boxes of air handling units, in which case they shall be parallel blade type or as indicated on the drawings.

- .2 Flanged connection type only if one dimension is less than or equal to 500 mm (20 in.) or if mechanism is not accessible for maintenance purposes (disassembly and replacement of linkages).
- .3 Dampers without insulation for return air and with insulation for new and exhaust air.
- .4 Materials:
 - .1 Uninsulated damper:
 - .1 Chassis and blades shall be made of aluminum extrusions, 2.05 mm (0.08 in.) thick. "Air-Foil" type blades, with a width of 125 mm (5 in.) to 155 mm (6 in.). Chassis made from aluminum channels, with reinforcing mullions and grooves to insert the vinyl lining. Typical dimensions of the frame shall be 25 mm x 100 mm x 25 mm (1 in. x 4 in. x 1 in.) on four (4) sides. The control shaft shall be made of hexagonal aluminum extrusion 12 mm (0.05 in.), set in the blade axle. Bearings shall be a dual bearing system composed of a Celcon inner bearing inserted into the chassis so there is no rotation. The linkage hardware shall be designed to avoid friction, metal on metal or metal on bearings. The blades shall be designed for minimum resistance to airflow. Vinyl liners shall be fitted in the grooves of the chassis for this purpose.
 - .2 Insulated damper (fresh air and exhaust):
 - .1 Chassis and blades shall be made from aluminum extrusion 2.05 mm (0.08 in.) thick. "Air-Foil" type blades, with a width of 125 mm (5 in.) to 155 mm (6 in.) and shall be aluminum extruded with insulated cavities with 22 mm (0.87 in.) thick polyurethane foam with thermal barrier. The extruded aluminum frames shall be 100 mm (4 in.) deep with three (3) insulated sides with polystyrene foam with a factor RSI-088 (R-5.0). Bearings shall be a dual bearing system composed of a Celcon inner bearing inserted into the chassis so there is no rotation. The linkage hardware shall be installed in the frame side, out of the airstream.
- .5 Dimensions:
 - .1 Blades: Width of at least 125 mm (5 in.) to at most 155 mm (6 in.) and length of at most 1,200 mm (47 in.).
 - .2 Maximum module dimensions: width of 1,200 mm (47 in.) by a height of 2,400 mm (94 in.).
 - .3 Multiple blade dampers shall be fitted with stiffeners and transverse coupling rods.
 - .4 The dampers shall be of sufficient size, so it does not restrict the useful area of the duct. The installation of such inserted registers is not acceptable if one dimension is less than or equal to 500 mm (20 in.) or if the mechanism is not accessible for maintenance.
- .6 Performance:
 - .1 Maximum allowable leak: 50 L/s.m² (9.85 cfm/in²) for a static pressure of 1.0 kPa (4 in. of water).
 - .2 Temperature range for insulated registers: From -40°C to 68°C (-40°F to 154°F).
 - .3 Temperature range for uninsulated registers: from -40°C to 100°C (-40°F to 212°F).
 - .4 Maximum speed: 5 m/s (16.4 in/s) at the face.

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 insulated dampers on fresh air intakes and exhaust.
- .2 Install where indicated.
- .3 Install in accordance with recommendations of SMACNA and the manufacturer's instructions.
- .4 Install so the blades are horizontal.
- .5 Install on tilted or vertical conduits so the blades are horizontal.
- .6 Seal the joints of multiple dampers modules using a non-transparent sealant silicone, that is recognized by UL, and in accordance with NFPA 90A.
- .7 At the start-up of the system, ensure that dampers registers are working properly.
- .8 Install an access door near each damper.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S112-10, Standard Test Method of Fire Test of Fire Damper Assemblies.
 - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
 - .3 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for fire and smoke dampers, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Indicate the following:
 - .1 Fire dampers;
 - .2 Smoke dampers;
 - .3 Firestop flaps;
 - .4 Servomotors;
 - .5 Fusible links;
 - .6 Break-away joints (design details).
- .3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.6 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 FIRE DAMPERS**

- .1 Fire Dampers: Bear label of ULC, meet requirements of Fire Commissioner of Canada (FCC), ANSI/NFPA 90A, and Authority Having Jurisdiction; in accordance with CAN4-S112.
- .2 Mild steel, factory-fabricated, for fire-rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Fire Dampers: Automatic operating type, having dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .4 Top Hinged-Fire Dampers: Multi-blade hinged or interlocking type; guillotine type. Sized to maintain full duct cross-section.
- .5 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-blade type or roll door type in horizontal position with vertical air flow.
- .6 Fire dampers shall be of types defined by SMACNA (Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems) with sealing for high pressure.
 - .1 For wall air transfer: Type A.
 - .2 For rectangular ducts: Type B or C.
 - .3 For round ducts: Type CR.
 - .4 For oval ducts: Type CO.
- .7 Fire damper installed in factory sleeve; the minimum sleeve thickness shall be in accordance with the recommendations of SMACNA and UL 555 Standard.

- .8 Fire dampers with galvanized-steel frame/sleeve installed so as not to interfere with the operation of the damper and not to interrupt the continuity of the air duct in which it is mounted.
- .9 Equip sleeves or frames with perimeter mounting angles on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling in compliance with ULC.
- .10 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .11 Retaining Brackets: To be installed around the sleeve perimeter, on both sides of the fire separation.
 - .1 Folded galvanized-steel sheet angles 40 mm x 40 mm x 2.8 mm (1.6 in. x 1.6 in. x 0.11 in.) for sleeves where the largest dimension is less than 1,200 mm (47 in.).
 - .2 Folded galvanized-steel sheet angles 40 mm x 40 mm x 3 mm (1.6 in. x 1.6 in. x 0.12 in.) for sleeves where the largest dimension is equal to or greater than 1,200 mm (47 in.).
- .12 Fire Rated: In accordance to the requirements of the Quebec Construction Code and municipal by-laws, but not less than 1.5 hours.
- .13 Acceptable Products: Controlled Air Manufacturing Ltd.; Nailor; Penn Ventilator Canada Ltd.; Ruskin (Kerr-Hant); AMI.

2.2 SMOKE DAMPERS

- .1 To be ULC or UL listed and labelled.
- .2 Normally closed, reverse action, smoke vent: Folding blade type, opening by gravity upon detection of smoke and/or from remote alarm signaling device actuated by an electrothermal link. Two (2) flexible stainless-steel blade edge seals to provide required constant sealing pressure.
- .3 Normally open, smoke/dampers: Folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signaling device. Blade edge seals of flexible stainless steel to provide required constant sealing pressure. Provide stainless-steel negator springs with locking devices to ensure positive closure for units mounted horizontally in vertical ducts.
- .4 Motorized: Folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.
- .5 Electrothermal Link: Dual responsive fusible link which melts when subjected to local heat of 74°C (165°F) and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.
- .6 Acceptable Products: Controlled Air Manufacturing Ltd.; Nailor; Penn Ventilator Canada Ltd.

2.3 COMBINED FIRE AND SMOKE DAMPERS

- .1 Damper: Similar in all respects to smoke dampers specified above.
- .2 Combined Actuator: Electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

2.4 FIRE STOP FLAPS

- .1 To be ULC listed and labelled, and fire tested in accordance with CAN4-S112.2.

- .2 Fire stop flaps shall comply with the Canadian Heating, Ventilating and Air-Conditioning Code, published by the Associate Committee on National Building Code, as well as the National Building Code.
- .3 Construct of minimum 1.5 mm (0.06 in.) thick sheet steel with 1.6 mm (0.06 in.) thick non-asbestos insulation, ULC listed, and corrosion-resistant pins and hinges.
- .4 Normally open flaps shall close under the action of a fusible link complying with ULC-S505, when temperature reaches 28°C (82°F) above the normal operating temperature, causing the flap to close.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing, as well as in accordance with SMACNA's assembly details "Basic Fire Damper Installation Details".
- .2 Maintain integrity of fire separation while performing work.
- .3 Install fire dampers in air ducts whenever they cross a firewall in the building, such as:
 - .1 Floors separating two (2) storeys.
 - .2 Walls of technical shafts.
 - .3 Walls of technical rooms.
 - .4 False ceilings classified as fire rated.
 - .5 Locations shown on the drawings.
 - .6 Building walls classified as firewalls in Architectural Documents.
 - .7 Locations required by the Quebec Construction Code or by the Municipality.
 - .8 Any other place required, but not specified in this list.
- .4 When appropriate, obtain approvals of complete installation from Authority Having Jurisdiction.
- .5 Install access door adjacent to each damper.
- .6 Coordinate with installer of fire stopping and smoke materials.
- .7 Ensure access doors/panels, fusible links, or servomotors are easily observed and accessible.
- .8 Install break-away joints of approved design on each side of fire separation.

- .9 Assembly: In accordance with the SMACNA Installation Guide (Fire, Smoke and Radiation Damper, Installation Guide for HVAC Systems), Section Basic Fire Damper Installation Details.
 - .1 Partition installation: "Case 2: Vertical Fire Damper Installation".
 - .2 Floor installation: "Case 3: Horizontal Fire Damper Installation".
 - .3 Wall air transfer installation: "Case 7: Vertical Fire Damper Installation".
 - .4 Installations other than those specified in articles 9.1, 9.2, and 9.3, shall not be accepted.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-12, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 Sheet Metal and Air-Conditioning Contractors National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2005.
- .4 Underwriters Laboratories (UL).
 - .1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S110-2007, Standard Methods of Tests for Air Ducts.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for flexible ducts, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Indicate:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire-rating characteristics.
- .3 Test and Evaluation Reports:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency, signifying adherence to Codes and Standards.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 GENERAL**

- .1 Factory-fabricated, to CAN/ULC-S110.
- .2 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 SEMI-RIGID ACOUSTIC AND INSULATED DUCTS (LOW PRESSURE)

- .1 Perforated flexible ducts made of three (3) layers of aluminum foil with fiberglass insulation, covered with aluminized vapor barrier:
 - .1 Duct thickness: 0,023 mm (45 microns).
 - .2 Insulation thickness: 25 mm.
 - .3 Vapor-barrier thickness: 0.015 mm (30 microns).
- .2 Performance:
 - .1 Minimum operating pressure: 900 Pa.

2.3 ACCESSORIES

- .1 Nylon clamp, UL rated Class 1.

Part 3 Execution**3.1 DUCT INSTALLATION**

- .1 Install flexible ducts in specified locations and in accordance with SMACNA, ANSI/NFPA 90A and 90B, and UL 181 Standards.
- .2 Flexible ducts must be supported in accordance with SMACNA recommendations.
- .3 Flexible ducts connected to air diffusers must not exceed 1,200 mm in length.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM).
 - .1 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .2 ASTM C916-85 (2007), Standard Specification for Adhesives for Duct Thermal Insulation.
 - .3 ASTM C1071-12, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - .4 ASTM C1338-08, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .5 ASTM G21-09, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .3 North American Insulation Manufacturers Association (NAIMA).
 - .1 NAIMA AH116-2002, Fibrous Glass Duct Construction Standards.
- .4 Sheet Metal and Air Conditioning Contractor s National Association (SMACNA).
 - .1 SMACNA, HVAC Duct Construction Standards, Metal and Flexible - 2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings Under Construction - 2007.
- .5 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 DUCT LINERS**

- .1 General:
 - .1 Mineral Fibre Duct Liner: Air surface coated mat facing.
 - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.
 - .3 Recycled Content: EcoLogo certified with minimum 35% by weight recycled content.
 - .4 Fungi resistance: To ASTM C1338 and ASTM G21 Standards.
- .2 Flexible:
 - .1 Use on round or oval surfaces as indicated.
 - .2 25 mm thick, to ASTM C1071 Type 1, fibreglass blanket duct liner.
 - .3 Density: 24 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 1.11 (m².degrees C)/W for 38 mm thickness, 0.74 (m².degrees C)/W for 25 mm thickness, 1.41 (m².degrees C)/W to 50 mm thickness, 0.37 (m².degrees C)/W for 12 mm thickness when tested in accordance with ASTM C177, at 24°C mean temperature.
 - .5 Maximum velocity on coated air side: 30.5 m/s.
 - .6 Minimum NRC of 0.75 at 25 mm thickness based on Type A mounting to ASTM C423 Standard.

2.2 ADHESIVE

- .1 Adhesive: To NFPA 90A and NFPA 90B Standards.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range - 29°C to + 93°C.
- .3 Water-based type fire retardant.

2.3 FASTENERS

- .1 2 mm diameter weld pins, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

2.4 TAPE

- .1 Poly-vinyl coated, open weave fiberglass membrane, 50 mm wide.

2.5 SEALER

- .1 Meet requirements of NFPA 90B and NFPA 90 Standards.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range - 68°C to + 93°C.

Part 3 Execution**3.1 EXAMINATION**

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

3.2 GENERAL

- .1 Unless otherwise specified, do work in accordance with SMACNA "HVAC Duct Construction Standard" and as indicated.
- .2 Line inside of ducts with acoustical lining, where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

3.3 DUCT LINER INSTALLATION

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive to ASTM C916 Standard.
 - .1 Exposed leading edges and transverse joints to be factory-coated or coated with adhesive during fabrication.
 - .2 Install weld pins not less than two (2) rows per surface and not more than 425 mm on centres with impact-driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.
 - .1 Spacing of mechanical fasteners in accordance with SMACNA "HVAC Duct Construction Standard".
- .2 In systems, where air velocities exceed 20.3 m/s, install galvanized-sheet metal nosing to leading edges of duct liner.

3.4 JOINT SEALING

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations, and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply two (2) coats of sealer over tape.
- .2 Replace damaged areas of liner at Departmental Representative's request.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- .2 Section 23 33 00 - Air duct accessories.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA).
 - .1 ANSI/AMCA Standard 99-2010, Standards Handbook.
 - .2 ANSI/ASHRAE 51-07 (ANSI/AMCA 210-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300-2008, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for exhausters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Include:
 - .1 Fan performance curves showing specified point of operation.
 - .2 Sound rating data.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products**2.1 SYSTEM DESCRIPTION**

- .1 Characteristics of Fans: As indicated in the table of fans shown on the drawing.
- .2 Statically and dynamically balanced. Constructed to ANSI/AMCA Standard 99.
- .3 Sound Ratings: Comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Unit shall bear AMCA certified sound rating seal.
- .4 Performance Ratings: Based on tests performed in accordance with ANSI/AMCA Standard 210, unit to bear AMCA certified rating seal.
- .5 Bearings: Heavy-duty grease lubricated ball or roller bearings sealed lifetime oilite bearings of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 80,000 hours.

2.2 CENTRIFUGAL INLINE FANS

- .1 Fan Wheels:
 - .1 Welded steel or aluminum construction.
 - .2 Maximum speed of centrifugal fans not exceeding 50% of critical speed.
 - .3 Airfoil aerodynamic vanes, unless otherwise indicated.
- .2 Ball or roller, spherical, grease-lubricated, oil seal, dust-tight and oil-retaining seals, with a certified useful life of at least 80,000 hours in accordance with the ABMA L 10 service life standard. The nominal characteristics of the bearings must be chosen in accordance with ABMA 9 and ABMA 11 Standards. Provide a device to lubricate the bearings.
- .3 Casings:
 - .1 Steel casings shaped in volute with inlet cones, for wheels 300 mm (12 in.) in diameter and more, and in steel for smaller wheels with spacers and welded supports. Discharge outlet adaptable for fans with impellers up to 675 mm (27 in.) in diameter, and fixed for larger wheels.
 - .2 Casings with longitudinal or transverse joints with flanges placed on each part to allow bolting, and watertight fittings in stainless and non-flammable material.

2.3 ROOF EXHAUSTERS

- .1 Axial fan or "V" belt driven.
 - .1 Housings: Spun aluminum galvanized complete with resilient mounted motor and fan.
 - .2 Impeller: Aluminum non-overloading.
 - .3 Adjustable motor sheave.
 - .4 12 mm mesh 2.0 mm diameter aluminum birdscreen.
 - .5 Automaticor Motorized gasketed aluminum backdraft dampers.
 - .6 Disconnect switch within fan housing.
 - .7 Continuous curb gaskets, cadmium plated securing bolts and screws, and curbs where indicated. Hinge curb plate for access to internals for maintenance.
- .2 Sound Curbs: Of same manufacturer as fan and built to suit model specified.
 - .1 Double baffle and self-flashing type. Required decibel sound attenuation spectrum:

Frequency Octave Band	1	2	3	4	5	6	7	8
dB Attenuation	3	5	11	16	22	20	17	13
 - .2 Pressure loss through curbs: 37 Pa maximum at rated L/s.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roof and wall exhausters 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 Departmental Representative.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 At the request of the Departmental Representative, measure vibration levels on fans as well as on the machine housing according to ISO 10816-1. The technician responsible for taking measurements shall be certified Category 2 in accordance with technical requirements of ISO 18436-2 Standard. Provide a report indicating location of the measuring points in the machines as well as an analysis of the vibration level of components under study of the machine.

3.3 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces, as specified.

3.4 CLEANING

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA).
 - .1 ANSI/ASHRAE 51-07 (ANSI/AMCA 210-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 International Organization of Standardization (ISO).
 - .1 ISO 3741-2010, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .4 Underwriter s Laboratories (UL).
 - .1 UL 181-2005 (R2008), Factory-Made Air Ducts and Air Connectors.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for air terminal units, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Indicate the following:
 - .1 Capacity;
 - .2 Pressure drop;
 - .3 Noise rating;
 - .4 Leakage.
- .4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 VARIABLE VOLUME BOXES**

- .1 Pressure-independent devices.
- .2 Performance: To AHRI-880 Standard.
- .3 Differential pressure not to exceed 25 Pa (0.1 in. of water), at inlet air velocity of 10 m/s (2,000 ft/min).
- .4 Minimum operating pressure for mechanical system box: 125 Pa (0.5 in. of water) for low-pressure systems and 375 Pa (1.5 in. of water) for high-pressure systems.
- .5 Sound ratings of assembly not to exceed 30 NC, at 1.5 m (5 ft), for an inlet pressure of 250 Pa (1 in. of water).
- .6 Complete with:
 - .1 Servomotor and controller: See article 2.2 - Control, below.
 - .2 Velocity sensor: As per manufacturer's specifications.
- .7 Casing: Constructed of 0.8 mm (22 gauge) thick galvanized steel, with lining of at least 12 mm (½ in.), made of fiber glass with a density of 0.7 kg (1½ lbs), to UL 181 and ANSI/NFPA-90A, complete with bands to connect air ducts.
 - .1 Mount control components inside protective metal casing.
 - .2 Leaks through casing wall shall not surpass 1% of calculated velocity, while pressure upstream and downstream of controller shall be 750 Pa (3 in. of water) and 0 Pa (0 in. of water), respectively. The controller maintains velocity at ±5% operating velocity.
- .8 Damper: Galvanized steel, with peripheral gasket and self-lubricating bearings. Air leakage thru closed damper not to exceed 2% of nominal rating at 750 Pa (3 in. of water) inlet static pressure, in accordance with ASHRAE 130 Test Procedure.
- .9 Characteristics: As indicated in the "Air Terminal Units Schedule" shown in drawings.
- .10 Acceptable products: Price, model SDV; Titus, model DESV; Anemostat, model EZTS or EZTA with attenuator.

2.2 CONTROL

- .1 Equipment supplied by Control Section:
 - .1 Digital controller.
 - .2 Current Transformer.
 - .3 Speed pressure transmitter.
 - .4 Servomotor.
- .2 Equipment provided by this Section:
 - .1 Pitot tubes.
 - .2 PVC pipes between Pitot tube and speed pressure transmitter.

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 in accordance with manufacturers' recommendations and as indicated on drawings.
- .2 Support independently of ductwork.
- .3 Directly upstream of each terminal component, install with at least 1,000 mm (40 in) of flexible ducting and minimum of four duct diameters of straight duct, same size as inlet.
- .4 Locate so that controls, dampers and access panels are easily accessible.
- .5 Coordinate control systems with Control Section.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for diffusers, registers, and grilles, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Indicate following:
 - .1 Capacity;
 - .2 Throw and terminal velocity;
 - .3 Noise criteria;
 - .4 Pressure drop;
 - .5 Neck velocity.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Spare Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 General**

- .1 Standard products that meet requirements and specifications with respect to capacity, throw and terminal velocity, noise criteria, pressure drop, and neck and outlet velocity.
- .2 Fire-stop bulkhead connectors for grilles, registers, and diffusers shall be fitted with steel sleeves attached to the framing, to NFPA 90A Standard.
- .3 Frames:
 - .1 Steel: Primed, pressed steel, cold-rolled with visible joints welded and miter gaskets at corners.
 - .2 Aluminum: Extruded aluminum, brushed finish with mechanical ties and miter gaskets at corners.
 - .3 Sealing gasket: Along the edge of all frames.
 - .4 Plastering frames: To retain frames in place when installed in a partition, a plaster wall, or gypsum panels.
 - .5 Fastening and operating devices: Concealed.
 - .6 Performance data: As indicated and in accordance with Diffusers, Registers, and Grilles Schedule shown in the drawings.
 - .7 Finish and colours: White.
 - .8 Acceptable Products: E.H. Price; Titus; Nailor; Anemostat; Air Vector; Tuttle & Bailey.

2.2 Prefabricated Components

- .1 Grilles, registers, and diffusers of same generic type to be product of one manufacturer.

2.3 Fabric air ducts (Air diffuser)

- .1 All diffusers must be made of woven material that delays the spread of flames and comply with the following characteristics:
 - .1 Fabric design: 100% flame retardant;
 - .2 Weight: 6.5 oz/v2 according to ASTM D3776;
 - .3 Color: To coordinate with Architectural (choice of silver, blue, red, black, taupe, and white);
 - .4 Air porosity: 2 (+ 2 / -1) cfm according to ASTM D737, Frazier;
 - .5 Temperature range: -18 to 82°C (0 to 180°F);
 - .6 Flame spread: Approved by Underwriters Laboratories of Canada in accordance with NFPA 90-A 25/50 Standard on the propagation of flames and fumes, as well as CAN / ULC-S102.2 Standard.
- .2 System Manufacturing Requirements:
 - .1 Air dispersion is accomplished by circular outlets (i.e. perforations) and by the porosity of the fabric. The perforations are made by laser by the manufacturer, at the factory.
 - .2 Sizing and position of perforations must be specified and approved by the manufacturer.

- .3 Connection to the metal conduit will be made with a protective plastic collar with anchoring parts supplied by the manufacturer. The anchors are fixed to the metal conduit by "Zip Screw Fastener" type screws (supplied by the Contractor).
 - .4 Connection to conduit entry includes a zipper for easy removal and maintenance.
 - .5 Tube lengths are equipped with zippers, as specified by the manufacturer.
 - .6 System must be equipped with air rectifiers, if necessary, for the balancing of the system. The restriction includes the ability to adjust the airflow resistance from 0.06 - 0.60 in. of static pressure water.
 - .7 Conduit tip includes zipper for easy maintenance.
 - .8 Fabric system must have connections to the suspension system described below.
 - .9 Any modification of a straight line must be made with a gradual bend or a "T" section allowing air flow without turbulence. Elbows and "T" sections must have at least five (5) sewn sections. The elbows must have a radius of curvature equal to 1.5 times the diameter of the fabric air ducts.
- .3 Design Parameters:
- .1 Systems with flexible tubes must be designed with an external static pressure of minimum 0.25 to maximum 2.0 in. of water, with a standard value of 0.5 in. of water.
 - .2 Air distribution tubes will be exposed to temperatures between -18°C and 82°C (i.e. between 0°F and 180°F).
 - .3 Design parameters, such as air volume, static pressure and length of tubes, must be established or approved by the manufacturer.
 - .4 Do not install fabric tubes in covered areas.
 - .5 Use only fabric ducts in sections of mechanical ventilation system with positive static pressure.
 - .6 The manufacturer must demonstrate, when submitting the shop drawings, that the arrangement of the perforations and the size of the perforations in the fabric air duct allow good air distribution in the room in heating mode, and in air conditioning mode, and this, considering the air temperatures described in the tables on the drawings for the aeraulic unit dedicated to the room. Air distribution must at least meet the following requirements:
 - .1 Air released from the fabric air ducts must be entirely directed towards the floor and walls of the room. No air diffusion towards the ceiling will be accepted. Windows and doors of the room must be well treated in the air distribution in heating mode to avoid condensation;
 - .2 In heating mode, the air speed at the hangar floor must be at least 0.08 m/s (16.4 ppm) considering an installation height of the fabric air duct 5.5 m (18 ft).
- .4 Suspension Accessories:
- .1 Fabric tensioning system (Skelecore FTS): Air diffusers must be constructed with an internal tensioning frame.
 - .1 The system must have a cylindrical tension over the entire length of the textile duct.

- .2 The tensioning system must support a tension on 360° and must be supplied with intermediate rings with quick connection hidden inside the fabric tensioning system.
- .3 The interior structure must include multiple mechanically adjustable tensioning devices. In order to ensure tension in textiles, the structural system and the textile must be configured in segments no longer than 6 m (20 ft).
- .4 Textile components must be supported only by cylindrical metal rings.
- .5 Each cylindrical ring must have a vertical metal safety cable.
- .6 The system must be designed for diameters ranging from 200 mm to 1,500 mm (8 in. to 60 in.).

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 diffusers, registers, and grilles in accordance with manufacturer's instructions.
- .2 Install with cadmium-plated flat head screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers, and diffusers in place, in gymnasium and similar game rooms. Provide safety chain on each grille or diffuser.
- .4 For double deflector grilles, ensure that the blades are open to the required orientation.
- .5 Provide grilles and diffusers with balancing dampers.

3.3 Installation and cleaning of fabric air ducts

- .1 Install the suspension system in accordance with the manufacturer's requirements. The assembly instructions must be provided by the manufacturer upon delivery of the product.
- .2 Clean central air unit and metal ducts before fabric air duct system, one at a time, as installed. Clean the external surfaces of any substance liable to cause corrosion or deterioration of the surface.
- .3 Temporary Closure: Cover the ends of the tubes which are not yet connected to the metal conduits or the distribution equipment during installation with polyethylene or other protection, to ensure the cleanliness of the system before the overall installation is complete.
- .4 If the fabric air ducts are to be soiled during installation, they must be dismantled and cleaned according to the manufacturer's cleaning standards.

END OF SECTION

Part 1 General**1.1 REFERENCE STANDARDS**

- .1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - .1 ANSI/ASHRAE 52.2-12, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.
 - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.
 - .4 CAN/CGSB-115.13-85, Filter Media, Automatic Roll.
 - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
 - .8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
 - .9 CAN/CGSB-115.20-95, Polarized Media Air Filter.
- .3 International Organization of Standardization (ISO).
 - .1 ISO 14644-1-99, Clean Rooms and Associated Controlled Environments - Part 1: Classification of Air Cleanliness.
- .4 National Fire Protection Association (NFPA).
 - .1 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .5 Underwriters Laboratories of Canada (ULC).
 - .1 ULC -S111-07, Standard Method of Fire Tests for Air Filter Units.
- .6 US Department of Defense - Test Method Standard.
 - .1 MIL-STS-282-95, Filter Units, Protective Clothing, Gas-Mask Components and Related Products; Performance Test Methods.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for HVAC filter, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Spare Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide list of individual manufacturer's recommended spare parts for equipment, such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: In addition to filters installed immediately prior to acceptance by Departmental Representative, supply one (1) complete set of filters for each.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 GENERAL**

- .1 Media: Suitable for air at 100% RH and air temperatures between -40°C and 50°C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: As indicated in Filters Schedule.
- .3 Pressure drop when clean and dirty, sizes and thickness: As indicated on schedule.

2.2 ACCESSORIES

- .1 Holding Frames: Permanent, galvanized steel, "T" section construction, 1.6 mm thick, except specified otherwise.
- .2 Seals: To ensure leakproof operation.
- .3 Blank-off Plates: As required, to fit all openings and of same material as holding frames.
- .4 Access and Servicing: Through doors/panels on each side.

2.3 COTTON FILTER PANELS

- .1 Disposable pleated reinforced cotton dry media: To CAN/CGSB 115.18.
- .2 Holding Frame: Disposable, durable chipboard.
- .3 Performance: MERV 8-A, according to ASHRAE 52.2.
- .4 Nominal Thickness: 25 mm for heat pump and 50 mm for ventilation units.

2.4 SUPPORTED BAG TYPE FILTERS, MERV 11, MERV 13, AND MERV 14 EFFICIENCY

- .1 Filter Element: Ultrafine fiberglass particles inflating automatically in use, disposable bag type.
 - .1 High efficiency, in accordance with CAN/CGSB 115.11.
 - .2 Medium efficiency, in accordance with CAN/CGSB 115.12.
- .2 Mounting Frame: Galvanized steel.
- .3 Filter Element Support: Welded galvanized sheet.
- .4 Efficiency: MERV 11-A, MERV 13-A, and MERV-14-A.
- .5 Comply with ASHRAE Standard 52.2.

2.5 FILTER GAUGES

- .1 Dial type: Diaphragm actuated, direct reading.
- .2 Pressure Limits: Based on initial pressure drop and final pressure drop.
- .3 Quantity: One (1) gauge per filter unit.
- .4 Manufacturers' recommended benchmarks for pressure drop (initial to final).

Part 3 Execution**3.1 INSTALLATION - GENERAL**

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance, and replacement.

3.2 REPLACEMENT MEDIA

- .1 Replace media with new upon acceptance.
- .2 Filter media new and clean, as indicated by pressure gauge, at time of work acceptance.

3.3 FILTER GAUGES

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy-readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.4 CLEANING

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

- .1 Air Conditioning, Heating and Refrigeration Institute (AHRI).
 - .1 AHRI 410, Standards pour les serpentins de refroidissement et de chauffage d'air forcé.
- .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 - .1 ASHRAE 52, Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- .3 CSA International Group (CSA).
 - .1 CSA C22.2 No. 46, Electric Air Heaters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for duct heaters, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit product data and include:
 - .1 Heater element support details.
 - .2 Heating coil: Total kW rating, voltage, phases.
 - .3 Number of stages.
 - .4 Rating of stage: rating, voltage, phase on each floor.
 - .5 Heater element watt/density and maximum sheath temperature.
 - .6 Maximum discharge temperature.
 - .7 Unit support.
 - .8 Internal components wiring diagrams.
 - .9 Minimum operating airflow.
 - .10 Pressure drop operating airflow.

1.4 DELIVERY, STORAGE, AND HANDLING

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

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect duct heaters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 ELECTRIC HEATERS

- .1 Air Ducts: Insert type.
 - .1 Built in accordance with CSA Standards certification mark.
 - .2 Approved for zero clearance with any combustible material.
- .2 Heater elements made of helical coils of nickel chrome alloy (NiCr 60) resistance wire (Grade C).
- .3 Heater Elements Watt/Density:

- .1 The density of the heating elements shall consider the minimum air velocity and its maximum temperature to ensure the durability and safe operation of the heaters. However, this density shall not exceed the maximum values indicated below.
- .2 When the air velocity through the coil is greater than 2.28 m/s (450 ppm), provide elements with a maximum density of 6 W/cm² (40 W/in²). When the air velocity through the coil is less than 2.28 m/s (450 ppm), supply low density elements according to the table hereafter:

Minimum air velocity m/s (in/min)	0.5 (100)	1 (200)	1.5 (300)	2.28 (450)
Maximum density of elements W/cm ² (W/in ²)	1.1 (7)	2.8 (18)	4.5 (30)	6 (40)

- .4 Staging:
 - .1 Staged heaters: Balanced line current at each stage.
 - .2 Each stage: Element heater to provide its integral power rating.
- .5 Built with galvanized-steel frame of appropriate size, with mounting flanges allowing installation without opening the control box.
- .6 Controls:
 - .1 Factory-wired and mounted in control box. Use terminal blocks for power and control wiring to thermostat.
 - .2 "Go-No Go" controls, mounted in a CSA approved box, include the following:
 - .1 Magnetic contactors;
 - .2 Stages controller;
 - .3 Control transformer with control circuit fuse;
 - .4 Mandatory differential pressure switch ensuring that the elements are not activated if there is no airflow;

- .5 Toggle switch for control;
- .6 Main fuse;
- .7 Main switch without fuse;
- .8 Primary thermal protection sensor with automatic reset;
- .9 Secondary thermal protection sensor with manual reset.
- .3 Proportional or modulating control devices, mounted in a CSA approved box, include the following:
 - .1 Magnetic contactors;
 - .2 SSR or SCR modulating controller;
 - .3 Electronic controller with temperature sensors;
 - .4 Differential pressure switch ensuring that the elements are not activated if there is no airflow;
 - .5 Toggle switch for controls;
 - .6 Main fuse;
 - .7 Main switch without fuse;
 - .8 Primary thermal protection sensor with auto-reclosing;
 - .9 Secondary thermal protection sensor with hand reset.
- .7 Accessories:
 - .1 Protective grating on each side.
- .8 Characteristics: As indicated in Electric Coils Schedule shown on drawing.
- .9 Acceptable Products: Delta Sélec, model DS; Neptonic, model CI00H; Thermolec, model SC.

Part 3 Execution**3.1 INSTALLATION**

- .1 Install electric heaters in accordance with manufacturer's instructions and in such way for easy removal from ventilation ducts.
- .2 Coordinate connection to power supply with Division 26 and to control devices with Division 25.

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- .2 Section 23 33 00 - Air Duct Accessories.
- .3 Section 23 33 15 - Dampers - Operating.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE 84-2013, Method of Testing Air-to-Air Heat/Energy Exchangers (ANSI approved).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for energy recovery equipment, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports:
 - .1 Catalogued or published ratings: Obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to Codes and Standards in force.
 - .2 Provide confirmation of testing.

1.4 DELIVERY, STORAGE AND HANDLING

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

June 30, 2020

Part 2 Products**2.1 AIR EXCHANGER (ERV-1 AND ERV-2)**

- .1 General.
 - .1 Factory-assembled devices to form an air distribution device meeting design criteria indicated.
 - .2 Device designed to be installed on roofing.
 - .3 Units must be cleaned at the factory before packaging using a "Shrink Wrap" type plastic membrane which must completely coat each unit upon delivery.
 - .4 On site, units must be handled with the necessary precautions to avoid any damage to internal components, walls, and exterior finish.
 - .5 On site or elsewhere, store units in a clean place protected from weather and any risk associated to the construction site.
 - .6 Units must not operate, temporarily or permanently, before an official start-up has been carried out in the presence of a manufacturer's representative.
 - .7 Design and assembly of the unit must be carried out to resist the maximum static pressure that fans can reach under design conditions.
 - .8 The factory design and assembly of the units must be done in order to obtain external connections for the units.
 - .9 Doors or access panels must be provided so that each of the internal mechanical components can be removed without compromising the structural integrity of the unit casing.
 - .10 All fan / motor assemblies must be mounted on a base supported by earthquake-resistant type vibration isolators.
 - .11 Motion limiters must be provided on each fan to ensure stable operation and to protect flexible fittings against tearing.
 - .12 Unit does not require a condensate pan or drain piping. The design of the unit will prevent any form of condensate and will prevent freezing of the heat exchanger for the operating conditions indicated in the schedules found on drawings.
- .2 Fans.
 - .1 The supply and return fan is of centrifugal type with blades curved forward and statically and dynamically balanced at the factory.
 - .2 The fan drive is by V-belt. Pulleys of the motors and fans are adjustable.
 - .3 Motors are of "ODP" type for continuous operation; they are protected against overloads and possess a lifetime lubricated ball bearing. The voltage will be of 575/3/60 V.
 - .4 Performance: As indicated on drawings.
- .3 Envelopes.
 - .1 20-gauge galvanized steel double-wall factory-made envelopes.

June 30, 2020

- .2 Insulation.
 - .1 The composition of panels must have a flame spread index of not more than 25 and a smoke power index of not more than 50, in accordance with CAN / ULC S102 Standard.
 - .2 Thermal insulation: Surfaces not exposed to air conditioning covered with a thermal insulation of 25 mm (1 in.) of thermal acoustic insulation covered with aluminum foil.
 - .3 Thermal bridge.
 - .1 Construction must be done without thermal bridge to avoid interior and exterior condensation.
 - .4 Acoustic performance.
 - .1 The acoustic performance of panels used in the construction of caissons must have been approved by an independent laboratory.
 - .2 Methods used to establish the insertion loss of the panels must comply with ASTM-E90 Standards.
 - .3 Methods used to establish the sound absorption coefficients of panels with perforated walls must comply with ASTM-C423 and ASTM-E795 Standards.
 - .5 Access panels.
 - .1 Where access space is limited, access panels must be provided in place of hinged doors. They must be of similar construction to doors described above.
 - .2 Each removable panel must be equipped with two (2) cane-shaped handles, operable from the outside.
- .4 Outdoor Air Intake and Exhaust.
 - .1 Hoods for fresh air intake and exhaust will be provided with the unit.
- .5 Motorized Dampers.
 - .1 Insulated dampers must be parallel blades with airtight construction with side trim to allow sealing of 7.5 l / s / m^2 (1.5 pcm / ft^2) of shutter at a differential pressure of 250 Pa (1 in. H₂O), as prescribed by the test method defined in AMCA 500 Standard.
 - .2 Each unit must be fitted with a bird screen in the fresh air intake section.
 - .3 The damper must be equipped with a modulating actuator with direct connection and return spring.
- .6 Filter Section.
 - .1 Boxes must be made of the same material as the box, model filters arranged as indicated, using elements disposable after use.
 - .2 Pre-filters and filters are front-loaded when there is an access section available upstream. Otherwise, they are inserted laterally by means of a hinged hatch and slides in aluminum profiles.

June 30, 2020

- .3 Filters will be installed on the outside air inlet and the return air inlet. The filters will be 2-in. thick and 35% efficient (MERV 8).
- .4 Provide blocking plates to prevent any bypass of air around the filters.
- .5 Performance: As indicated on drawings.
- .7 Fixed Air / Air Exchangers.
 - .1 Exchange surfaces: Specially treated cellulose fiber membrane and separated by corrugated layers to allow total heat to recover energy (sensitive and latent), sealed at the end and bonded to the envelope.
 - .2 Contamination of admitted air circuit / rejected air circuit: No contamination tolerated.
 - .3 Exchanger must operate at low temperature without risk of freezing.
 - .4 Removable inspection panels.
 - .5 Vacuum cleaning.
 - .6 Performance: As indicated on drawings.
- .8 Electrical Connections.
 - .1 All internal connections are prefired at the factory according to the specifications of the Electrical Division.
 - .2 An electrical panel is supplied and mounted on the unit, which includes contactors and starters for fan motors.
 - .3 The unit is supplied with a fuseless electrical disconnect switch installed on the unit.
- .9 Controls.
 - .1 Terminal blocks for connection of the fresh air damper: Power supply and management (24 VAC, 10 VA) for the fresh air shutter (internal or external to the unit).
 - .2 Terminal blocks for connection of evacuation air damper: Supply and management (24 VAC, 10 VA) for the evacuation air damper (internal or external to the unit).
 - .3 BACnet compatible controller: The unit is equipped with a BACnet MS / TP compatible controller.
 - .4 Stop / Start dry contact: The state of the unit (Stop / Start) is controlled from a normally open (NO) dry contact.
 - .5 General alarm dry contact: When the unit goes into Alarm mode, a (NO) dry contact is closed.
 - .6 Occupancy control dry contact: The state of the unit (Stop / Start) is controlled from a normally open (NO) dry contact.
 - .7 Run confirmation for OA: (NO) Dry contact which closes when the fresh air engine is started.
 - .8 During defrost, dry contact is sending a signal to open a motorized shutter external to the unit (by Division 23).

June 30, 2020

- .10 Insulated roof-mounting base, such as the ventilation unit, prefabricated, at least 600 mm in height, comply with the requirements of the NRCA (National Roofing Contractors Association), equipped with an anti-vibration and earthquake-resistant of type B4, in accordance with Section 23 05 48.
- .11 Warranty.
 - .1 Units will be covered by a warranty on all parts for a 2-year period and of 10 years on the enthalpy core.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Provide appropriate protection and security devices.
- .2 Install devices in accordance with manufacturer's instructions and as indicated.
- .3 Provide clearances necessary for the execution of operation and maintenance work.

3.3 FANS

- .1 Install drive belt necessary for final balancing of air flow.
- .2 Install flexible connection sleeves at inlet and outlet of fans.
- .3 Install anti-vibration mounts.

3.4 START-UP

- .1 A service representative approved by the manufacturer must perform the start-up. Allow a minimum of four (4) hours of start-up per unit.
- .2 The manufacturer must fully cooperate to allow the integration of the equipment into the centralized building control system. Allow a 4-hour site visit for coordination with the Division 23 Contractor.
- .3 At the request of the Departmental Representative, measure vibration levels on fans as well as on the machine housing according to ISO 10816-1. The technician responsible for taking measurements shall be certified Category 2 in accordance with technical requirements of ISO 18436-2 Standard. Provide a report indicating location of the

measuring points in the machines as well as an analysis of the vibration level of components under study of the machine.

3.5 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- .2 Section 23 33 00 - Air Duct Accessories.
- .3 Section 23 33 15 - Dampers - Operating.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI).
 - .1 ANSI/AHRI 430-10, Performance Rating of Central Station Air-Handling Units.
- .2 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES).
 - .1 ANSI/ASHRAE 52.2-2012, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - .2 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .3 Green Seal (GS).
 - .1 GS-11-11, Standard for Paints and Coatings.
 - .2 GS-36-11, Standard for Adhesives for Commercial Use.
- .4 South Coast Air Quality Management District (SCAQMD).
 - .1 SCAQMD Rule 1113-11, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesives and Sealants.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for insulation, filters, adhesives, and paints, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Indicate the drawings: Filters, fans, motor drive, fan characteristic curves showing operating point, mixing boxes, hot and cold batteries, registers, devices flow control, bearings, enthalpy heat exchanger, heat pump group; they shall also indicate the performance characteristics of these elements.

June 30, 2020

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for air handling equipment for incorporation into manual.
- .3 Provide the necessary data on the following: Total cooling capacity, inlet temperature, dry bulb, fans, bearings, sensitive cooling capacity, outside temperature (fresh air), registers, air flow control devices, volume control devices, inlet temperature, wet bulb, motors, heat recovery performance, and performance of the heat pump group.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one (1) spare set of filters.
- .3 Provide list of individual manufacturer's recommended spare parts for equipment, such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .4 Spare Filters: In addition to filters installed immediately prior to acceptance Departmental Representative, supply one (1) complete set of filters for each filter unit or filter bank.

1.6 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 PERFORMANCE REQUIREMENTS**

- .1 Seismic Performance: Air treatment systems shall withstand the effects of seismic displacement calculated according to the Quebec Construction Code.
- .2 Performance related to design pressure:
 - .1 Manufacture and design of boxes to withstand a design pressure of 1.25 kPa (5 in. H₂O).

June 30, 2020

- .3 Comply with the requirements of Standard AHRI 430.
 - .1 Performances superior to the minimum requirements imposed by ASHRAE 90.1-2013 Standard.

2.2 GENERAL

- .1 Self-contained roof-mounted appliances, with electric heating coil, direct expansion cooling block, and energy recuperator, labeled CSA.
- .2 Units with a casing and a frame, a supply fan, an exhaust fan, a heat wheel type heat exchanger (as indicated in schedules shown on drawings), control / regulation devices, a filter air, a refrigerant cooling battery, a compressor-condenser unit with coil and fans, a fresh air intake register with servomotor, a return register, and an exhaust register with servomotor.
- .3 Roof-mounting base, such as the ventilation unit, prefabricated, at least 600 mm in height, in accordance with the requirements of the NRCA (National Roofing Contractors Association), equipped with an anti-vibration and earthquake-resistant base of type B4, in accordance with Section 23 05 48.
- .4 Device shall bear the AHRI label and its nominal characteristics shall comply with AHRI 430 Standard.
- .5 Description and Characteristics: As indicated in schedules of the aeraulic devices shown on drawings.

2.3 CASING

- .1 Casing: Having undergone a weather-resistance test in accordance with the requirements of the AGA rain tightness test Standards and approved by the latter; also having a noise index corresponding to the number of dBAs provided for in the AHRI 270 Standard.
- .2 Frame and Supports: Welded steel, galvanized after manufacture, 2 mm thick, with lifting lugs.
- .3 Outer Casing: Weatherproof, G90 22-gauge galvanized steel, coated with baked enamel paint. The unit cabinet is designed to withstand a pressure of 1,245 Pa. Galvanized steel outer casing is also designed to withstand a minimum of 1,000 hours when subjected to salt spray according to ASTM B117 Standard.
- .4 Thermal Insulation: Surfaces not exposed to air conditioning, covered with a 50-mm (2-in.) thermal insulation of sprayed hydrophobic polyurethane having a nominal thermal resistance of RSI-1.14 per 25 mm (R-6.5 per in.).
- .5 Access Doors:
 - .1 Fabricate doors with the same materials as wall panels, with same type and same thickness of insulation.
 - .2 Provide each door with at least two (2) stainless-steel hinges and a latch, operable from the outside.
 - .3 180° door opening.

June 30, 2020

- .4 Sealing between the door and its frame shall be made by a neoprene gasket with closed cells. Gasket should be attached to the door, not the door frame.
- .5 See sketch on drawings for exact location of accesses.

2.4 CENTRIFUGAL SUPPLY FAN

- .1 Centrifugal fans of plenum type, Class-II aluminum construction, direct drive, and easily accessible inside the enclosure of the casing.
 - .1 Fan statically and dynamically balanced.
 - .2 AC induction type motor with variable frequency drive without branch, installed at the factory. Motor shall be fitted with earthing rings for induced currents. Modulating type motors with electronic switching (ECM) or motors fitted with variable speed drives installed in the machine itself.
- .2 Fan shall be installed on an anti-vibration spring base.

2.5 EXHAUST FAN AND SAVER

- .1 Unit shall be equipped with an energy-saving section by supplying outside air with comparison of return temperature and outside temperature.
- .2 Unit shall be equipped with an electronic switching modulating (ECM) exhaust fan. An integral control module in the ventilation unit shall be able to regulate the speed to maintain a building pressure setpoint adjusted on the unit controller.
- .3 Unit shall be equipped with two (2) Class II plenum type direct drive exhaust fans with aluminum wheels. They shall operate in parallel using the same control signal from the unit controller.
- .4 Each exhaust fan motor shall be of the premium efficiency type with electronic switching (ECM) to allow variable depressurization of the air pressure in the return section of the unit. Motor should include thermal protection and a phase loss monitor to prevent damage to the motor in the event of phase loss.

2.6 FILTERS AND FILTER SUPPORTS

- .1 Provide prefilter and final filter.
- .2 Prefilters:
 - .1 Filter media shall be composed of a mixture of cotton and synthetic fibers, pleated, with a thickness of 50 mm (2 in.).
 - .2 Minimum efficiency of the filter shall be MERV 8 in accordance with ASHRAE 52.2 Standard and of MERV-A 8 type, when tested according to Appendix J of the same Standard.
 - .3 Use a pressure loss of 250 Pa (1 in. H₂O) in prefilters for the sizing of fans.
- .3 Final Filters:
 - .1 Filter media shall be synthetic fibers, pleated, with a thickness of 100 mm (4 in.).

June 30, 2020

- .2 Minimum efficiency of the filter shall be MERV 11 in accordance with ASHRAE 52.2 Standard and of MERV-A 11 type when tested according to Appendix J of the same Standard.
- .3 Use a pressure loss of 250 Pa (1 in. H₂O) in the filters for the sizing of fans.
- .4 Loading Filters:
 - .1 16-gauge galvanized steel support for side loading.
 - .2 Install 16-gauge galvanized steel blanking plates around frame or filter support to make the filter section completely sealed.

2.7 ELECTRIC HEATER BATTERY

- .1 Electric resistance heaters with SCR control in accordance with Section 23 55 13.

2.8 ENERGY RECOVERY DEVICE

- .1 Refer to schedules in drawings to know which units shall be equipped with an energy recovery device.
- .2 Unit shall be equipped with an AHRI 1060 certified synthetic media heat wheel for air-air recovery of latent and sensitive energy, complete with seals, motor, drive belts, and bypass flaps with integrated electric actuators for operation of the unit in free cooling. The recovery wheel should be covered with silica gel permanently bonded to the matrix. This desiccant should be designed for use in high humidity conditions. The thermal wheel is controlled by the unit controller through factory installed sensors which measure the outside air temperature, the return air temperature, the temperature of the air leaving the side wheel exhaust air temperature at the outlet of the impeller on the supply side. The wheel bearings shall have a L-10 400,000-hour useful life. The wheel should be mounted in a sliding frame for easy maintenance from the unit access panels. The impeller shall have a fixed bleed which allows control of air transfer between the exhaust air and the outside air supply. All components of the wheel must have received anti-corrosion treatment.
- .3 Unit shall prevent the formation of frost on the thermal wheel by modulating the speed of rotation of the wheel thanks to a variable frequency drive managed by the controller of the unit. The unit shall also be able to modulate the capacity of the heat wheel according to needs.
- .4 Unit shall be equipped with 50-mm (2-in.) MERV8 type filters on outside air and exhaust air. These filters protect the wheel and ensure optimal operation. Unit shall have hinged access doors for replacing filters.

2.9 COOLING SYSTEM

- .1 Heat pump type unit. All pieces of equipment, such as evaporator, condenser, compressors, and refrigerant circuit, are designed to be operated like a heat pump.
 - .1 Refrigerant circuit contains a 4-way reversing valve to be able to provide heat.
 - .2 Outdoor coil includes an electronic expansion valve control to control the refrigerant flow during the operation of the heat pump.

June 30, 2020

- .3 The unit controller modulates the expansion valve to keep the compressor running within the compressor operating range.
- .2 Energy Performance: Greater than or equal to that prescribed by ASHRAE 90.1 Standard.
- .3 Cooling Coils: Aluminum "microchannel" type. Manufactured and factory tested in accordance with ASHRAE 33 and AHRI 410 Standards; multiple refrigerant circuits, seamless copper collectors with connections assembled by soldering (strong soldering) and galvanized steel chassis. Coils shall have a minimum operating pressure of 2,070 kPa (300 psig) and be factory tested at 3,105 kPa (450 psig) and 2,070 kPa (300 psig) underwater. Design allowing operation up to an air speed of 0.38 m / s (75 ft / min.).
- .4 Compressors: Hermetic scroll compressors, fitted with built-in vibration isolators and crankcase heaters that turn off when the compressors are running; fitted with thermal relief valves, filter driers, and sight glasses.
 - .1 Minimum number of compressors: One.
 - .2 Refrigerant: R-410A.
 - .3 Quantity and type of compressor: A variable speed compressor, using "Inverter" technology or a variable frequency drive.
 - .4 Isolating valves for maintenance and isolating valves on liquid and suction pipes.
 - .5 Compressor(s) fitted with low pressure cut-off protection: manual reset after three (3) automatic reset failures.
 - .6 Compressor(s) fitted with high pressure cut-off protection with manual reset.
 - .7 Compressor(s) with motor overload protection with manual reset.
 - .8 Compressor(s) with immobilizer protection: Prevents a compressor from restarting within five (5) minutes of stopping.
- .5 Expansion Valve: Electronically controlled expansion valve. The unit controller shall control the expansion valve to maintain the cooling of the liquid and the overheating of cooling system.
- .6 Condenser: Integrated into unit.
 - .1 Envelope: With removable panels for access to controls, drip holes for water drainage, and fixing holes in the base.
 - .2 Refrigeration circuit shall have brass isolation valves for maintenance, fittings and instrument sockets that come out of the enclosure.
 - .3 Packaged condenser coil of microchannel type made only of aluminum.
 - .4 Fan: Variable speed, aluminum helical type, directly coupled to a brushless electronic communication motor (ECM), greased for life, with built-in protection against thermal overloads.
 - .5 Unit shall be fitted with a condenser protection screen of anti-vandal type. Screen shall be able to be easily removed for cleaning and inspection of the condenser heat exchanger.
 - .6 Cooling system shall be able to control the pressure in order to maintain a mechanical operation of the compressor to a minimum of -18°C (0°F).

June 30, 2020

- .7 Modulating Heating with Hot Gases ("Hot Gas Reheat").
 - .1 Heating coil of hot gas modulating, entirely in aluminum, is provided for the control of dehumidification.
 - .1 Hot gas reheating coil includes an aluminum tube micro-channel with a design of high-efficiency brazed aluminum fins to ensure optimal heat transfer.
 - .2 Modulating reheating battery provides temperature and humidity control to maintain required space conditions.
 - .3 Controls for the operation of modulating heating using hot gases are integrated into the unit. The heating coil is activated whenever dehumidification is required without using additional energy from the backup heater, being the electric heating coil.

2.10 DRIP BASINS

- .1 Materials: Stainless steel.
- .2 Drainage tanks with a 1.5% double slope.
- .3 Provide, in each basin, a drainage connection with threaded end installed laterally at the low point of each of the basins. Design panels so that the drainage opening can be connected from the outside of the unit.
- .4 Install drip pans in the following section:
 - .1 Section of the cooling coil.

2.11 DAMPERS

- .1 Insulated dampers shall be parallel blades with airtight construction with side trim to allow sealing of 7.5 l / s / m^2 (1.5 pcm / ft^2) of shutter at a differential pressure of 250 Pa (1 in. H₂O) as prescribed by the test method defined in AMCA 500 Standard.
- .2 Each unit shall be fitted with a bird screen in the fresh air intake section.
- .3 The shutter shall be equipped with a modulating actuator with direct connection and return spring.

2.12 ANTI-VIBRATION DEVICES

- .1 Flexible connection sleeves to install at the inlet and outlet of each fan unit, according to Section 23 33 00.
- .2 Anti-vibration mounts to be installed under each fan unit with seismic devices, according to Section 23 05 48.

2.13 CONTROL AND SAFETY DEVICES

- .1 Internal controller capable of independently controlling the unit or via the building's EMS. Include all control devices allowing autonomous operation.

June 30, 2020

- .2 Control panel shall be complete and include the following:
 - .1 BACnet MS / TP communication card;
 - .2 Contactors;
 - .3 Transformers;
 - .4 Protections;
 - .5 Terminal block;
 - .6 All equipment necessary for the proper functioning of the unit.
- .3 Physical control points:
 - .1 Stop / start.
- .4 Control devices supplied with the unit, installed and connected by the Integrated Automation Contractor:
 - .1 Supply air duct temperature sensor.
- .5 Control of the following points via BACnet MS / TP communication:
 - .1 Air supply setpoint;
 - .2 Modulation of fan speed;
 - .3 Alarms.

2.14 ELECTRICAL SUPPLY

- .1 All electrical components: CSA or CUL approved.
- .2 Each unit shall be provided with a single electrical connection with padlockable, fuseless disconnect, factory fitted to the unit.
- .3 Unit shall be equipped with a 115-V service outlet. The electrical supply to this outlet shall be made separately at the site.
- .4 Unit shall be equipped with a loss, an inversion, and a phase imbalance monitor installed and connected at the factory.

2.15 CAPACITIES AND CHARACTERISTICS

- .1 See the roof unit schedule shown on drawings.

2.16 GUARANTEES

- .1 Warranty of the unit shall respect the indications of the general conditions.
- .2 Compressors of the unit shall be guaranteed for five (5) years.

June 30, 2020

Part 3 EXECUTION**3.1 EXAMINATION**

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

3.2 INSTALLATION

- .1 Provide appropriate protection and security apparatuses.
- .2 Install devices in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.

3.3 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

3.4 DRIP PANS

- .1 Install deep seal P-traps on drip lines.
 - .1 Depth of water seal to be 1.5 times static pressure at this point.

3.5 START-UP

- .1 A service representative approved by the Manufacturer shall perform the start-up. Allow a minimum of four (4) hours of start-up per unit.
- .2 Perform installation and start-up checks in accordance with manufacturer's written instructions.
 - .1 Verify that the refrigerant charge is sufficient and that the cooling circuit has been subjected to a leak test.
 - .2 Check the compliance of the installation.
 - .3 Verify that actuators are functional.
 - .4 Verify that motors and fans are rotating in the correct direction.
 - .5 Check the vibration level of the fans.
 - .6 Check and record the performance of equipment protection devices.

June 30, 2020

- .7 Test and adjust control and safety devices. Replace damaged or defective controls and equipment.
- .8 Make all necessary adjustments to achieve the performance expected by the designer.
- .3 Inspect components assembled on site, installation of equipment, as well as piping and electrical connections.
- .4 Prepare test and start-up reports with data taken on site. Give a copy of the French report to the Departmental Representative.
- .5 The manufacturer must cooperate fully to allow the integration of the equipment into the centralized building control system. Allow a four (4) hour overtime site visit for coordination with the Division 23 contractor.
- .6 At the request of the Departmental Representative, measure vibration levels on fans as well as on the machine housing according to ISO 10816-1. The technician responsible for taking measurements shall be certified Category 2 in accordance with technical requirements of ISO 18436-2 Standard. Provide a report indicating location of the measuring points in the machines as well as an analysis of the vibration level of components under study of the machine.

3.6 CLEANING

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for humidifiers, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate project layout, dimensions, and extent of humidification system.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Spare Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing, or replacing, for inclusion into operating manual.

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 HUMIDIFIERS**

- .1 Certified Devices:
 - .1 ANSI / NFPA 70 - National Electric Code.
 - .2 ARI 640, Standard for Commercial and Industrial Humidifiers.
 - .3 ASHRAE SSPC 135 BACnet.
 - .4 CSA certified and ULC listed.
 - .5 ISO 9001-2008.
- .2 Elements assembled in a factory-made enclosure, coated with finishing enamel paint also applied at the factory and fitted with an electrically locked door.
- .3 One-piece type steam generator incorporating resistive element technology with the following characteristics:
 - .1 Double magnetic electronic float system located outside of boiling water to ensure precise control of the water level and reduced maintenance. Systems using conductivity probes or floats located in a hot tank are not acceptable;
 - .2 Modulation of the flow between 3% and 100% of its nominal capacity;
 - .3 Control accuracy up to $\pm 1\%$ RH using an optional SSR and a high precision humidistat with adjustment every two (2) seconds;
 - .4 Microprocessor-controlled water inlet and outlet valves for automatic water management;
 - .5 An internal drainage water cooler ensuring a maximum temperature of 60°C. The external drainage water cooler is not acceptable;
 - .6 An integrated filling cup with air gap of at least 25 mm preventing return by siphoning;
 - .7 304 stainless steel tank;
 - .8 Resistive heating elements based on Incoloy 825 for steam production;
 - .9 16-gauge steel cabinet coated with acrylic enamel, fitted with a stainless-steel drip tray with drainage connection;
 - .10 Cabinet with durable powder coating with no clearance required on sides;
 - .11 Insulated compartments for plumbing and electrical components enclosed in an 18-gauge metal housing powder coated and including a 20-gauge metal door. The modular plumbing and electrical components shall be fully assembled and pre-wired (shall not require any assembly on site);
 - .12 A display of the remote operating management system messages indicating operating status, errors, and warnings;
 - .13 Automatic shutdown out of season (after 3 days of "no call") will completely empty the boiling tank and automatically restart on humidity;
 - .14 An automatic pulsation cleaning device to eliminate any obstruction of the solenoid drain valve;
 - .15 Self-diagnosis during system startup to prevent inadvertent operation of the unit(s):
 - .1 Check the filling valve;

- .2 Checking the floating level;
- .3 Verification of the drain pump.
- .16 Display of total operating time and actual operating time (e.g. 2 hours of operation at 50% of capacity = 1 hour of total use);
- .17 Water level detector preventing overflows during filling;
- .18 Proven effectiveness over a wide range of water conditions;
- .19 Simple and quick maintenance without dismantling or moving the humidifier and without using special tools;
- .20 Bottom drainage ensuring maximum removal of minerals. Surface skimmers are to be avoided;
- .21 Patented removable lime management system prevents lime from becoming permanently encrusted on the resistive elements and allows lime to be evacuated from the tank. Drain pump placed above the limestone collector to allow deposits to fall into the receptacle. System for removing the receptacle for emptying without having to open the device and remove the tank. Limestone management guarantees extremely short maintenance times and a long operating life or (For model without limestone management) Water softener upstream of the humidifier. Large perforated strainer on the drain to prevent blockage of the faucet and drainage piping;
- .22 Connection of primary power supply without tools;
- .23 The cabinet will be supplied with support for wall installation;
- .24 30-month warranty on parts following delivery date;
- .25 Standard "Keep warm" function for faster response time;
- .26 Optional extended fill cup for operations up to 10 in. water column;
- .27 Detection and correction of fluctuations in outdoor conditions to improve the accuracy of humidity during sudden temperature changes and during season changes;
- .28 Standard foam detection system and disposal by total drainage when necessary;
- .29 OSHPD certification in accordance with seismic requirements.
- .4 Control / Regulation Devices.
 - .1 An integral microprocessor control system with the following characteristics:
 - .1 Intuitive touchscreen control and color graphical user interface;
 - .2 BACnet MSTP communication system;
 - .3 USB interface for new software / new function for downloading operational information;
 - .4 Accepts a single or dual analog signal capable of supporting a probe or controller signal. Able to control setpoints from the humidifier using probes.

- .5 Steam diffusion device directly to the room (For kennel only):
 - .1 Set of a diffusion fan, a vapor dispersion nozzle, and condensate basin, from the same manufacturer as the steam generator. Designed for operating an atmospheric type steam generator. The diffusion device shall be installed separately from the steam generator (see drawings for more information concerning the installation distances between the two (2) items). The diffusion device is supplied with:
 - .1 A fan powerful enough to cover the entire area of the room served (see drawings for more information). The fan has two (2) speeds (low and high), which can be controlled via the steam generator control interface.
 - .2 A filter to prevent the accumulation of dog hair and other contaminants on the vapor dispersion nozzle as well as on the fan.
 - .3 Power supply for the vapor diffusion device shall come from the steam generator. The electric cable is supplied with the humidifier and installed by Division 26.
 - .4 The control commands for the vapor diffusion device shall come from the steam generator. The automatic control cable is supplied with the humidifier and installed by Division 23.
- .6 Steam injection distributors (For the hangar):
 - .1 Distributor from the same manufacturer as the steam generator.
 - .2 Monotube, multitube or pre-assembled multitube valves.
 - .3 Distributor including the following:
 - .1 Stainless-steel vapor separator; separation by centrifugal force eliminating condensation water. Holes of adequate diameter and in sufficient quantity for each specific application;
 - .2 Round stainless-steel injection tube of the "tube in a tube" type allowing the surface of the tube to be 100% preheated by steam, ensuring humidification steam without condensation water;
 - .3 Steam inlet control valve, modulating type, with 0 10 V DC or 4-20 mA signal;
 - .4 Filter with removable screen;
 - .5 Steam trap for condensation water.
 - .4 Accessories: Temperature switch.
 - .5 In case of pre-assembled multitube type, all tubes and separators shall be pre-assembled and connected to a manifold at the factory. Everything shall be ready to be installed on site.
 - .6 Characteristics: As indicated in the distributor schedule shown on drawing.

Part 3 Execution**3.1 EXAMINATION**

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

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 When project is accepted, humidifier and evaporator media to be new and clean.
- .3 Install humidistat as indicated.
- .4 Water service overflow drain: As indicated.
- .5 Install access doors or panels in adjacent ducting.
- .6 When installing in ducting, provide impervious duct up and downstream in accordance with Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.
- .7 Install female capped drain connection at low point in duct.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer shall make recommendations and periodic site visits to verify if installation has been realized according to his 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 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within three (3) days of review, and submit immediately to Departmental Representative.
- .2 Performance Verification (PV):
 - .1 General: In accordance with Section 01 91 13 - General Commissioning (CX)
Requirements: General Requirements, supplemented as specified.

- .2 At moment of execution:
 - .1 After TAB of ducted air systems.
 - .2 At same time as PV of related air handling units.
- .3 Start-up:
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (CX)
Requirements: General Requirements, supplemented as specified.
- .4 The manufacturer must fully cooperate to allow the integration of the equipment into the centralized building control system. Allow a 4-hour site visit for coordination with the Division 23 Contractor.
 - .1 Verify:
 - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
 - .2 Vapor lines and manifolds are sloped to ensure condensate is drained away from the duct system.
 - .3 Visually check distribution manifold to ensure:
 - .1 Even distribution of vapor;
 - .2 Freedom from water deposits.
- .5 Commissioning Reports:
 - .1 General: In accordance with Section 01 91 13 - General Commissioning (CX)
Requirements: reports, supplemented as specified. Include:
 - .1 PV results on approved PV Report Forms;
 - .2 Product Information Report Forms.

3.4 DEMONSTRATION

- .1 Training: In accordance with Section 01 91 13 - General Commissioning (CX) Requirements:
Training of O&M Personnel.

END OF SECTION

DIVISION 25

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems, and Automation Society (ISA).
 - .1 ANSI/ISA 5.5, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).
 - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE STD 135, BACnet - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-FM89(C1995), Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
 - .1 CEA-709.1, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA).
 - .2 Canadian Environmental Protection Act (CEPA).
- .7 Health Canada - Workplace Hazardous Materials Information System (WHMIS).
 - .1 Data Sheets (DS).
- .8 Transport Canada (TC).
 - .1 Transportation of Dangerous Good Act (TDGC), c. 34.

1.3 CONTRACTOR

- .1 The EMCS Contractor must have a minimum experience of 5 years in automatic controls and a related experience in the installation of digital control systems.

- .2 Only the following contractors can submit a quote:
 - .1 Original equipment manufacturers or authorized distributors carrying the complete line of equipment required for the job;
 - .2 Who have as main activity the supply, the installation, and commissioning of digital control systems;
 - .3 Having qualified technicians able to answer a service call 24 hours a day, 365 days a year.

1.4 SYSTEM DESCRIPTION

- .1 Refer to drawings for system architecture.
- .2 The above-mentioned Section aim at the modification of the existing system. The system in place must include the following, but limited to:
 - .1 Building controllers;
 - .2 Control devices as listed in I/O point summary tables;
 - .3 Data communications equipment necessary to EMCS data transmission system;
 - .4 Field control devices;
 - .5 Software/Hardware complete with full documentation;
 - .6 Complete operating and maintenance manuals, on-site training of operators, programmers, and maintenance staff;
 - .7 Staff training;
 - .8 Acceptance tests, technical support during commissioning, full documentation;
 - .9 Wiring interface co-ordination of equipment supplied by others;
 - .10 Miscellaneous work as specified in other Sections and as indicated.
- .3 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of all types to meet project requirements. Number of measuring points and their content to be reviewed by Engineer prior to installation.
 - .3 Location of controllers to be reviewed by Departmental Representative prior to installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS, as indicated.
- .4 Display and Operation Language:
 - .1 Provide passwords to use the system in English or in French, depending of case.

1.5 COMMISSIONING

- .1 Confirm with the Departmental Representative that Design Criteria and Design Intents are still applicable.

- .2 Do commissioning as prescribed.
- .3 Do commissioning under the Departmental Representative's supervision.
 - .1 Inform the Departmental Representative in writing, at least five (5) days before the start of commissioning or prior to each test, in order to get his approval.
- .4 Test each system independently and then in unison with other related systems.
- .5 Correct deficiencies and re-test until satisfactory results and performance are obtained.
- .6 Acceptance of tests will not relieve Contractor from his responsibility to ensure that complete systems are complying with requirements of the Contract.
- .7 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intent.
- .8 Demonstrate to Departmental Representative the operation of the systems, including control sequences in normal and emergency modes, as well as in normal and emergency modes, and the start/stop, interlocks, and prohibitions causing stops.
- .9 Provide a written commissioning report stating that each system operates as per Design Criteria.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review:
 - .1 Data sheets of equipment used.
 - .2 Controls schematics, materials lists, sequences of operation, and points lists.
- .3 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to Standards quoted plus any additional specified requirements.
 - .2 Where CSA certified equipment is not available, submit proposed equipment to approval of inspection authorities prior to delivery on site.
 - .3 Submit proof of compliance to specified Standards with shop drawings and data sheets. Label or listing of specified organizations is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by Engineer, certifying that the material was tested in accordance with their test methods and that item complies with their Standards/Code.
 - .5 For materials whose compliance is not regulated by organization using its own listing or label as proof of compliance, provide certificate stating that material complies with applicable referenced Standard or Specification.
 - .6 Permits and fees: In accordance with general conditions of Contract.

- .7 Submit an acceptance certificate provided by the competent authority to the Departmental Representative.
- .8 Existing devices intended for re-use: Submit test report.

1.7 TRAINING

- .1 Provide the required training for a complete comprehension of the system. Required training for this contract is 8 hours.
- .2 Provide required material for training.
- .3 Coordinate training with the Departmental Representative for required dates and staff to train.
- .4 Submit training content for approval to the Departmental Representative.

1.8 QUALITY ASSURANCE

- .1 Have local office within 100 km of project, staffed by trained personnel capable of providing EMCS training, routine maintenance, and emergency service on system.
- .2 Provide record of successful previous installations of similar computer systems.
- .3 Have access to local supplies of essential parts and provide 7-year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work, and attend site meetings.

1.9 IDENTIFICATIONS

- .1 Nameplates for Panels.
 - .1 Nameplates: Plastic laminate, 3 mm ($\frac{1}{8}$ in.) thick, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
 - .2 Sizes: 25 x 67 mm (1 in. x 2½ in.) minimum.
 - .3 Lettering: Minimum 7 mm ($\frac{9}{32}$ in.) high, black.
 - .4 Inscriptions: Machine engraved, indicating function of panel.
- .2 Nameplates for Field Devices.
 - .1 Field devices to be identified by means of a plastic or metallic card held by a chain.
 - .2 Sizes: 50 x 100 mm (2 in. x 4 in.) minimum.
 - .3 Lettering: Minimum 5 mm ($\frac{3}{16}$ in.), black, engraved and indelible.
 - .4 Cabinet: Identify interior components using plastic enclosed cards with point name and point address.
 - .5 Identifications used must be same as those appearing in control diagrams.

- .3 Wiring Identification.
 - .1 Supply and install numbered tape markings on wiring, panels, junction boxes, splitters, cabinets, and outlet boxes.
 - .2 Colour coding: To CSA C22.1. Use colour coded wiring in communication cables, matched throughout system.
 - .3 Cables without conduit must be orange or bear a marking of this color.
 - .1 Power wiring: EMCS circuit breakers must be identified.
- .4 Conduit Identification.
 - .1 All conduits, junction boxes, and connections of the EMCS must be identified with an orange color marker.
- .5 Existing Panels.
 - .1 Correct existing identifications to show changes made to the system.

1.10 WARRANTY

- .1 All software, equipment, and systems provided by the manufacturer must be warranted against material and manufacturing defects for one (1) year from date of acceptance of the project.
- .2 Provide services, materials, and equipment to maintain EMCS during specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .3 Emergency Service Calls:
 - .1 Initiate service calls each time EMCS is not functioning properly.
 - .2 During period of Contract, qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost for Departmental Representative.
 - .3 Perform work continuously until EMCS is restored to reliable operating condition.
- .4 Work Requests: Record each service call request on approved form, including:
 - .1 Location, date, and time of call received;
 - .2 Nature of trouble;
 - .3 Names of personnel assigned;
 - .4 Quantity and type of materials used;
 - .5 Date and time of work start and completion.

1.11 O & M MANUALS

- .1 Custom design Operation and Maintenance (O&M) Manuals (both hard and soft copies) to contain material relevant to this project only; and must provide full and complete coverage of subjects referred to in this Section.

- .2 O&M Manuals must be exhaustive. They must include complete coverage in concise language, readily understood by operating personnel, using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics, or in-depth theoretical knowledge.
- .3 Manuals to include:
 - .1 Controls schematics, including existing equipment related to modified systems.
 - .2 Material and points lists.
 - .3 Control sequences.
 - .4 Equipment maintenance record.
 - .5 Specific procedures: Restarting, alarms reception, printing, etc.
 - .6 Informations related to licences: Version, certificates, and updating procedures.

1.12 INTEGRATION OF DOCUMENTS TO WORKSTATION

- .1 All information related to the system to be provided in soft copy and integrated by the Contractor to the central station and the workstations. This information must include:
 - .1 Complete software used to create the database;
 - .2 Updated back-up copy of the database;
 - .3 System operation manual;
 - .4 Spec sheets of the material used;
 - .5 Controls schematics in a format that can be viewed by the operator;
 - .6 Departmental Representative's drawings in PDF format.

1.13 WORK IN EXISTING INSTALLATIONS

- .1 If work is to be done in existing building, integrate system modifications to Departmental Representative's documents, soft and hard copies, in order to update them.
- .2 Incorporate to existing documents all modifications to control system, while keeping information relevant to existing equipment still in use.

1.14 EXISTING CONTROL/REGULATION DEVICES

- .1 Collect existing control/regulation devices that will not be reused or are unnecessary. Store them in an approved storage area, in order to dispose of them as per instructions.

Part 2 Products

2.1 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: To ASHRAE STD 135.

- .2 Complete list of equipment to be used in work, which list is part of tender documents, by adding manufacturer's name, model number, and details related to manufacturing materials of each equipment, and submit for approval.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: To manufacturer's recommendations.

3.2 PAINTING

- .1 Perform painting in accordance with the following requirements:
 - .1 Clean and retouch surfaces that were scratched so that they have the same original finish;
 - .2 Where retouches are not sufficient, a complete reconditioning (primer coat and finishing coat) of the damaged surfaces is required;
 - .3 Clean and use a primer coating on visible elements, such as supports, fasteners, chassis of equipment, and any other fixing devices;
 - .4 Paint all unfinished material installed indoor.

END OF SECTION

Part 1 General**1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C2, National Electrical Safety Code.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Departmental Representative s (ASME).
 - .1 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .3 American National Standards Institute (ANSI)/National Fire Protection Association (NFPA).
 - .1 ANSI/NFPA 70, National Electrical Code.
- .4 Canadian Standards Association (CSA)/CSA International.
 - .1 CSA C22.1, Canadian Electrical Code, Part 1.
 - .2 CSA C22.2, Canadian Electrical code, Part 2.
 - .3 CAN/CSA C22.3 No. 1, Overhead Systems.
 - .4 CAN/CSA C22.3 No. 7, Underground Systems.
 - .5 CSA 22.2 No. 45, Rigid Metal Conduits.

1.2 SYSTEM DESCRIPTION

- .1 Electrical Equipment:
 - .1 Provide power wiring from existing power and emergency panels or provided by the Electrical Contractor to EMCS field panels. Circuits shall be reserved exclusively for EMCS equipment. Panel switches shall be labeled and existing contacts locked. Each panel shall include an identification legend of the various circuit breakers.
 - .2 Hardwiring between field control devices and EMCS field panels.
 - .3 Communication wiring between EMCS field panels and OWS, including climate control centre.
 - .4 Modify existing starters to provide for EMCS, as indicated in I/O Summaries and as indicated.
 - .5 Refer to wiring diagrams included as part of flow diagrams. Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by Departmental Representative prior commencing work.
- .2 Mechanical Equipment:
 - .1 Pipe taps required for EMCS equipment will be supplied and installed according to the applicable Sections (EMCS Contractor guideline).
 - .2 Wells and control valves shall be supplied by EMCS Contractor and installed according to the applicable Sections (EMCS Contractor guideline).

- .3 Installation of air flow stations, dampers, and other sheet metal devices to be installed according to the applicable Sections.
 - .3 VAV Terminal Units:
 - .1 Air flow probe for VAV boxes to be supplied and installed. Air flow "dp" sensor, actuator, and associated VAV controls to be supplied and installed by EMCS Contractor. Tubing from air probe to "dp" sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS Contractor. Coordinate air flow adjustments with balancing trade.
 - .4 Structure:
 - .1 Any metal construction as required for installation of work.
- 1.3 PERSONNEL QUALIFICATIONS**
- .1 Qualified supervisory personnel to:
 - .1 Continuously direct and monitor all work.
 - .2 Attend all site meetings.
- 1.4 EXISTING CONDITIONS**
- .1 Opening and Resurfacing: Refer to prescriptions hereafter.
 - .2 Repair all surfaces damaged during execution of work.
 - .3 Submit to Departmental Representative's existing equipment and material removed from work which are not meant to be recovered.
- Part 2 Products**
- 2.1 SPECIAL SUPPORTS**
- .1 Structural grade steel, primed and painted after construction, but before installation.
- 2.2 WIRING**
- .1 As per requirements of Division 26.
 - .2 For 70 V and above: Copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600 V. Colour code to CSA 22.1.
 - .3 For wiring under 70 V: Use FT6 conductors if not conveyed in a conduit. In any other cases, use FT4 conductors.
 - .4 Sizes:
 - .1 120 V power supply: To match or exceed existing breaker, size #12 minimum.

- .2 Wiring for safeties/interlocks for starters, motor control centres: To be stranded, #14 minimum.
- .3 Field wiring to digital device: At least 20 AWG stranded twisted pair, and as per application.
- .4 Analog I/O: At least shielded #20 minimum stranded twisted pair. Wiring shall be continuous without joints.
- .5 Terminations:
 - .1 Screw connectors suitable for conductor rating and number of terminations planned.

2.3 CONDUITS

- .1 As per requirements of Division 26.
- .2 Conduits shall have a minimum of 20 mm (0.79 in) diameter.
- .3 Electrical metallic tubing to CSA C22.3. Flexible and liquid tight flexible metal conduit to CSA C22.2. Rigid steel threaded conduit to CSA C22.2 No. 45.
- .4 Junction and Pull Boxes: Welded steel.
 - .1 Surface mounting cast FS: Screw-on flat covers.
 - .2 Flush mounting: Covers with 25 mm (1 in.) minimum extension all round.
- .5 Cabinets: Sheet steel, for surface mounting, with hinged door, latch lock, two (2) keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions or all panels part of the Contract, as agreed.
- .6 Outlet Boxes: 100 mm (4 in.) sideways minimum, square.
- .7 Moulded Boxes, Fittings:
 - .1 Bushings and connectors: With nylon insulated throats.
 - .2 With push pennies to prevent entry of foreign materials.
- .8 Fittings for Rigid Conduit:
 - .1 Steel couplings and fittings: Threaded type.
 - .2 Double locknuts and insulated bushings: Use on sheet metal boxes.
 - .3 Use factory "ells" where 90° bends required for 25 mm (1 in.) and larger conduits.
- .9 Fittings for Thin Wall Conduit:
 - .1 Steel connectors and couplings: Set screw type.

2.4 RECEPTACLES, COVER PLATES

- .1 Complying with relevant CSA Standards.

- .2 Receptacles:
 - .1 Duplex: CSA type 5-15R.
 - .2 Single: CSA type 5-15R.
 - .3 Cover plates and blank plates: Finish to match other plates installed in area.

2.5 SUPPORTS FOR CONDUIT, FASTENINGS, AND EQUIPMENT

- .1 Solid Masonry, Tile, and Plastic Surfaces: Lead anchors or nylon shields.
 - .1 Hollow masonry walls, suspended drywall ceilings: Toggle bolts.
- .2 Exposed Conduits or Cables:
 - .1 50 mm (2 in.) diameter and smaller: One-hole steel straps.
 - .2 Larger than 50 mm (2 in.) diameter: Two-hole steel straps.
- .3 Suspended Support Systems:
 - .1 Individual cable or conduit runs: 6 mm (¼ in.) diameter threaded rods with clamp.
 - .2 Two or more suspended cables or conduits: Stirrups on threaded suspension rods of 6 mm (¼ in.) diameter.

Part 3 Execution

3.1 INSTALLATION

- .1 Install equipment and components so that manufacturer's and CSA labels are visible and legible after commissioning is completed.
- .2 Pass-through Conduits:
 - .1 All wiring shall be installed in EMT conduits:
 - .1 In exposed areas, mechanical and electrical rooms.
 - .2 In gypsum ceilings and other unattainable ceilings.
 - .3 Masonry walls.
 - .2 In suspended ceilings, protected multi-strand cables can be installed without conduit if properly affixed to structure.
 - .3 Use rigid conduits and weatherproof joints for conduits installed outside the building.

3.2 OTHER SUPPORTS

- .1 Install required special supports, as indicated.

3.3 ELECTRICAL NETWORK - GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 ANSI C2 Standard;

- .2 ANSI/NFPA 70 Standard;
- .3 CSA 22.1, Canadian Electrical Code;
- .4 Division 26 - Electrical and prescribed in this Section.
- .2 Fully enclose or properly protect electrical wiring, terminal blocks, high voltage above 70 V contacts, and properly identify to prevent accidental injury.
- .3 Do underground installation to CAN/CSA C22.3 No. 7, except otherwise specified.
- .4 Complying with manufacturer's recommendations for storage, handling, and installation.
- .5 Check factory-made connections and joints. Tighten where necessary to ensure electrical continuity.
- .6 Install electrical equipment between 1,000 (39 in.) and 2,000 mm (78 in.) above finished floor, wherever possible, and close to related equipment.
- .7 Protect exposed live equipment such as panel, mains, and outlet wiring during construction for life safety.
- .8 Shield and identify live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: Flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes, and other structural work required to install electrical conduit, cable, pull boxes, and outlet boxes.
- .12 Install cables, conduits, and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.4 CONDUIT SYSTEM

- .1 Install telecommunication cables in conduits.
- .2 Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and allowing future expansion capabilities of system. Maximum conduit fill-up not to exceed 40%. Design drawings do not show conduit layout.
- .3 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .4 Do not run exposed conduits in normally occupied spaces, unless otherwise indicated or impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors and allowing future expansion capabilities, as prescribed in specifications.

- .5 Locate conduits at least 150 mm (6 in.) from parallel steam or hot water pipes and ducts installed parallel to the latter, and at least 50 mm (2 in.) at crossovers.
- .6 Bend conduit so that diameter is reduced by less than $\frac{1}{10}$ th original diameter.
- .7 Field thread on rigid conduit carried out on-site to be of sufficient length to give tight joints.
- .8 Limit conduit length between two pull boxes to less than 30 m (98 ft.).
- .9 Use outlet boxes for conduit up to 32 mm (1¼ in.) diameter and pull boxes for larger sizes.
- .10 Use flexible conduits to make the transition between control elements and the EMT conduits. Flexible conduits shall not exceed 500 mm (20 in.) in length.
- .11 Fastenings and supports for conduits, cables, and apparatus:
 - .1 Provide brackets, frames, hangers, clamps, and similar types of devices, as indicated and as required, to support cable and conduit runs.
 - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
 - .3 Use supports or equipment installed by other trades for conduit, cable, and raceway supports only after written approval from Departmental Representative.
- .12 Install polypropylene fish cord in empty conduits for future use.
- .13 Remove and replace blocked conduit sections.
- .14 Pass conduits through structural components only after receipt of Departmental Representative's written approval.
- .15 Conduits may be run in steel structural shapes.
- .16 Group conduits wherever possible on suspended or surface channels.
- .17 Pull Boxes:
 - .1 Install in inconspicuous, but attainable locations.
 - .2 Support boxes independently of connecting conduits.
 - .3 Fill boxes with paper or foam to prevent entry of construction material.
 - .4 Provide correct size of openings. Reducing washers not permitted.
 - .5 Mark location of pull boxes on project record drawings.
 - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .18 Install terminal blocks or strips indicated in cabinets according to Division 26.
- .19 Install bonding conductor for 120 V and above in conduit.

3.5 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: Use only qualified personnel. Demonstrate that:
 - .1 Circuits are continuous, free from short-circuits or ground faults.
 - .2 Resistance to ground of all circuits is inferior to 50 Megohms.
- .5 Provide Departmental Representative with test results showing, among others, locations and circuits.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct contact with compression screw.
- .9 Install all strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.6 RECEPTACLES AND COVER PLATES

- .1 Receptacles:
 - .1 Install vertically in gang type outlet box when more than one (1) receptacle is required in same location.
- .2 Cover Plates:
 - .1 Install suitable common cover plate where wiring devices are grouped.
 - .2 Use flush type cover plates only on flush type outlet boxes.

3.7 GROUNDING

- .1 Install complete, permanent, and continuous grounding system for equipment, including conductors, connectors, and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.

- .4 Tests: Perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.8 TESTING

- .1 Perform following tests, in addition to tests specified elsewhere in specifications.
 - .1 Preliminary tests:
 - .1 Conduct as directed to verify compliance with specified requirements.
 - .2 Make needed changes, adjustments, and replacements.
 - .3 Insulation resistance tests:
 - .1 Measure all circuits, feeders, and equipment for 120 - 600 V with 1,000 V megohmmeter. Ground resistance to be more than required by relevant Code before energizing.
 - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and Authority Having Jurisdiction.
 - .2 Give 14-day written notice prior to test.
 - .3 Conduct in presence of Departmental Representative and Authority Having Jurisdiction.
 - .4 Conceal work only after tests satisfactorily completed.
 - .5 Report results of tests to the Departmental Representative in writing.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 25 05 01 - EMCS: General Requirements.
- .2 Section 25 30 02 - EMCS: Field Control Devices.
- .3 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
 - .1 C22.2 No. 205, Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
 - .1 Document 25 00 05, Energy Monitoring and control Systems (EMCS) Design Guidelines (Available upon request).

1.3 ACCEPTABLE PRODUCTS

- .1 Products from the following manufacturer are accepted and must comply with BACnet Standards:
 - .1 Alerton (VCI).

1.4 NETWORK ARCHITECTURE

- .1 Drawings show minimum network architecture required, especially regarding the number of master controllers (MCU or NCU).
- .2 If additional controllers are required due to the nature of a vendor's controllers, the vendor will need to coordinate with other disciplines to provide for the required network outlets and power supply. The necessary modifications will be at his expense.
- .3 Submit proposed architecture with bid, indicating and highlighting elements where the proposal differs from specified architecture.
- .4 Specific Cases: Connection of TCUs and elements provided by other.

- .5 Integrated equipment controls (VFDs, humidifiers, etc.) shall be connected to the subsystem of the system to which they are attached.
- .6 Input-output modules (DRIL) shall be in the same enclosure as the processor controlling them.

1.5 DESCRIPTION OF CONTROLLERS

- .1 A network of controllers using MCUs (or NCU), LCUs, and TCUs shall be provided in accordance with the architectural system schematic. This network shall be compatible with building systems and related operation sequences described in this Section.
 - .1 Provide sufficient controllers to meet intents and requirements of this Section.
 - .2 Controller quantity and point contents to be approved by Departmental Representative during preliminary design review.
- .2 Controllers: Standalone intelligent control units. They shall:
 - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
 - .2 Be provided with communication interface ports for communication to LANs to exchange information with other controllers.
 - .3 To be connected to operator interface device.
 - .4 Execute their logic and control using their primary inputs (inputs and outputs in direct interaction) directly connected to their onboard input/output field terminations or slave devices, without need to interact with another controller; secondary input used for resetting, such as outdoor temperature, may be located on the other controllers.
 - .1 Secondary input used for resetting, such as outdoor temperature, may be located on other controllers.
- .3 A connection via the network shall allow remote connection. Network jacks are provided as shown in the architecture diagram. If more outlets are required to provide access to the system according to specifications, they will be at the expense of the Division 25 Subcontractor.
- .4 The objective, in terms of access, is to allow a portable computer equipped with graphics software to be plugged into each room where are located master controllers, within a radius of 15 m from each control.

1.6 DESIGN REQUIREMENTS

- .1 Controllers shall be able to execute the following functions:
 - .1 AI and DI inputs scanning for detection of change of value and processing alarms;
 - .2 "Go-No Go" digital control of connected points, including resulting required states, generated through programmable logic outputs;
 - .3 Analog control using programmable logic (including PID), with dead bands and adjustable deviation alarms;
 - .4 Control of systems, as described in sequence of operations;
 - .5 Optimization routines execution as listed in this Section.

- .2 Total spare capacity for MCUs and LCUs: At least 20% of each point type distributed throughout different MCUs and LCUs.
- .3 Control points within a building system shall reside into same controller. As well, a controller shall be used for each main ventilation system or network portion. Refer to network architecture.
- .4 Local Interfaces Connection Modules (LICM):
 - .1 To CSA C22.2 No. 205 Standard.
 - .2 LICM electronically connect sensors and regulators to the central unit.
 - .3 LICM shall include, but not be limited to:
 - .1 Microprograms or logic circuits designed to meet technical and functional requirements;
 - .2 Power supplies for logic devices and related equipment on site;
 - .3 In the event of transmission failures between the DRIL and the central unit, or failure thereof, controlled systems shall remain in or go into integrated security mode;
 - .4 Prescribed minimum number of analog and digital inputs and outputs for the I/O interface;
 - .5 Screw or plug-in connection terminals for wiring.
 - .4 Analog input interfaces shall:
 - .1 Make analog digital conversion with 10-bit analog digital definition;
 - .2 Receive signals having the following characteristics:
 - .1 4 to 20 mA;
 - .2 0 to 10 VDC;
 - .3 Temperature measuring probe thermistors 10 kohms.
 - .3 Comply with IEEE C37.90.1 - Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus;
 - .4 Weak signals greater than 60 dB at 60 Hz in common mode;
 - .5 Have certified precision resistors as required to supplement specified accuracy of sensors and transmitters.
 - .5 Analog output interfaces shall:
 - .1 Convert digital signals transmitted by the central unit to analog signals with a 10-bit digital analog resolution;
 - .2 Provide signals having the following characteristics:
 - .1 4 to 20 mA;
 - .2 0 to 10 VDC.
 - .3 Comply with IEEE C37.90.1 - Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus;
 - .6 Digital input interfaces shall:
 - .1 Be able to detect changes in state of field detection contacts and transmit result to the controller;

- .2 Comply with IEEE C37.90.1 - Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus;
- .3 Receive pulsed signals up to 2 kHz.
- .7 Digital output interfaces shall:
 - .1 Respond to output signals from the controller processor and switch them; switch output signals up to 0.5 A at 24 VAC;
 - .2 Be able of switching output signals up to 5 A at 220 VAC using an optional interface relay.
- .5 Controllers and related hardware and software can operate properly in a temperature range of 0 to 44°C (32°F to 111.2°F), and relative humidity, 20% to 90%, without condensation.
- .6 Each MCU controller shall be mounted in a NEMA 1 wall cabinet with hinged doors and have its own power supply.
 - .1 Top, bottom, or sides of cabinet shall have conduit entries.
 - .2 LCU and TCU controllers may be mounted in equipment cabinets or in separate enclosures.
 - .3 Submit mounting details of ceiling elements for approval.
- .7 Cabinets shall protect equipment from water dripping from the ceiling while being sufficiently ventilated to prevent overheating inside.
- .8 Interconnect wiring connections shall provide surge protection and brownout protection.
- .9 Provide the LICM to be able to connect a minimum of 20% additional points of each type in each control panel. Ensure that the processor and memory have sufficient capacity to accept these additional points.

1.7 SUBMITTALS

- .1 Make submittals.
 - .1 Submit product data sheets for each product proposed for this project.

Part 2 Products

2.1 MASTER CONTROL UNIT (MCU/NCU)

- .1 General: Primary function of MCU/NCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines, such as demand limiting or enthalpy control programs.
- .2 MCU shall include high-speed communication LAN Port for Peer-to-Peer communications with OWSs and other MCU level devices.
 - .1 MCU/NCU shall support BACnet/IP to the primary network and BACnet MS/TP to the subsystem.

- .3 Capacity input/outputs of MCU shall respect the following conditions:
 - .1 The I/O points of the CPU are allocated according to the I/O list or as indicated on drawings;
 - .2 LCUs may be added to support system functions;
 - .3 NCU have no input-output points. Points shown to be connected to an MCU shall be connected to separate LCUs dedicated to those points.
- .4 Central Processing Unit (CPU/NCU).
 - .1 Processor shall consist of minimum 16-bit microprocessor capable of supporting software meeting specified requirements.
 - .2 CPU idle time shall be 30% superior when system is configured to maximum input and output, and deal with the most unfavorable case of program execution.
 - .3 Minimum addressable memory to be at manufacturer's discretion. It shall, however, have sufficient capacity to fully meet all technical and functional requirements of specifications, and include a minimum of 25% of free space. This memory shall include, but not be limited to, the following:
 - .1 Non-volatile EEPROM containing operating system, executive, application, routine, other configuration definitions software;
 - .2 Battery backed RAM (72-hour minimum capacity) to reduce need to reload operating data in event of power failure), with enough capacity to contain CDLs, application parameters, and operating data or software required to be alterable by the operator, such as schedules, set points, alarm limits, PID constants, which may be directly alterable, on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
 - .4 CPU/NCU shall include an uninterruptible clock accurate to ± 5 secs/month, capable of deriving year/month/day/hour/minute/second, with accumulators providing a minimum of 72 hours of operation in event of power failure.
- .5 Local Operator Terminal (OT): For each MCU/NCU, provide at least one network port for connecting a portable terminal.
 - .1 OTs shall support workstations for local control input, display of current and histories data, and program additions and modifications.
 - .2 OTs shall display simultaneously a minimum of 16-point identifiers allowing operator to view single screen dynamic displays depicting entire mechanical systems.
 - .3 Functions to include to OTs, but not be limited to, as follows:
 - .1 Start and stop points;
 - .2 Modify setpoints;
 - .3 Modify PID loop parameters;
 - .4 Establish priority on PID command;
 - .5 Change time/date;
 - .6 Add/modify/start/stop weekly scheduling;
 - .7 Add/modify set point weekly scheduling;

- .8 Introduce temporary override schedules;
- .9 Define holiday schedules;
- .10 View analog limits;
- .11 Enter/modify analog warning limits;
- .12 Enter/modify analog alarm limits;
- .13 Enter/modify analog differentials.
- .4 OTs shall provide access to real and calculated points in controller to which it is connected or to any other controller in network. This capability shall not be restricted to subset of predefined "global points", but shall allow fully open data exchange between an OT and each network controller.
- .5 Operator access to OTs: Same as OWS user password and password changes to automatically be downloaded to controllers on network.
- .6 OTs shall provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed, to eliminate possibility of operator's error.
- .7 Indicative of real or calculated points shall be consistent into entire network. Use same point indicatives as OWSs for access of points at OTs to eliminate looking-up tables.

2.2 LOCAL CONTROL UNIT (LCU)

- .1 LCUs shall provide multiple control functions for autonomous apparatus and sets of autonomous HVAC or hydronic systems, and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
- .3 LCUs shall include microprocessors capable of supporting necessary software and hardware meeting specified requirements as listed in previous MCUs article, with following additions:
 - .1 LCUs shall include minimum two interface ports for connection of local computer terminal;
 - .2 LCUs shall be design so that shorts, opens, or grounds on input or output will not interfere with other input or output signals;
 - .3 LCUs shall include physically separated line voltage (70 V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment;
 - .4 LCUs shall be equipped with power supplies for their own operation and related field equipment;
 - .5 In event of loss of communications with, or failure of, MCU and LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable;
 - .6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 TERMINAL CONTROL UNIT (TCU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU functional specifications.

- .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature set points, flow set points, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.
- .3 TCUs shall be capable of controlling at least 4 outputs and 4 inputs, a minimum of 8 I/O points.
- .4 The controller may include pre-programmed functions for repetitive applications. Applications can however be selected or parameterized as needed.
- .5 Accepted pre-programmed devices are clearly identified on drawings and specification. In case these devices are not clearly identified, provide fully programmable controllers.
- .6 VAV Terminal Controller.
 - .1 Microprocessor-based controller with integral flow transducer, including routines to execute PID algorithms, calculate airflow for integral flow transducer, and measure temperatures, for producing I/O summary reports. Sequence of operation to ASHRAE HVAC Applications Handbook.
 - .2 Controller to operate independently of network in case of communication failure.
 - .3 Controller to include damper actuator and terminations for input and output sensors and devices. Damper actuator shall be able to be replaced independently of the controller in case of breakage.

2.4 SOFTWARE

- .1 General:
 - .1 Include as minimum: Operating system executive, communications, application programs, operator interface, and systems sequence of operation (CDLs).
 - .2 Include "firmware" or instructions which are programmed into permanent memory.
 - .3 Include initial programming of all system controllers.
- .2 Program and Data Storage:
 - .1 Supervisor programs and configuration data shall be stored in permanent memory.
 - .2 Control logic data and operating data, including set points, operating constants, and alarm trip thresholds, shall be stored in non-volatile memory or RAM type. or EEPROM with a backup battery guaranteed for 5 years, so that it can be displayed and modified by the operator.
 - .3 Historical operation data shall be archived for a 7-year period at an interval of 15 minutes. Archive all analog and binary values of inputs, outputs, set points, and variables. Provide the necessary storage space on the server to ensure required archiving.
- .3 Programming Languages.
 - .1 Program Control Description Logic software (CDL) shall be programmed using an advanced language or a high level general graphical control language.

- .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. "GO TO" constructs not allowed unless approved by Departmental Representative.
- .4 Operator Terminal Interface.
 - .1 Operating and control functions to include the following:
 - .1 Multi-level password access protection to allow user/manager to limit workstation control;
 - .2 Alarm management: Processing and messages;
 - .3 Operator commands;
 - .4 Reports;
 - .5 Displays;
 - .6 Point identifications.
- .5 Pseudo or Calculated Points.
 - .1 Software to provide access to all values or states registered in controller or other networked controller to define and calculate pseudo-points. When current pseudo-point's value is established, normal alarm checks shall be performed or value used to totalize.
 - .2 Inputs and outputs for process: Include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
- .6 Control Description Logic (CDL):
 - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. User shall have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BCs from any OWS.
 - .2 CDL shall use high level language allowing algorithms and interlocking programs to be written simply and clearly. Operator shall only introduce parameters into system (e.g. set points) to be able to use an algorithm. Operator to be able to alter operating parameters on-line from OWS and BC to tune control loops.
 - .3 Operator shall be able to perform changes to CDL on-line.
 - .4 Control logic to have access to values or status of points available to controller, including global or common values, allowing cascading or interconnection control.
 - .5 Energy optimization routines, including enthalpy control and supply temperature reset, to be LCU or MCU resident functions and be part of CDL.
 - .6 MCU to be able to perform following pre-tested control algorithms:
 - .1 "GO-NO GO" position control;
 - .2 Proportional Integral and Derivative (PID) control.
 - .7 Control software to provide ability to define time between successive starts of each piece of equipment to reduce cycling of motors.

- .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands involving heavy electrical loads.
- .9 Power Fail Restart: Upon detection of power failure, system to verify availability of Emergency Power as determined by emergency power transfer switches, analyze controlled equipment to determine its appropriate status under Emergency power conditions, and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, verify normal occupancy scheduling, and turn equipment "On" or "Off", as required, to resume normal operation.
- .7 Event and Alarm Management: Alarm reports shall be produced according to an exception management. This requirement is applicable to entire system. This approach will ensure that only principal alarms are reported to OWS. Events occurring as direct result of primary event are suppressed by system and only events which were supposed to occur, but did not, are reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are operational temperature alarm limits which are exceeded when main air handler stops or general fire condition shuts down air handlers, only a fire alarm status is reported. Exception being when air handler, which is supposed to stop or start, fails to do so afterwards when it was supposed to.
- .8 Energy Management Programs: Include specific summarizing reports with time stamping indicating events detected which have activated and or terminated equipment.
 - .1 In coordination with subordinate LCU, TCU, MCU shall execute the following energy management routines:
 - .1 Time-of-day scheduling;
 - .2 Calendar based scheduling;
 - .3 Holiday scheduling;
 - .4 Temporary schedule overrides;
 - .5 Optimal start-stop;
 - .6 Night setback control;
 - .7 Enthalpy (economizer) switchover;
 - .8 Peak demand limiting;
 - .9 Temperature compensation load transfer;
 - .10 Fan speed/flow rate control;
 - .11 Cooling battery reset;
 - .12 Chilled water reset;
 - .13 Condenser water reset;
 - .14 Chiller sequencing;
 - .15 Night purge.
 - .2 Programs to be automatically executed without need for operator to intervene and be flexible enough to allow customization.

- .3 Apply programs to equipment and systems, as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: Features to provide predefined reports which show daily, weekly, and monthly accumulating totals, and which include high rate (time stamped) and low rate (time stamped), as well as monthly cumulative total.
 - .1 MCUs to automatically accumulate and store run-time for binary I/O points.
 - .2 MCU to automatically sample, calculate, and store consumption totals on daily, weekly, or monthly basis for user-selected analog or binary pulse input-type points.
 - .3 MCU to automatically count events occurring (cycle number of a pump) on a daily, weekly, or monthly basis.
 - .4 Totalization routine to have sampling resolution of 1 minute or less for analog inputs.
 - .5 Totalization routine to provide calculations and storage of accumulations up to 99,999.9 units (e.g.: kWh, litres, tonnes, etc.).
 - .6 Store event totalization records with minimum of 9,999,999 events before reset.
 - .7 User to be able to define warning limits and generate user-specified messages when limits are reached.

2.5 LEVELS OF ADDRESS

- .1 Upon operator's request, EMCS to present status of any single point, system or point group, entire area, or entire network on printer or OWS, as selected by operator. EMCS to also:
 - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
 - .2 Update displayed analog values and status when new values received.
 - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
 - .4 Updates to be change-of-value (COV)-driven or if polled, not exceeding 2-second intervals.

Part 3 Execution

3.1 LOCATION

- .1 Location of Controllers to be approved by Departmental Representative.

3.2 INSTALLATION

- .1 Provide necessary power from local 120 V branch circuit panel for equipment. Coordinate with the electrician subcontractor.
- .2 Equipment that shall be functional in emergency and coordination mode are connected to an uninterrupted power supply (UPS).

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCE STANDARDS

- .1 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500D, Laboratory Method of Testing Dampers for Rating.
- .2 American National Standards Institute (ANSI).
 - .1 ANSI C12.7, Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13, Standard Requirements for Instrument Transformers.
- .3 American Society for Testing and Materials International (ASTM).
 - .1 ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings.
- .4 Canadian Standards Association (CSA).
 - .1 CSA-C22.1SB, Canadian Electrical Code, Part 1 (19th Edition) Safety Standard for Electrical Installations.
- .5 National Electrical Manufacturer's Association (NEMA).

1.3 SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions.
- .2 Testing prior to installation:
 - .1 Submit samples taken at random from equipment delivered, as required by the Departmental Representative, to be tested prior to commencement of installation. Replace appliances or components whose performance and accuracy do not meet the prescribed requirements.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 EXISTING CONDITIONS

- .1 Cutting, adjustment, and repair work: As per specific requirements and those indicated hereafter:
 - .1 If needed, repair surfaces that were damaged during work execution;
 - .2 Hand over to the Departmental Representative all removed material that cannot be reused.

Part 2 Products**2.1 GENERAL**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, vibration-proof assembly.
- .3 Operating Conditions: 0 - 32°C (32°F to 89.6°F) with 10 - 90% relative humidity (RH) (non-condensing), unless otherwise specified.
- .4 Terminations: Use standard conduit box with slot screwdriver compression connector block, unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters, including walkie-talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in selections of sensors and controls.
- .7 Outdoor Installations: Use weatherproof construction in NEMA 4 enclosures.
- .8 Installed measuring instruments ranges must be such that normal reading should be between the first third and second third of the total measuring range of the instrument. The Contractor is responsible of choosing the operating ranges, even after the approval of shop drawings.
- .9 Devices installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 ELECTRIC HUMIDISTAT

- .1 Duct electric humidistat with synthetic sensing element.
- .2 Operating Range: 15-95%.
- .3 Nominal Current: 3.6 A at 240 VAC.
- .4 Acceptable Products: Schneider HC-201.

2.3 PRESSURE DETECTOR (AIR)

- .1 Pressostat for air, used as an operating status.
 - .1 Sensible element, neoprene diaphragm.
 - .2 Adjustment range 0.07 to 1 in. (1.8 to 25.4 mm) pressure; differential 0.04 in. (1 mm).
 - .3 Maximum overpressure: Three (3) times the maximum reading.
 - .4 Nominal current: 6.25 A at 120 VAC. Automatic reset (or manual for high-pressure protection).

- .2 Acceptable Products: Dwyer 1823; Schneider PC-301; Johnson P32; Siemens 141-0518.

2.4 CONTROL TRANSFORMERS

- .1 Open type transformers.
- .2 Transformers installed in control panels or in separate boxes. Control boxes must be installed in accessible places. No transformer to be installed in ceilings.
- .3 All transformers not provided with short-circuit protection, or of capacity more than 45 VA must have a control fuse or a circuit breaker. Fuses or circuit breakers must not be installed on the transformer casing, but in the same control box.
- .4 Acceptable Products: Delta; Exacta.

2.5 TEMPERATURE SENSORS

- .1 Resistive Type Temperature Sensors:
 - .1 Technology:
 - .1 Thermistor type resistive element, negative temperature coefficient, nominal value 10.000 ohms at 24°C (75.2°F), accuracy 0.2°C (0.36°F), usable when the reception module can linearize the signal. Response time lower than 3 seconds for a temperature variation of 10°C (50°F).
 - .2 Resistance: Platinum type, nominal value 100 or 1,000 ohms at 0°C (32°F) (± 0.2 ohm), designed to allow reduction of stress, with 3 wires, and a resistance variation of 0.00385 ohm/ohm°C. Use only with a 4-20 mA transmitter.
 - .2 Mounting according to application:
 - .1 On sheath: With conduit connection box.
 - .2 Outside: NEMA 12 connection box.
 - .3 Averaging sensors for duct mounting, containing many sensor elements allowing the reading of the averaging temperature. Minimum length 6,000 mm (20 ft). When being installed, the averaging sensor must be flexible at any point with a bending radius of 100 mm (4 in.), without any effect on their efficiency.
 - .4 Unless otherwise specified, room sensors to be as indicated below:
 - .1 Offices: Adjustable smart sensors, with limited setpoints.
 - .2 Classes: Adjustable smart sensors, with limited setpoints.
 - .3 Corridors and public spaces: Blind sensors.
 - .4 Technical spaces: Blind sensors.
 - .3 Range adapted to the application, with possibility to limit the range for room sensors.
 - .4 Power supply: 5 VDC, from an automaton.
 - .5 Options:
 - .1 Day-night models: With reset button for day mode.

.2 Intelligent Sensors:

- .1 Room temperature sensors are addressable. The sensing element is thermistor with a negative temperature coefficient, impedance compatible with the other room sensors. Sensors must be connected to the digital controller via a dedicated communication network. They are equipped with programmable pushbuttons and an alphanumeric display indicating the room temperature, setpoint, and all other points desired by the Departmental Representative.
- .2 A connection plug for a portable programming tool is included. Wireless connection is also acceptable. Include one programming tool for every 100 sensors, or portion of it.

2.6 HUMIDITY SENSORS

- .1 Relative humidity combined sensor and transmitter.
 - .1 Capacitive type sensor.
 - .2 Mounting:
 - .1 Duct: With stainless-steel connection box for conduit. Mechanical protection of the sensor in stainless steel to allow installation in ducts with air speed of 10 m/s (1,968.5 ft/min.).
 - .2 Room: With decorative box and separate base.
 - .3 Outside air humidity sensor: Temperature range from -40°C to 50°C (-40°F to 122°F). NEMA 12 protection enclosure. Not sensible to condensation or saturation at 100%.
 - .3 Range of relative humidity from 5% to 90%, minimum.
 - .4 Service temperature from 0°C to 60°C (32°F to 140°F).
 - .5 Signal transmitter with 0-5 VDC output.
 - .6 Measuring accuracy: $\pm 2\%$. Maximum linearity error $\pm 2\%$ from base curve.
- .2 Acceptable Products: Greystone RH100; Mamac HU224; Johnson Controls HE-6700; Siemens QFA; Honeywell H7600.

2.7 STATIC PRESSURE SENSOR

- .1 Pressure sensor for duct mounting.
 - .1 Multiple points and manifold for averaging reading.
 - .2 Accuracy of $\pm 1\%$ of actual static pressure in the duct.

2.8 DIFFERENTIAL PRESSURE SENSORS FOR VELOCITY READING

- .1 Differential pressure sensor for duct mounting.
 - .1 Multiple points and manifold for averaging reading, for both static pressure and total pressure.
 - .2 Accuracy of $\pm 1\%$ of actual velocity in the duct.

2.9 PRESSURE TRANSMITTERS, STATIC OR DIFFERENTIAL (AIR)

- .1 Transmitter for reading the pressure and converting to an electronic signal.
 - .1 Diaphragm type construction with capacitive element.
 - .2 Internal materials suitable for continuous contact with industrial standard instrument air or gas, as applicable.
 - .3 Input protection against overpressure, minimum twice the nominal pressure.
 - .4 Output short-circuit and open circuit protections.
 - .5 Duct mounting and connection box included.
 - .6 Range required as per the application. Centered zero for room pressure sensors.
 - .7 Output signal 4 to 20 mA with a maximum resistive load of 500 ohms (1-5 VDC).
 - .8 Integral zero and span adjustment.
 - .9 Hysteresis, non-linearity, and fidelity error combined must not be more than $\pm 0.5\%$ of full-scale output signal for the whole range. Temperature variation of 50°C (90°F) not affecting the reading by more than $\pm 1.5\%$ of full scale. Variation of output signal lower than 0.2% of full scale for a variation of $\pm 10\%$ of the input power voltage.
- .2 Acceptable Products: Setra 264; Mamac PR 200; Veris PXPLX.

2.10 ELECTROMECHANICAL RELAYS

- .1 Dual-voltage relays, inverters, bipolar, plug-in, with connection base.
 - .1 Electromagnetic coil activation, 120 VAC or 24 VDC.
 - .2 Change-over contacts plated, or not subject to corrosion.
 - .3 DIN rail mounting.
 - .4 Output contacts 5 A to 120 VAC.
 - .5 DEL status indication.
- .2 Acceptable Products: Carlo Gavazzi; Omron.

2.11 CURRENT TRANSDUCERS (ANALOG)

- .1 Combined sensor/transducer, to measure line current and produce proportional signal:
 - .1 Measurement by electromagnetic induction.
 - .2 Adjustable mounting brackets to allow for secure/safe mounting inside MCC.
 - .3 Field adjustable range to suit applications. Select range so that maximum reading is about $\frac{2}{3}$ of range.
 - .4 Output signal 0-1 VDC, 0-5 VDC or 4-20 mA.
 - .5 Accuracy to 1% of full scale. Frequency insensitive from 10 - 80 Hz.
 - .6 Adjust setpoint to detect breakage of a belt (i.e. on a fan).
- .2 Acceptable Products: Veris H923; Greystone SC-550.

2.12 ELECTRONIC DAMPERS ACTUATORS

- .1 Direct Coupling Actuators.
 - .1 Gear mechanism, 2-direction electric motor with feedback position control.
 - .2 End of travel electronic stops.
 - .3 Rotating span of 95° limited by mechanical stops.
 - .4 Power supply 120 VAC or 24 VAC; typical power consumption of 5 VA. Select by priority 24 VAC actuators.
 - .5 Control signal 0-10 VDC for modulating actuators. Button for rotation direction selection.
 - .6 Safety spring return mechanism for outside air and mixing dampers, for return to normal position in case of power loss. Direction of safety return by actuator inversion on the shaft.
 - .7 Feedback signal: 0-10 VDC indicating the 0-100% position.
 - .8 Maximum travel time of 120 seconds for 0-100% positioning.
 - .9 Sufficient power double the one to allow the positioning of dampers at maximum operating pressure and dynamic pressure for opening and closing. Use multiple actuators mounting when required. Coordinate with the damper supplier.
 - .10 Provide and install remote installation kits if required where the direct mounting of actuators does not allow the access to actuators for service.
- .2 Acceptable Products: Belimo AFB/NFB; Johnson Controls M9200; Siemens GCA.

2.13 ACTUATORS FOR TERMINAL UNITS

- .1 Direct Coupling Actuators.
 - .1 Gear mechanism, 2-direction electric motor with feedback position control.
 - .2 End of travel mechanical and electronic stops.
 - .3 Power supply 24 VAC; typical power consumption of 2 VA.
 - .4 Control signal 0-10 VDC or floating with position feedback for modulating actuators. Button for rotation direction selection.
 - .5 Floating actuators acceptable when the damper positioning is not required in the sequence of operation.
 - .6 Maximum travel time of 120 seconds for 0-100% positioning.
- .2 Acceptable Products: Belimo LMB24; Neptronic; Siemens; Johnson Controls.

2.14 CONTROL / REGULATION PANELS

- .1 Multi-section tables as required and indicated, capable of accommodating all devices required for installation and with a 25% reserve, for the addition of other equipment, without addition of cabinets.

- .2 All instruments in the panel must be clearly marked with a P-Touch tape. The indications on the façade must be engraved on ebonite plates. All wiring inside the panels must be done properly inside gutters.
- .3 Each control panel must be equipped with a terminal strip to make all connections of the internal components to terminals. The terminals must be clearly identified as indicated in specs.
- .4 Each wire must be clearly identified and those to be connected to the outside must be returned to terminals. The unused inputs or outputs of the control panel must be connected to the terminals to facilitate any additions.
- .5 Each system must be equipped with a monobloc panel having the following characteristics:
 - .1 Table mounted in 2.5 mm thick steel cabinet, finished in baked enamel;
 - .2 Relays, switches, and controllers mounted inside panel;
 - .3 Temperature indicators, pressure gauges, graphic display of installation, indicator lamps and panel-mounted push buttons;
 - .4 NEMA 1 enclosure, with hinged door and key lock; A single lock key for all tables;
 - .5 NEMA 4 enclosure in humid environment.
 - .6 Panels mounted adjacent to associated equipment on vibration-free wall or on legs;
 - .7 Each control panel must be equipped with a 120 VAC, duplex receptacle and a transformer to power the controllers at 24 VAC.

2.15 GAS DETECTION SYSTEM

- .1 Gas sensors are used to detect hazardous gases, transmit information, and initiate actions.
 - .1 Sensors are electrochemical or catalytic depending on the gas to be detected. The sensors are CSA-approved. Power: 24 VAC (17-27 VAC).
 - .2 Dedicated transformer for each transmitter.
 - .3 Operation range:
 - .1 CO: 0-250 ppm (alarms: 25 and 100 ppm).
 - .2 NO₂: 0-10 ppm, (alarms: 0.7 and 2 ppm).
 - .4 Output signal; contacts 5 A to 250 VAC, and signal 4-20 mA.
 - .5 Reading accuracy: 3% of the full scale. Digital display of the read value; 85 dBa sound alarm; visual indications of power, alarm, and fault.
 - .6 Install the wiring in a dedicated conduit for this purpose. Install the sensors according to the manufacturer's recommendations.
 - .7 Provide a start-up and installation certificate produced by the manufacturer or an authorized representative.
- .2 Acceptable Model: Opera, Honeywell, Armstrong or approved equivalent.

Part 3 Execution**3.1 INSTALLATION**

- .1 Install equipment and components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures, and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: Install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases where dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters, and sensors on pipe stands or channel brackets.
- .5 Manage required space for fire protection material. Provide and maintain the nominal characteristics of the fire protection.
- .6 Electrical System:
 - .1 Complete installation in accordance with Section 25 05 60.
 - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .3 Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review before beginning Work. Refer to electrical control schematics included as part of control design schematics on drawings mentioned in Section 25 90 01 EMCS: Site Requirements, Applications and Systems Sequences of Operation.
 - .4 Terminate wires with screw terminal type connectors suitable for wire size and number of terminations.
 - .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels, and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Conduit filling should not exceed 40% of their capacity.
 - .4 Design drawings do not show conduit layout.
 - .6 Do not run exposed conduits in normally occupied spaces, unless otherwise indicated or unless impossible to do otherwise. Wiring in mechanical rooms, wiring in service rooms, and exposed wiring must be in conduit.
- .7 VAV Terminal Units: Supply, install and, adjust as required.
 - .1 Air probe, actuator, and associated VAV controls.
 - .2 Tubing from air probe to "dp" sensor as well as installation and adjustment of air flow sensors and actuators.

- .3 Co-ordinate air flow adjustments with balancing trade.

3.2 TEMPERATURE AND HUMIDITY SENSORS

- .1 Install to ensure minimum field adjustments or calibrations.
- .2 Sensors must be readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Install room sensors at a height of 1,400 mm. Align sensors above lighting switches where applicable, except when in presence of rheostats.
- .4 Outdoor Installations:
 - .1 Install the sensors in NEMA 4 enclosures, on north-east side, at a minimum height of 2,5 m from ground to protect against vandalism.
 - .2 Protect sensors from solar radiation and wind effects by non-corroding shields.
- .5 Air Duct Installations:
 - .1 Do not mount in dead air space.
 - .2 Locate sensors within sensor vibration and velocity limits.
 - .3 Securely mount averaging sensors.
 - .4 Thermally isolate sensors from brackets and supports to respond to air temperature only.
 - .5 Support sensors separately from hot or cold coils and filter racks.
- .6 Averaging Duct Type Temperature Sensors.
 - .1 Install averaging element horizontally across the ductwork starting 300 mm (11 in.) from top of ductwork. Each additional horizontal run to be no more than 300 mm (11 in.) from one above it. Continue until complete cross-sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in Series for low-temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use software averaging algorithm to derive overall average for control purposes.
- .7 Thermowells: Install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.

3.3 CONTROL PANELS

- .1 Arrange for conduit and tubing entry from top, bottom, or either side. Install wiring trays where wiring enters the panel.
- .2 Identify devices with "P-Touch" type indicators.

.3 Wiring and tubing within panels: Locate in trays or individually clipped to back of panel. All connections will be made on modular terminal plates of appropriate dimensions.

.4 Clearly identify wiring and conduit in accordance with shop drawings.

3.4 PRESSOSTATS, DIFFERENTIAL PRESSOSTATS, AND SENSORS

.1 When the Code allow it, install an isolation valve and a dampening device between the sensor and the pressure source.

.1 In steam and hot water piping at high temperature, protect the sensible elements with a pigtail siphon between the valve and the sensor.

3.5 IDENTIFICATION

.1 Identify field devices in accordance with Section 25 01 01 - EMCS: General Requirements.

3.6 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 01 - EMCS: General Requirements.

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED SECTIONS**

1. Public Works and Government Services Canada (PWGSC)/Real Estate General Directorate/Architectural and Engineering Services.
 1. Document 25 00 05, Energy Management System Design Guidelines (Document provided on request).

Part 2 Operating Sequences**2.1 GENERAL SEQUENCES**

- .1 The following sequences apply to all mechanical systems when necessary:
 1. When a ventilation or air conditioning system is shutdown, humidifiers are inoperative as soon as the flow evidence is lost by the differential pressure switch. The cooler air and air-evacuated dampers are closed, and the return flaps are open.
 2. Critical protections or those required by Codes (gas detection, fire, etc.) must not be circumvented in any way, either manually or by the computer. If an entry is required to the centralized system, provide a relay to perform the dual control and alarm function.
 3. When a fan is in air conditioning, the humidifier must be switched off.
 4. When a system departs or a major change in the percentage of fresh air, the opening of the outdoor air damper must be done gradually to allow the allowed air to warm up.
 5. Where there is an information input as proof of operation, a totalization of the operating hours of the mechanical equipment (compressors, water tower, fans, pumps, air conditioning units, etc.) must be automatically carried out with reset by an operator's command.
 6. Schedule alarms for all the following:
 - .1 Inconsistency between a command and the corresponding proof of operation;
 - .2 Room temperature at more than 2°C (3.6°F) from the actual setpoint;
 - .3 Ventilation system temperature at more than 2°C (3.6°F) from the actual setpoint for 30 minutes;
 - .4 Water system temperature at more than 1°C (1.8°F) from the actual deposit point for 30 minutes;
 - .5 Other values: 5% deviation from the deposit.
 7. When the program switches from one control mode to another (e.g., natural to mechanical cooling), a dead range must be included on the deposit points. Similarly, several sequence-controlled steps have a minimum time of "EN" and "HORS." These measures eliminate the danger of cyclical operation of equipment.
 8. When a power outage or other such disturbance returns, the systems must be returned to normal operating mode in a progressive start-up sequence. It is possible to use an interval of up to 15 minutes.

June 30, 2020

9. On evidence of fire detection through the fire control panel, the fans stop. When the systems are restarted, the fans start according to their pre-set sequence.
10. The following sequences should be read in conjunction with the plans and the points list. Provide all the checkpoints necessary to complete the control sequences, whether listed or implied.
11. Program trend points for all analog entry and output points, as well as variables that change over time.

2.2 HANGAR - UTA-01 - OFFICES/CLASSES

1. System Description:
 1. The system consists of a plate heat exchanger that supplies new air and a one-piece ventilation unit to the roof.
 2. The system ventilates, heats, air-conditioning and humidifies the office and classroom sector.
2. Operating Sequence:
 1. When the system is shutdown, the fans are shutdown, the heat exchanger is shutdown, the outside shutters are closed, and the humidifiers are shutdown.
 2. The system starts on a scheduled schedule at the central control system.
 3. The static pressure reading point of the ducts established by the swinging contractor is transmitted through the central system.
 4. The roof system is controlled by its own controls that control heating, mechanical air conditioning, free cooling as well as fan flow control. The system's power temperature record point is transmitted through the central system based on the average of the four (4) room thermostats.
 5. The humidifiers are controlled by the return probe to maintain a minimum of 30%. The high-power limit stops the humidifier if the humidity exceeds 85%.
 6. In each area, on the request of air conditioning, a room temperature sensor modulates the flow between the minimum and the maximum to maintain the room temperature record point (22°C, Adjustable). On request of heating, the probe controls in sequence the heating coil and the electric baseboard.
 7. When the heat exchanger is in defrosting mode, the minimum new air in the ventilation unit is adjusted upwards to ensure minimum fresh air. When the minimum new air is returned to normal, it is reset.
 8. Install the static pressure tube in the room and connect it to the unit's static pressure sensor to the roof, which is used to control the exhaust fan.
3. Alarms:
 1. Unwanted fan shutdown.
 2. Temperature off limit.
 3. Humidity off limit.
 4. Ventilation unit alarm.

June 30, 2020

2.3 HANGAR - UTA-02 - DOGS TRAINING

1. System Description:
 1. The system consists of a one-piece roof unit provided for constant flow ventilation, heating, air conditioning and humidification.
 2. The heating is divided into two (2) zones.
2. Operating Sequence:
 1. When the system is shutdown, fans are shutdown, outside dampers are closed, and the humidifier is stopped.
 2. The system starts on a programmed schedule at the central control system.
 3. The roof system is controlled by its own controls controlling heating and air conditioning according to the return sensor provided with the system. The system's supply temperature is transmitted through the central system based on the average demand of both (2) room thermostats.
 4. In each of the deux (2) zones, the room sensor modulates the coil heating to maintain the temperature record point (21°C, adjustable). Terminal heating is not permitted when the unit is in demand for air conditioning.
 5. In unoccupied periods, the system is normally shutdown. On the request of heating at the night deposit point of 18°C, the system restarts in recirculation.
 6. The humidifier is controlled by the return probe to maintain a minimum of 30%. The high-limit supply stops the humidifier if humidity exceeds 85%.
 7. Install the static pressure tube in the room and connect it to the unit's static pressure sensor to the roof, which is used to control the power exhaust.
3. Alarms:
 1. Unwanted fan shutdown.
 2. Temperature off limit.
 3. Humidity off limit.
 4. Ventilation unit alarm.

2.4 HANGAR - UTA-03 - DOGS TRAINING

1. System Description:
 1. The system consists of a one-piece roof unit that provides constant flow ventilation, heating, air conditioning and humidification.
1. Operating Sequence:
 1. When the system is shutdown, fans are shutdown, outside shutters are closed, and the humidifier is stop.
 2. The system starts on a scheduled schedule at the central control system.
 3. The required flow setpoint is transmitted by the central system.

June 30, 2020

4. The roof system is controlled by its own controls that control heating and air conditioning based on the room sensor provided with the system and installed in the room. The room temperature record point is transmitted through the central system.
 5. In unoccupied periods, the system is normally shutdown. On the request of heating at the night deposit point of 18°C, the system restarts in recirculation.
 6. The humidifier is controlled by the return probe to maintain a minimum of 30%. The high-limit supply stops the humidifier if humidity exceeds 85%.
 7. Install the static pressure tube in the room and connect it to the unit's static pressure sensor to the roof, which is used to control the power exhaust.
2. Alarms:
1. Unwanted fan shutdown.
 2. Temperature off limit.
 3. Humidity off limit.
 4. Ventilation unit alarm.

2.5 HANGAR - ERV-02 - GARAGE

1. System Description:
 1. The system is 100% new air and is equipped with a plate exchanger for recovery and a new air intake to compensate for the air evacuated during defrosting.
 2. The heating of the space is provided by air heaters.
2. Operating Sequence:
 1. At the stop, the power fan and the ventilator are shutdown, the new air and exhaust air damper are closed, and the heating is stopped.
 2. The system continuously works.
 3. The supply temperature sensor controls the heating to maintain the supply temperature. The setpoint is adjusted to reflect the average demand for rooms:

SETPPOINT - SUPPLY AIR TEMPERATURE		
Mode	Request for Room Air Conditioning	Supply Temperature
Heating	0%	18°C (65°F) - maximum
Cooling	100%	13°C (55°F) - minimum
 4. When the exchanger is in de-icing mode (the supply fan shuts down and the exhaust fan stays on), the wall fresh air intake opens to compensate for the exhaust air.
 5. In each area, the room sensor controls the electric air heater to maintain the room temperature record point (21°C, adjustable). Air heaters cannot function when the unit's supply air setpoint is less than 18°C (adjustable).
 6. The system always works in normal operation, the system operates at 33% of the flow. On detection of CO or diesel, the system starts at 100% flow.
 7. On detection of CO or NOx gas, an alarm is transmitted to the control system.

June 30, 2020

3. Alarms:
 1. Unwanted fan shutdown.
 2. Temperature off limit.
 3. Ventilation unit alarm.

2.6 KENNEL - UTA-01 - VENTILATION

1. System Description:
 1. The system is 100% fresh air and is constant flow. It is equipped with a thermal wheel for recovery.
2. Operating Sequence:
 1. At the stop, the supply fan and the exhaust fan are shutdown, the fresh air and exhaust air dampers are closed, and the thermal wheel and heating are shutdown.
 2. The rooftop system is controlled by its own controls that control heating and cooling according to the power temperature sensor. The system's setpoint is transmitted through the central system based on the average demand for room thermostats.
 3. In each area, the room sensor controls the electric heating coil and the heating baseboard to keep the temperature at (21°C, adjustable).
3. Alarms:
 1. Unwanted fan shutdown.
 2. Temperature off limit.
 3. Ventilation unit alarm.

2.7 HANGAR - TELECOMMUNICATIONS ROOM

1. System Description:
 1. Autonomous split system.
2. Operating Sequence:
 1. The room temperature is controlled by the sensor supplied with the air conditioning unit.
 2. A room probe connected to the centralized system signals an alarm in case of high or low temperature.
1. Alarms:
 1. Temperature off limit.

2.8 HANGAR AND KENNEL - ELECTRIC ROOM (TWO SIMILAR)

- .1 Operating Sequence:
 1. On a high temperature detection of 3°C above the room's setpoint, the ventilator starts and the fresh air and evacuation flaps open until they reach the setpoint of the room.

June 30, 2020

2. For kennel only: On a low temperature detection of 3°C below the setpoint of the room, the heating baseboard is modulated until it reaches the setpoint of the room.

2. Alarms:

1. Unwanted fan shutdown.

2.9 HANGAR - VE-2 - CONCIERGE

- .1 The exhaust fan always works.
- .2 At the start of the exhaust fan, tamper opens.
- .3 If the fan stops, an alarm is reported.

2.10 INTEGRATION OF STANDALONE CONTROLS UNITS (ROOFTOPS AND EXCHANGERS)

1. The following should be available to the centralized network for integration into control sequences and graphs:
 1. Points in read and write:
 1. Stop-start command;
 2. Temperature control point (supply or return);
 3. Minimum damper position;
 4. Maximum load limit.
 2. Points in read only:
 1. Mode local/distant;
 2. Flow reading;
 3. Supply air temperature
 4. Return air temperature
 5. Mode of operation
 6. Amperage;
 7. Heating demand;
 8. Cooling demand;
 9. Status of external entries;
 10. Local setpoint;
 11. Alarm.

2.11 INTEGRATION OF HUMIDIFIERS

- .1 The following points must be available to the centralized network for integration into control sequences and graphics:
 1. Read and write points:
 - .1 Humidity setpoint;

June 30, 2020

- .2 Start-stop command;
- .3 Maximum load limitation.
- 2. Read-only points:
 - .1 System status;
 - .2 Operation mode;
 - .3 Demand signal;
 - .4 Operation level (%);
 - .5 Local setpoint;
 - .6 Alarm.

2.12 INTEGRATION OF GAS DETECTORS

- .1 The following points must be available to the centralized network for integration into control sequences and graphics:
 - 1. Read and write points:
 - .1 Detection setpoint;
 - .2 Alarm setpoint.
 - 2. Read-only points:
 - .1 System status;
 - .2 Operation mode;
 - .3 Local setpoint;
 - .4 Reading of each detection probe;
 - .5 System alarm;
 - .6 State of each system probe.

Part 3 Execution

3.1 NON-APPLICABLE

- .1 Non-Applicable

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED SECTIONS**

- .1 Section 25 90 01 - SGE - Site Requirements, Applications and Systems Sequences of Operation.

1.2 APPROVAL

- .1 Submit the graphics menu as well as graphic types to illustrate proposed final work.

1.3 REPORT OF OPERATION

- .1 Submit a final report including:
 - .1 Programming;
 - .2 Graphics;
 - .3 A certificate of compliance to this Section.

Part 2 Requirements for Programming Mode**2.1 GENERAL SEQUENCES**

- .1 Program each sequence in the controllers in a logical order, which refers to the sequence described in the specifications.
- .2 Document the different programming sections indicating modes, summer and winter sequences, as well as special programming (e.g. Free Cooling).
- .3 In programming, describe usage of variables (e.g. PC-CH-MAX-CO1: Maximum Heating Setpoint Controller #1).

2.2 PASSWORD ACCESS

- .1 Create at least two passwords:
 - .1 A **Viewing** password allowing to change setpoints only.
 - .2 A **Change** password allowing total access to the system.

2.3 VARIABLES

- .1 All setpoints that could be modified by an operator must be programmed in variables. This includes setpoints, indoor-outdoor curve-fitting, and operation modes (summer-winter).
- .2 Use acronyms of variables describing the use for which they are intended.
- .3 Except where otherwise specified, these values must be shown on graphic screens.

June 30, 2020

2.4 SCHEDULES

- .1 Program a master time schedule for the building or a time schedule for each sector, according to the application.
- .2 Time schedules must be available on each system they control.
- .3 Program the holiday schedule.
- .4 Ensure that time changes are automatically made.

2.5 CONTROL LOOPS

- .1 Program different control loops, each having their own proportional band, integral and derivative parameter values for all loops with change of mode (e.g. Heating-Cooling and Humidification-Dehumidification).
- .2 Slow down output updating, when required for loop stabilization, instead of using proportional bands out of standards.
- .3 Program a dead band between both modes.
- .4 Provide, if required, necessary interlocks to avoid overlapping output between both modes.
- .5 Adjust PID parameters to obtain a stable operation, without cycling, with setpoint reached in less than 10 minutes.
- .6 In anticipation of the acceptance of the work, program trends containing values at 15-second intervals for the control of outdoor air dampers, heating loops, control of water and air pressure, as well as any loop considered potentially unstable. These histories may be deleted after acceptance of the work if they are no longer considered useful.

2.6 ROOM CONTROLS

- .1 Set limits to room setpoints between 20 and 24°C in heating, and between 23 and 27°C in cooling.
- .2 Program a minimum dead band of 1°C between heating and cooling.
- .3 Provide, if required, necessary interlocks to avoid overlapping output between both modes.

2.7 EQUIPEMENT INTEGRATED BY COMMUNICATION

- .1 Program time schedules into the master controller, not in the integrated equipment itself.
- .2 Integrate alarms to the general alarms monitoring system.
- .3 Create alarms for all points considered as critical.

June 30, 2020

.4 Create histories for all main points of the equipment, such as:

- .1 Input temperature;
- .2 Output temperature;
- .3 Start-stop of compressor.

2.8 ALARMS

.1 Program alarms for all input points. Select switch points away from setpoints when no alarm is desired for the moment.

.2 Program alarms for following cases:

- .1 Inconsistency between a command and the corresponding status of operation;
- .2 Room temperature off by more than 2°C (3.6°F) of the effective setpoint;
- .3 Ventilation temperature by more 2°C (3.6°F) of the effective setpoint during 30 minutes;
- .4 Water system temperature by more than 1°C (1.8°F) of the effective setpoint during 30 minutes;
- .5 Other values: 5% difference compared to the setpoint.

.3 Program in the master controller alarms for system faults:

- .1 Controller stopped or communication malfunction.

.4 Alarm Destinations:

- .1 Unless otherwise specified, alarms must be directed to the following peripherals, when these are part of planned network on drawings:

POINTS	ALARM	HOURS OF OPERATION	TRENDS	ALARM DESTINATION	NOTES
ANALOG INPUTS	X		X	F,P,S	
ANALOG OUTPUTS	X		X	F,P,S	
DIGITAL INPUTS	X	X		F,P,S	Related to corresponding output
DIGITAL OUTPUTS		X		F,P,S	
SETPOINTS	X		X	F,P,S	
VARIABLES	X			F,P,S	
SYSTEM MANAGEMENT	X			F,P,M	

F: File

P: Printer

M: Modem or network

S: Screen

June 30, 2020

- .5 Establish with Client the list of critical alarms and how they must be directed, by e-mail, by pager, or by telephone.
- .6 In the absence of such a list, the following alarms are generally considered as critical:
 - .1 Loss of communication of a controller;
 - .2 Power outage (Phase detector);
 - .3 High level of water at sump (Or high level on the ground);
 - .4 Low room temperature;
 - .5 Low main collector temperature (Heating water);
 - .6 Heating equipment general alarms;
 - .7 Freeze alarms (Ventilation);
 - .8 High level of CO, natural gas, or refrigerant.
 - .9 Heating pump alarm.
- .7 Alarm messages must indicate:
 - .1 Name of the building;
 - .2 System name;
 - .3 Point name;
 - .4 Alarm status.

2.9 TOTALIZATIONS

- .1 When there is an information entry as proof of operation, a totalization of the hours of operation of the mechanical equipment must be automatically performed with reset by an operator command.

2.10 TREND LOGS

- .1 Create trend logs for all systems modulating inputs and outputs. These history values will store 200 values at 15-minute intervals.
- .2 Create trend logs for specified rooms inputs and modulating outputs. At a minimum, create trend logs for 10% of installed points. These history values will store 200 values at 15-minute intervals.
- .3 Where a long-term trend log is requested, accumulate data on a permanent digital format to be viewed later. These historical values will store values at 15-minute intervals for a minimum of 10 years.
- .4 Long-term trend logs are required in following cases:
 - .1 Existing central is already equipped with the long-term trends software;
 - .2 When mechanical installation consists of geothermal system.

June 30, 2020

Part 3 Requirements Related to Graphics**3.1 GENERAL PRESENTATION**

- .1 All graphics should constitute a coherent package, easy to read, representing the entire project.
- .2 Graphics added to an existing system must be consistent with those existing and respect installed standards.
- .3 Choose colors and sizes of text that allow easy viewing without overloading the diagram.
- .4 Avoid graphics overloading diagrams without adding relevant information.
- .5 Use animated graphics to represent the **states** of pumps and fans, not the commands.
- .6 A set of graphics to include:
 - .1 A start page containing general informations, general plan of the building, accesses to all systems or groups of systems, access to the alarms management page, and access to the controllers' architecture network.
 - .2 A page showing the controllers architecture network.
 - .3 A page representing each floor or area of the building, with representation and access to the zone controllers, and a link to access the ventilation and heating supplying the area. Indicate the position of digital controllers on the floors with the name of the systems they control. Program a link from controller to the monitored systems.
 - .4 A page for each room control indicating all relevant values, inputs, setpoints, and outputs.
 - .5 A page for each special room control, including the relevant values, inputs, setpoints, outputs, alarms, and trend logs.
 - .6 A page representing each main system.
 - .7 A summary screen values of energy consumption, including power or consumption rate as well as the cumulative consumption values for all meters.

3.2 PRESENTATION OF A GRAPHIC

- .1 Include in the graph of a system including all the following items:
 - .1 General information, such as:
 - .1 System's name;
 - .2 Outdoor temperature and outdoor humidity;
 - .3 Time and date;
 - .4 System mode (occupied, unoccupied, etc.).
 - .2 All the points specific to the system, including inputs, outputs, time, alarms, and trend logs.
 - .3 A link towards zoning controls related to this system.
 - .4 A link towards associated systems.
 - .5 A link towards control sequence and drawing in .pdf format.

- .6 An area for writing memos.
- .2 Use symbols and colors different to represent the different mechanical elements, such as filters, flow stations, coils, boxes, etc., in order to easily identify all items.
- .3 If a graph contains too many elements, create the diagram on two (2) or more graphics including a quick link between the different sections.
- .4 Include in the room zones graphics, setpoints, temperature, and humidity of the zones.
- .5 Use different background colors to represent areas supplied by different systems or major ducts.
- .6 Points in manual mode should be clearly indicated in graphs.

END OF SECTION

DIVISION 26

June 30, 2020

Part 1 General**1.1 REFERENCE STANDARDS**

- .1 CSA Group.
 - .1 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .2 CAN/CSA-C22.3 No.7-F10, Underground Systems.
 - .3 CSA C22.1-F18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .4 CSA C22.2 No. 0.3-06(R2014), Test Methods for Electrical Wires and Cables.
 - .5 CSA 282-15, Emergency Electrical Power Supply for Buildings.
 - .6 CSA-Z462-18, Electrical Safety.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC).
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 DEFINITIONS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 The Contractor must submit for review single line electrical diagrams to the Department Representative. After approval, the Contractor must provide single line electrical diagrams under plexiglass, in A1 format, and located in the main electrical installations local.
- .3 The Contractor must submit for review fire alarm riser diagram, plan, and zoning of building. After approval, the Contractor must provide fire alarm riser diagram, plan, and zoning of building. under plexiglass in A2 format, at fire alarm control panel and annunciator.
- .4 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 If changes are required, notify Departmental Representative of these changes before they are made.

June 30, 2020

- .5 Short-Circuit Coordination Study:
 - .1 Using the commutation cabinet shop drawings, provide the short-circuit protection device coordination, including the main breaker. The study must be conducted by an employee of the manufacturer and must be signed by a certified engineer of the province of Quebec. The coordination study must be submitted for approval in the same way as the shop drawings. The final corrected copies must accompany the O&M Manuals.
 - .2 The coordination study shall be conducted and presented as described in IEEE 242-2001.
 - .3 Supply a short-circuit study of the protection devices, in the same fashion as the coordination study. The study must be signed by an engineer registered and licensed in the Province of Quebec. The short-circuit study must be submitted for approval in the same way as the shop drawings. The final corrected copies must accompany the O&M Manuals.
- .6 Electrical Arc-Flash Danger:
 - .1 Supply the arc-flash report. The study must be signed by a certified engineer from the province of Quebec.
 - .2 Supply and install a label on each electrical equipment (excepted those who comply to article 4.3.3.1 of the CSA Z462-18 Standard), as requested by CCQ-E and types "Figures Q.2 and Q.3" as indicated in appendix Q of the CSA Z462-18 Standard. The manufacturer must affix the labels on the equipment according to the study results figure Q3 and prepare in both official languages (French and English). Labels must be approved on all electrical equipment such as distribution panels, transformers, switches, contactors, starters, etc.
- .7 Certificates.
 - .1 Provide CSA certified material and equipment.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to an authority having jurisdiction for approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of Contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .8 Manufacturer's Field Reports: Submit to Departmental Representative manufacturer, a written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL, a written report from the manufacturer stating that the work is compliant to the criteria is required.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

June 30, 2020

- .2 Operation and Maintenance Data: Submit operation and maintenance data:
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment;
 - .2 Start-up, proper adjustment, operating, lubrication, and shutdown procedures;
 - .3 Safety precautions;
 - .4 Procedures to be followed in event of equipment failure;
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed by CSC.
 - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .6 Ensure operating instructions will not fade when exposed to sunlight.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials, indoor, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse as specified in Waste Reduction Workplan in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating Voltages: To CAN3-C235.
- .2 Motors, electric heating, control, and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above Standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

June 30, 2020

- .3 Language Operating Requirements: Provide identification nameplates for control items in French and English.
- .4 Use one nameplate for each language.

2.2 MATERIALS AND EQUIPMENT

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

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment, and controls, as indicated.
- .2 Control Wiring and Conduit: In accordance with Section 26 29 03 - Control Devices except for conduit, wiring, and connections below 50 V which are related to control systems specified in Sections of Division 23, related to mechanical installations.

2.4 WARNING SIGNS

- .1 Warning Signs: In accordance with requirements of Departmental Representative.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

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

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: 3 mm thick Lamicoid, matt white finish face, black core, mechanically attached with self-tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES	DIMENSIONS	NB. OF LINES	HEIGHT
Size 1	10 x 50 mm	1 line	3 mm
Size 2	12 x 70 mm	1 line	5 mm
Size 3	12 x 70 mm	2 lines	3 mm
Size 4	20 x 90 mm	1 line	8 mm
Size 5	20 x 90 mm	2 lines	5 mm
Size 6	25 x 100 mm	1 line	12 mm
Size 7	25 x 100 mm	2 lines	6 mm

June 30, 2020

- .2 For fire alarm systems, plates must be red face with black inscription.
- .3 Labels:
 - .1 Embossed plastic labels with 6 mm high letters, unless specified otherwise.
- .4 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .5 Allow for minimum of twenty-five (25) letters per nameplate.
- .6 Registrations must be in English / French.
- .7 Use a plaque or label for each language (French and English).
- .8 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .9 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. ____" of Departmental Representative.
- .10 Indicator plates for disconnectors, starters and contactors shall indicate the controlled device, the disconnector / contactor or starter number, the panel number from which the supply originates with the circuit (s) used and the voltage, the feed loop P1 or P2.
- .11 Transformers: Indicate capacity, primary, and secondary voltages as well as P1 or P2 power loop.
- .12 Repeat circuit identification with typewritten cards for modified panels during the work.
- .13 Identify outlets and switches with a self-adhesive plastic label (Brother "P-Touch") indicating the panel number and power circuit. The labels must be white with black letters and be installed inside the plates. Indicate the number of the panel and the supply circuit on the inside of the plates with an indelible ink pencil.

2.7 WIRING IDENTIFICATION

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

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Color 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.

Type	Prime	Auxiliary
Up to 250 V	Yellow	---
Up to 600 V	Yellow	Green
Up to 5 kV	Yellow	Blue

June 30, 2020

Type	Prime	Auxiliary
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

2.9 MAINTENANCE, COMMISSIONING, AND OPERATION

- .1 Instruct Departmental Representative of operation and maintenance procedures for facilities, equipment, and components.
- .2 Retain and pay for the services of an engineer seconded from the manufacturer's plant to supervise the start-up of the installation, to check, adjust, balance, and calibrate the various elements and to instruct the operating personnel.
- .3 Provide these services for enough period of time, including the number of visits necessary to start the installation and ensure that operating personnel are familiar with all aspects of the maintenance and operation of the facility equipment.

2.10 IDENTIFICATION OF JUNCTION BOXES

- .1 Paint all around junction boxes according to Code, but not covers.
- .2 Using a large indelible ink marker, identify the source (panel) and circuit number (s) of all wiring passing through the boxes.

2.11 SINGLE DIAGRAMS

- .1 Install single diagrams framed in plexiglass as follows:
 - .1 Electrical Distribution System: In the main electrical room;
- .2 Provide a vertical distribution diagram of the fire alarm system indicating the plan and zoning of the building, framed under Plexiglas, and place it near the control panel and the fire alarm annunciator panel.
- .3 Drawings must be provided in A1 format for electrical distribution and in A2 format for fire alarms.

2.12 CONDUIT AND CABLE INSTALLATION

- .1 Conceal ducts and cables in all rooms on the ground floor and the floor.
- .2 Install conduits and sleeves before pouring concrete.
 - .1 Concrete penetration sleeves: Plastic pipe of diameter allowing free passage of conduit and exceeding 50 mm concrete surface on each side.
- .3 When using plastic sleeves for penetrations of walls or floors with a fire-resistance rating, remove them before installing the ducts.

June 30, 2020

- .4 Install cables, conduits, and fittings that are to be embedded or plastered in a neat manner against structural framing to minimize furring thickness.

2.13 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.
- .2 Paint outdoor electrical equipment "equipment green" finish as per the AMEEECY1-1-1195 Standard.
- .3 Paint indoor switchgear and distribution enclosures light gray as per the AMEEECY1-1-1958 Standard.
- .4 Clean and retouch painted workshop surfaces that have been scratched or damaged during shipment and installation; use a paint of type and color identical to the original paint.
- .5 Clean non-galvanized hooks, brackets, fasteners, and other fasteners and apply primer to protect them against rust.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Prior to proceed with installation:
 - .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 received of written approval to proceed from the Departmental Representative.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1, except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.7, except otherwise indicated.

3.3 NAMEPLATES AND LABELS

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

3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: Plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

June 30, 2020

- .3 Install cables, conduits, and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .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 3,000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.6 PROOFING

- .1 Where cables or ducts pass through floors and firewalls or premises with halon systems, fire and smoke protection will be provided using such products as 3M, CP25, 303, FS195, CS195, and 7902 and 7904 sealing kits. All will be installed according to the manufacturer's recommendations and CAN2 19.13 and modification.

3.7 OPENINGS

- .1 All required penetrations in slabs and walls (new and existing) are the responsibility of Division 26.
- .2 Make penetrations fireproof, as prescribed in this Section.

3.8 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment, unless otherwise specified or indicated.
- .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.
 - .1 Local switches: 1,200 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter backsplashes: 175 mm.
 - .4 In electrical and mechanical rooms: 1,400 mm.
 - .3 Panelboards: As required by Code or as indicated.
 - .4 Telephone and interphone outlets: 300 mm.
 - .5 Wall mounted telephone and interphone outlets: 1,500 mm.
 - .6 Fire alarm stations: 1,050 mm and at most at 1,150 mm.

June 30, 2020

- .7 Fire alarm bells: 2,100 mm.
- .8 Television outlets: See details in drawings.
- .9 Wall mounted speakers: 2,100 mm.
- .10 Doorbell pushbuttons: 1,200 mm.

3.9 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.10 WORKS IN AN EXISTING BUILDING

- .1 Coordinate with Departmental Representative, Work to be performed.
- .2 Any work that requires a complete or partial shutdown of any system to make connections or changes that affect other buildings, can only be performed during periods of downtime established by the Representative from the Department and upon prior written authorization.
- .3 Any request for a cut-off must be sent to the various parties at least one week in advance.
- .4 Provide a schedule of work to be done for coordination with the Departmental Representative and other Divisions to establish these shutdown periods.
- .5 Coordinate the receipt and handling of materials with the Departmental Representative or his representatives.
- .6 Minimize the inconvenience caused by noise and dust.
- .7 Always comply with Departmental Representative regulations and requirements for security or other rules.
- .8 All personnel, including subcontractors, must wear a badge or identification card when on site.
- .9 Remove and transport off-site all obsolete equipment as a result of new developments, including wiring, conduit, boxes, receptacles, switches, lighting fixtures, dispensing equipment, all ancillary systems, signaling or communications equipment, all accessories forming part of the electrical installations.
- .10 In general, remove wiring, conduits, panels, and boxes. However, casings and ducts embedded in the concrete shall be closed by means of lightweight concrete at the ends to a depth of not less than 200 mm. Some boxes (for smoke detectors in cells) and some ducts (existing arterial and branch lines) can be reused.
- .11 Restore power, control, signaling, or communications circuits, where continuity of these circuits is broken due to the demolition of existing facilities.

3.11 FIELD QUALITY CONTROL

- .1 All electrical work must be performed by licensed, qualified electricians or apprentices, as required by provincial law and the qualification of labor. Employees enrolled in a provincial apprenticeship program will be able to perform specific tasks, depending on their level of training and demonstrated ability to perform specific tasks, provided they are under the direct supervision of a qualified licensed electrician.

June 30, 2020

- .2 The work covered by this Division must be carried out by a master electrician or an electrical Contractor, licensed by the "Régie du bâtiment du Québec".
- .3 Load Balance:
 - .1 Measure phase current to panel boards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panel boards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
 - .4 At the request of the Departmental Representative, modify certain branch circuit connections to achieve better load balancing.
- .4 Conduct following tests in accordance with Section 01 45 00 - Quality Control, in the presence of the Departmental Representative, and pay the fees.
 - .1 Power distribution system including phasing, voltage, grounding, and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting system and control devices.
 - .4 Motors, heaters, and associated control equipment, including sequenced operation of systems where applicable.
 - .5 Systems: Fire alarm and communications.
 - .6 Any other system: As indicated in drawings and specifications.
 - .7 Provide a certificate or letter from the manufacturer stating that the entire installation of each network has been done to his complete satisfaction.
 - .8 Insulation resistance testing:
 - .1 Megger circuits, feeders, and equipment up to 350 V with a 500-V instrument.
 - .2 Megger 350-600 V circuits, feeders, and equipment with a 1,000-V instrument.
 - .3 Check resistance to ground before energizing.
- .5 Carry out tests in presence of Departmental Representative, as required in Division 26 requirements and as per Section 01 91 13 - General Commissioning (Cx) Requirements.
- .6 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of Project.
- .7 Submit test results to Departmental Representative.
- .8 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

June 30, 2020

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

3.12 SYSTEM START-UP

- .1 Instruct Departmental Representative in 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 (panels, breaker, switch, etc.), and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment (panels, breaker, switch, etc.) in operation and ensure that operating personnel are conversant with aspects of its care and operation.

3.13 COMMISSIONING

- .1 Commissioning equipment provided by Division 26 in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

3.14 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
 - .3 CSA C22.2 No. 41, Equipment for Application and Pouring.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC).
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for wire and box connectors, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Submittals for Sustainable Design Submittals.
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

June 30, 2020

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Pressure Type Wire Connectors: To CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors, as required.
- .2 Fixture Type Splicing Connectors: To CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing Stud Connectors: To NEMA and consisting of:
 - .1 Connector body and stud clamp for round copper conductor.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for TECK cable, armored cable, aluminum sheathed cable, mineral insulated cable, as required, to CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 EXAMINATION

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

June 30, 2020

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables, depending on case:
 - .1 Apply a layer of zinc-based joint compound on splices of aluminum cables before installing connectors
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install bushing stud connectors for lighting devices and tighten. Replace the insulating cap.
 - .4 Install bushing terminal connectors in accordance with EEMAC 1Y 2.
 - .5 Install stress cones and terminations and make splices according to manufacturer's instructions.
 - .6 As required, proceed with earth grounding according to CSA C22.2 No. 41 Standard.

3.3 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 20 - Wire and Box Connectors (0-1000V).
- .3 Section 26 05 36 - Cable Trays for Electrical Systems.
- .4 Section 26 05 43.01 - Installation of Cables in Trenches and In Ducts.
- .5 Section 33 65 73 - Concrete Encased Duct Banks and Manholes.
- .6 Section 33 65 76 - Direct Buried Underground Cable Ducts.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA)/ CSA International.
 - .1 CSA C22.2 No. 0.3, Testing Methods for Electrical Cables and Wires.
 - .2 CAN/CSA-C22.2 No. 131, TECK 90 Cables.
- .2 ULC Laboratories.
 - .1 ULS-S139-00, Method of Fire Test for Evaluation of Integrity of Electrical Cables.

1.3 PRODUCT DATA

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

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

1.5 TERMS OF REFERENCE

- .1 In general, use insulated copper conductors with 98% conductivity installed in EMT (steel) conduit.
- .2 Armored AC90 (BX) cables are permitted only for the connection of lighting fixtures in suspended ceilings, between a junction box and the luminaire. In this case, the AC90 armored cable should not be longer than 4 m.
- .3 "Daisy Chain" type connection is not permitted.
- .4 Aluminum conductors are not authorized.
- .5 Teak Cables may be used when specifically indicated on plans or specifications. Where permitted, multi-core, 1,000 V insulated Teak cables must be FT-4 PVC sheathed and must be shielded.
- .6 Use of cables with nonmetallic sheath is not permitted.

June 30, 2020

Part 2 Products**2.1 BUILDING WIRES**

- .1 Conductors: Stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Conductors: Copper with 600 V RW90XLPE "X Link" insulation for building wiring generally installed under conduit.
- .3 Main supplies must be made with insulated copper conductors under conduit. Provide a conductor of continuity of the masses (green wire) in all the conduits. Increase the size of the ducts as needed.
- .4 Provide color code for conductors. Conductors size 10 and under must be color sheathed at the time of manufacture at the factory. Conductors size 8 and up can be color coded, but only when the conductors are insulated with black insulation. Neutral conductors must be white. Where color coding is used, color strips shall be applied at a minimum distance of 50 mm from terminations, junction boxes, pull boxes, and conduit type connectors. Painted conductors will not be accepted.
- .5 Copper Conductors: According to the size indicated, under cross-linked thermosetting polyethylene insulation, for voltage 600 V or 1,000 V, and type RWU90 XLPE or RW90 XLPE as indicated in drawings.

2.2 MINERAL-INSULATED CABLES

- .1 Mineral insulated cable according to ULC-S139.
- .2 Conductors: Solid, bare soft-annealed copper, size as indicated.
- .3 Insulation: Compressed powdered magnesium oxide or silicon dioxide to form compact homogeneous mass throughout entire length of cable.
- .4 Outer Covering: Annealed seamless copper sheath, Type M1, rated 600 V, at 250°C.
- .5 Overall Jacket: None.
- .6 Two-hour fire rating.
- .7 Termination Kits: Approved for MI cable.

2.3 CONTROL CABLES

- .1 Type: LVT: Two (2) soft annealed copper conductors, sized as indicated:
 - .1 Insulation: Thermoplastic.
 - .2 Sheath: Thermoplastic jacket, and armor of closely wound aluminum wire.
- .2 Type: Low energy 300 V control cable: Solid annealed copper conductors sized as indicated:
 - .1 Insulation: Polyethylene.
 - .2 Overall covering: Interlocked armor of aluminum strip or FT-4 rated PVC jackets.

2.4 ACCEPTED PRODUCTS

- .1 Prysmian.

June 30, 2020

- .2 Alcatel.
- .3 Southwire.
- .4 General Cable.
- .5 Materials or replacement products approved by addendum, compliant with instructions given to bidders.

2.5 CONDUCTORS, CONNECTION BOXES AND MISCELLANEOUS MATERIALS

- .1 For connectors, wire splices and cables as well as for joints: unless indicated, use 3M products; Scotchlok; Thomas & Betts, PT Series; Buchanan "B", Electric IDI "Super Nut" or approved equivalent.
- .2 Use cable glands or connectors, cable boxes, and flexible conduits, as required.
- .3 Lugs, terminals, and screws used for terminating wiring must be suitable for copper conductor.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform the tests according to the methods approved by the local Authority Having Jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Unless otherwise specified, all conductors shall be installed in conduit. Use flexible conduits (or AC90 cables) for final connections to suspended luminaires and vibrating equipment.
- .2 Do not use a wire smaller than 12 AWG.
- .3 Control circuit conductors for motors and automation of mechanical equipment shall not be less than 14 AWG, except where specifically indicated.
- .4 Before pulling conductors into conduit, ensure conduit is clean and dry. If there is moisture, dry the ducts. To facilitate traction, the recognized lubricants specially manufactured for electrical conductors can be used. Do not use grease. Use appropriate techniques to prevent damage to the conductors when the ambient temperature is below the minimum allowed for each type of insulation. The installation of the ducts must be completed before installing the conductors.
- .5 There shall be no break in the conductors. Before energizing, measure the insulation resistance and comply with the Quebec Construction Code, Chapter V - Electricity - Canadian Electrical Code 2018, Submit a test report to the Departmental Representative showing the measured values.
- .6 Reduce number of splices in a circuit minimum and respect permissible cable lengths and installation conditions.

June 30, 2020

- .7 The conductors for lighting fixtures, outlets, electrical appliances and branch circuits shall have a capacity at least equal to the capacity of the protection device and shall have a rating for a maximum voltage drop of 2% from the power panel to the last device in the circuit. The length of the branch circuit used in determining the rating of a conductor shall be the combined distance, horizontal and vertical, from the switchboard to the last device in the circuit. The size of the conductors must never be less than the size indicated in the following table

120 V, 1 phase	
15-A Circuit	20-A Circuit
0-25 m: Min. No. 12 AWG	0-20 m: Min. No. 12 AWG
More than 25 m: Min. No. 10 AWG	20 m-30 m: Min. No. 10 AWG
	More than 30 m: Min. No. 8 AWG
347 V, 1 phase	
15-A Circuit	20-A Circuit
0-75 m: Min. No. 12 AWG	0-55 m: Min. No. 12 AWG
More than 75 m: Min. No. 10 AWG	More than de 55 m: Min. No. 10 AWG

- .8 Make final connections to lighting fixtures, discharge lamps, and other heat-generating devices with insulated thermoplastic sleeves. When the indicated operating temperature is higher than the insulation temperature of the conductor, use a conductor designed for this purpose.
- .9 Conductors must not be damaged when they need to be stripped.
- .10 Install cable in trenches in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.
- .11 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .12 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .13 Cable Color Coding: To Section 26 05 00 - Common Work Results for Electrical.
- .14 Conductor length for parallel feeders to be identical.
- .15 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .16 Wiring in Walls: Typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided, unless indicated.
- .17 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .18 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring:
- .1 In conduits, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

June 30, 2020

- .2 In underground ducts, in accordance with Section 33 65 73 - Concrete Encased Duct Banks and Manholes and for buried ducts in accordance with Section 33 75 76 - Direct Buried Underground Cable Ducts.

3.4 INSTALLATION OF MINERAL-INSULATED CABLES

- .1 Install cable exposed, securely supported by straps.
- .2 Support 2-hour fire rated cables at 1 m intervals.
- .3 Make cable terminations by using factory-made kits.
- .4 Cable Terminations: Use thermoplastic sleeving over bare conductors.
- .5 Where cables are buried in cast concrete or masonry, sleeve for exit and entry of cables.
- .6 Identify each MI cable with a "600 V" indication sticker at each 3-m interval.
- .7 Install the MI cables according to the manufacturer's recommendations.
- .8 Do not splice cables, unless otherwise indicated.

3.5 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground metal armor of control cables.

3.6 INSTALLATION OF CABLES SUPPLIED WITH EQUIPMENT

- .1 Install cables supplied with the equipment, instrument or component in conduits, flexible or rigid, metallic or non-metallic, according to the application.
- .2 Install straps and box connectors to cables, as required.
- .3 No gland connectors will be accepted for the cabling installed directly to an equipment, an instrument or a component.

3.7 IDENTIFICATION

- .1 For branch circuit wiring, follow the number identification system, Section 26 05 00 - Common Work Results for Electrical.
- .2 Connect single-phase equipment to minimize phase unbalance. Balancing loads on the phases is a place. Indicate all changes to drawings.
- .3 Place all color strips at cable feeders, at all cable ends, at all junction points, at all distribution panels and at all motor control centers. Use two rounds of tape, plastic film, 48 mm wide.
- .4 Color code must be assigned to conductors size 10 and under.

3.8 TEST

- .1 All insulation of power and control cables must be tested with a 1,000 V megohmmeter. Resistance values must be those recommended by the cable manufacturer.

- .2 All test results on conductors must be properly compiled, signed, dated, and submitted to the Departmental Representative.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 27 05 26 - Grounding and Bonding for Communications Systems.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE).
 - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions to install the grounding products. The submittal shall also include the printed product literature and data sheets for grounding equipment, and include product characteristics, performance criteria, physical size, finish, and limitations.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with the manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoor, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 EQUIPMENT**

- .1 Ground equipment according to the requirements of Canadian Electrical Code 2018.
- .2 Electrode Rods: Copper steel, 19 mm in diameter and at least 3 m in length.
- .3 Grounding Conductors: Bare stranded copper, tinned, soft annealed, size as indicated.
- .4 Insulated Grounding Conductors: Green, copper conductors, size as indicated.
- .5 Ground Bus: Copper, size as indicated, complete with insulated supports, fastenings, and 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 connectors.
 - .4 Thermit welded type connectors.
 - .5 Bonding jumpers, flexible braided connectors, and straps.
 - .6 Pressure-wire connectors.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate/supports.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied, as specified in drawings and subsequent items of the same section.

3.2 INSTALLATION - GENERAL

- .1 Install complete permanent, continuous grounding system, including electrodes, conductors, connectors, and accessories. Install connectors in accordance with manufacturer's instructions.
- .2 Provide an insulated copper ground conductor in each conduit used for power, lighting, fire alarm and all low voltage systems required by the building. When conductor size is not indicated, provide the minimum size specified in the Canadian Electrical Code 2018.
- .3 Installer in the data based to instructions of manufacturer.
- .4 Protect exposed grounding conductors.

- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Use buried connections and connections to conductive electrodes, using exothermic connectors, in accordance with ANSI / IEEE 837.
- .7 Soldered joints not permitted.
- .8 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or screw with washer. Provide a grounding conductor in all flexible conduits and connect it to grounding terminals at the equipment and source.
- .9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.3 MAINTENANCE HOLE(S)

- .1 Install conveniently located grounding stud, electrode, size as indicated stranded copper conductor in each maintenance hole.
- .2 Install ground rod in each maintenance hole so that top projects through bottom of maintenance hole. Install, in each maintenance window, a buried earth rod so that the top, provided with a connection flange, protrudes from the floor of the maintenance hole.
- .3 Confirm ground resistance meets or exceeds Canadian Electrical Code 2018 minimum requirements.

3.4 ELECTRODES

- .1 Make ground connections to water pipe, on building side of water meter.
- .2 Install indicated rod electrodes and make grounding connections.
- .3 Bond together separate electrodes.
- .4 Use copper conductors of size as indicated for connections to electrodes.
- .5 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, UPS, control panels, building steel work, distribution panels, outdoor lighting, cable trays, variable frequency drives, lighting frames, and natural gas entrances.
- .2 Provide a grounding conductor for all main electrical equipment and connect to the secondary grounding system. This includes the equipment located in the main electrical room and the equipment of each secondary room containing electrical equipment. Conductors must be of a size that complies with the Canadian Electrical Code 2018 and the equipment manufacturer's requirements.

3.6 GROUNDING BUS

- .1 Install grounding bus mounted in the main electrical room and the main communication room, or at location indicated on drawings.
- .2 Connect items of electrical equipment room and main communication equipment room to ground busbars, with individual bare stranded copper connections size 1/0 bare stranded bare copper conductors (unless otherwise specified on drawings).
- .3 Use copper grounding terminals to connect grounding conductors to ground busbars.

3.7 grounding of MECHANICAL EQUIPMENT

- .1 Install a grounding conductor in all conduits serving the motor supply circuits. Connect the conductor to grounding screw of junction boxes and to output boxes.

3.8 GROUNDING of LOW VOLTAGE SYSTEMS

- .1 Install a 6 AWG insulated conductor in a conduit from the ground bus to the following equipment:
 - .1 Main fire alarm panel;
 - .2 Main security panel;
 - .3 Entrance of communication cables;
 - .4 Cable entry of security systems;
 - .5 Closet and main telephone room;

3.9 grounding of COMMUNICATION SYSTEMS

- .1 Install an isolated grounding conductor in a main building earthing conduit as follows:
 - .1 1/0 AWG conductor to the ground busbar of the telecommunications room;
 - .2 Unless otherwise specified, ground all steel, for telephone and data conduit with 12 AWG insulation wire from the nearest communication ground busbar;
 - .3 Provide grounding of communication systems in accordance with shop drawing requirements and requirements of section 27 05 26;
 - .4 The earthing and connection system is dedicated to the telecommunications system, in accordance with ANSI / TIA 607: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, and its addendas. The system must be connected to the building grounding system;
 - .5 Make earthing connections for telephone, PA, fire alarm, security and intercom systems as follows:
 - .1 Telephone: Ground in accordance with Section 27 05 26 - Grounding and Grounding Telecommunications Networks and Telephone Company Requirements.
 - .2 Sound, fire alarm, security, and intercommunication: According to the manufacturer's requirements.

3.10 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions.
- .3 Measure resistance of grounding system with a megohmmeter for a ground test. Install additional ground rods and grounding conductors as required until the grounding resistance meets the requirements of the Canadian Electrical Code 2018 and less than 10 ohms. Transmit the test results to the Departmental Representative.
- .4 Ensure that test results are satisfactory before energizing electrical system.
- .5 .

3.11 grounding OF BUILDING SERVICES

- .1 Metallic Drinking and Wastewater Piping: Each metal conduit for potable and wastewater from the building shall be grounded by a minimum 6-AWG copper bond jumper, in accordance with the Canadian Electrical Code 2018.

3.12 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools, and equipment, in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 30 - Fasteners and Seismic Devices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hangers and supports from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 FASTENERS AND SUPPORT SYSTEM**

- .1 Materials:
 - .1 Structures for heavy loads shall be fabricated and welded from structural steel members. Apply a primer paint before installing these structures.
- .2 Finishes:
 - .1 Outdoor, for wet locations: Hot-dip galvanized finish.
 - .2 Indoor, for dry locations: Galvanized finish, if not available, apply primer.
 - .3 Nuts, bolts, and screws: Cadmium plated.

June 30, 2020

2.2 ANCHORS FOR CONCRETE AND MASONRY

- .1 Materials: Hardened steel anchors, galvanized to resist corrosion. All anchor bolts must be galvanized.
- .2 Components: Anchors for use in pre-drilled holes, sized to safely support the applied load, with a minimum safety factor of 4.

2.3 NON-METALLIC ANCHORAGE

- .1 Materials: Plastic dowels for sheet metal screws.

2.4 CONDUIT SUPPORTS

- .1 Malleable two-hole cast-iron ducts, weather resistant. Two-hole steel straps when used indoors.
- .2 Masonry, concrete, and stone: Anchors.
- .3 Metal uprights and ceiling hangers.

2.5 CABLE SUPPORTS AND ATTACHES

- .1 As for conduit, except for single-conductor cables, use non-ferrous fasteners or approved fasteners made of stainless steel or aluminum to support the cables.
- .2 Supports and fasteners must come from a recognized manufacturer and be CSA approved.

Part 3 Execution**3.1 EXAMINATION**

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

3.2 GENERAL

- .1 Do not cut or drill beams, joists or structural steel, except with the written permission of the Departmental Representative.
- .2 Distance between conduit and cable supports must not exceed Code requirements.
- .3 Supports to be adapted to actual equipment loads.
- .4 Supports must be securely fastened, free from vibration and excessive sagging or rotations. The maximum deflections are 4 mm over a length of 1 m and 8 mm over a length of 2 m.

June 30, 2020

- .5 Install fasteners and supports in sufficient quantity for each type of cable, equipment, and conduit, in accordance with manufacturer's installation recommendations.
- .6 Provide conduit supports including 25% spare capacity for future cable pulling.
- .7 Provide profiles with fittings for vertical sections of conduits and cables.

3.3 INSTALLATION

- .1 Secure equipment to masonry, ceramic, and plaster surfaces using lead anchors.
- .2 Secure equipment to poured concrete surfaces using expansion plugs.
- .3 Support conduits or cables with clips, spring bolts, or cable ties designed as accessories for "U" profiles.
- .4 The use of ligation wire or perforated strip to secure pipes or cables is prohibited.
- .5 Suspended Support Systems:
 - .1 Support each cable or conduit with 6 mm diameter threaded rods and spring clips.
 - .2 Support two or more cables or conduits on "U" -shaped sections supported by 6 mm diameter threaded suspension rods, when it is impossible to attach directly to the frame of the building.
- .6 Fixings with duct mounting gun may be used only with the written authorization of the Departmental Representative.
- .7 Use round or cylindrical head screws to attach fastening straps for boxes, conduits, and other equipment.
- .8 Do not support heavy loads from the lower chords of open steel joists.
- .9 Do not use conduits entering exit boxes, junction boxes, panels, and other electrical equipment to support this equipment. Support ducts at 600 mm outlet boxes. Support surface mounted electrical panels with a minimum of four (4) 6-mm clips.
- .10 For two or more stand out ducts, use "U" profiles installed at 1.5 m centers.
- .11 Install terminals, brackets, hooks, clamps, and any other type of metal bracket where indicated and where required, to support conduits and cables.
- .12 Provide suitable support for piping and cables installed vertically, without wall mounting, to equipment.
- .13 Do not use supports and equipment installed by other trades as conduit or cable support, except with the approval of both tradespeople and the Departmental Representative.
- .14 Fix devices, conduits, and equipment to structural members of the building. Use the appropriate media.

3.4 CLEANING

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

- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools, and equipment, in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 ASHRAE, Applications Handbook (SI).
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM E488-10, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
- .3 Canadian Standards Association (CSA International).
 - .1 CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Research Council Canada (NRC-CNRC).
 - .1 National Building Code of Canada (NBC) - 2015.
- .6 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA, Addendum No. 1, September 2000 to Seismic Restraint Manual, Guidelines for Mechanical Systems.
 - .2 SMACNA, Seismic Restraint Manual, Guidelines for Mechanical Systems.

1.3 DEFINITIONS

- .1 SRS: Acronym for Seismic Restraint System.

1.4 DESCRIPTION

- .1 SRS fully integrated into, and compatible with:
 - .1 Noise and vibration controls specified.
 - .2 Structural, mechanical, and electrical design of project.
- .2 Systems, equipment not required to be operational during and after seismic event.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
- .4 Designed by a professional engineer specializing in design of SRS and registered in Province of Quebec.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Quebec, Canada.
 - .2 Submit design data including:
 - .1 Full details of design criteria.
 - .2 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
 - .3 Separate shop drawings for each SRS and devices for each system, equipment.
 - .4 Identification of location of devices.
 - .5 Lists of types of SRS equipment and devices.
 - .6 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
 - .7 Installation procedures and instructions.
 - .8 Design calculations, including restraint loads to NBC and Supplement.
 - .3 Quality Assurance Submittals:
 - .1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: Submit manufacturer's installation instructions.

1.6 RESPONSABILITIES

- .1 Each contractor is responsible for the seismic measures required by his trade.
- .2 The conception of each seismic device must be designed by an engineer that is registered to practice in the Province of Quebec, Canada, mandated by the Contractor. The specialized engineer must sign and seal the design drawings.

1.7 ANCHORING DEVICES

- .1 Install the anchoring devices and the seismic stabilizers for the conduits and equipment according to the prescriptions in the "ASHRAE, A Practical Guide to Seismic Restraint" book, the ANSI-SMACNA 001 Standard and according to the building classification.

Part 2 Products**2.1 GENERAL**

- .1 All electrical equipment mounted on suspended ceilings must be attached directly to the building structure.
- .2 Seismic devices must prevent permanent displacement and damage caused by the horizontal and vertical movements, and overturning.

- .3 Seismic devices must be compatible with the electromechanical design. They should not interfere with normal operation of electromechanical systems.
- .4 SRS to provide gentle and steady cushioning action and avoid high impact loads. The latter must not interfere with any sound or vibration treatment elements.
- .5 Fasteners and attachment points to resist same load as seismic restraints.
- .6 Fasteners installed with a nail gun or in holes made to this effect are prohibited.
- .7 No device or related support nor any plot should yield before the structure or the structure breaks.
- .8 SRS utilizing cast-iron or threaded pipes not permitted.
- .9 Seismic control measures not to interfere with integrity of firestopping.
- .10 Accessories, such as speakers and lighting fixtures installed in suspended ceilings, do not have to be stabilized, except in exit corridors or if the ceiling is specifically designed to withstand earthquakes.

2.2 SRS DEVICES

- .1 The supports must be complete with longitudinal and transverse bracings. They can be rigid or cable types.
- .2 Do not stabilize material if the length of the suspension rods is less than 300 mm.
- .3 Stabilize channels and electrical conduits of 35 mm nominal diameter and more, located inside a mechanical room.
- .4 Stabilize channels and electrical conduits of 63 mm nominal diameter and more, located outside a mechanical room.
- .5 Install mechanical restraint devices at the following frequency:
 - .1 For transversal restraint:
 - .1 SHL-A: Every 6.1 m linear meters;
 - .2 SHL-B: Every 10 linear meters;
 - .3 SHL-C: Every 12.2 linear meters.
 - .2 For longitudinal restraint:
 - .1 SHL-A: Every 12 linear meters;
 - .2 SHL-B: Every 20 linear meters;
 - .3 SHL-C: Every 24.4 linear meters.
- .6 A transversal bracing can serve as a longitudinal brace, if the latter is installed 600 mm away from a channel/conduit direction change.

2.3 STATIC EQUIPMENT

- .1 The material must be fixed to the suspension supports that must be installed to the structure.
- .2 Use one or many of the following methods below or as per indications on drawings:
 - .1 Anchor equipment supports to structure;
 - .2 Stabilize the equipment mechanically in all directions;

- .3 Brace suspensions in each plane;
- .4 Brace the suspensions to the structure using cables.
- .3 SCS to prevent sway in horizontal plan, "rocking" in vertical plane, sliding and buckling in axial direction.
- .4 Hanger rods to withstand compressive loading and buckling.

2.4 EQUIPMENT HUNG WITH ISOLATORS

- .1 The material must be fixed to suspension supports that in turn, must be fixed to the structure using cables.
- .2 The devices must act continuously and in a supple manner.
- .3 The SRS must not constrain the soundproofing and antivibration properties of any element. In normal exploitation, a 6 to 12 mm gap between the equipment and the SRS must be maintained.

2.5 EQUIPMENT SUPPORTED WITH ISOLATORS

- .1 In case SRS are used, the latter must be designed and installed to resist minimal acceleration forces.
- .2 Devices must never be compressed to the point of losing their efficiency.
- .3 In case standard isolators are used, SRS must be incorporated to the antivibration elements to resist "toppling" of the latter.
- .4 SRS must not constrain the soundproofing and antivibration properties of any element. In normal exploitation, a 6- to 12-mm gap between the equipment and the SRS must be maintained.

Part 3 Execution

3.1 INSTALLATION

- .1 To withstand same maximum load that seismic restraint is to resist same maximum charges.
- .2 Ensure that the connection to the conduits and channels will not diminish the flexibility of the antivibration elements, and the conduits and channels will not transmit vibrations.
- .3 For equipment without integrated attach points, provide attach points with "belt" systems.
- .4 The structural base of any equipment must be stabilized to prevent toppling.
- .5 A 25-mm clearance must be respected between an SRS and any service element.

3.2 ANCHORS

- .1 Check that anchor bolts, diameters of the ankles, depth of the indentations in the concrete and length of the welds are done according to the drawings submitted for approval.
- .2 Bolt all the material that is not insulated to vibration transmission to the structure.
- .3 Oblong openings for adjustment bolts are prohibited.

- .4 To improve seismic resistance, smaller conduits and channels can be attached to larger conduits and channels that will retain them. The inverse practice is prohibited.
- .5 Anchors in the concrete slabs should be removed from the edges following the standard ASTM E488 and recommendations of the manufacturer of the anchors.

3.3 SLACK CABLE SYSTEMS (SCS)

- .1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.
- .2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
- .3 Orient restraint wires on ceiling hung equipment at approximately 90° to each other, tie back to structure at maximum of 90° to structure.
- .4 Tighten cable to reduce slack to 19 mm under thumb pressure. Cable not to support weight during normal operation.

3.4 INSTALLATION VERIFICATION FROM MANUFACTURER

- .1 The engineer designing the SRS must be on-site to verify the compliance of the installation. Then, he must supply to the Departmental Representative a report containing deficiency resolving recommendations.
- .2 If applicable, the Contractor must make the necessary corrections and adjustments based on the written report submitted by the supplier.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CSA C22.1-F-18, Canadian Electrical Code, Part 1, 24th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 SPLITTERS**

- .1 Construction: Sheet metal enclosure, welded corners, and formed hinged cover suitable for locking in closed position.
- .2 Terminations: Connection blocks or main and branch lugs to match required size and number of incoming and outgoing conductors, as indicated.
- .3 Spare Terminals: Minimum three spare terminals spare or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES FOR INDOOR INSTALLATION IN DRY LOCATIONS

- .1 Construction:
 - .1 Welded steel enclosure, phosphate or galvanized construction.

June 30, 2020

- .2 Components:
 - .1 Recessed mounting: Cover with edge protruding by at least 25 mm and retaining screw.
 - .2 Lid, for surface mounting: Lid with turned edge.
 - .3 Dimensions of the boxes must comply with the Canadian Electrical Code 2018, for a given number and diameter of pipes. The dimensions of the boxes must be in accordance with the Canadian Electrical Code 2018, for the layout, the number of conductors and the number of splices inside the boxes.
 - .4 Surface or recessed box with hinged door, lock, latch, and two keys identical to those of electrical panels.
 - .5 Back panel: 19-mm plywood.
- .3 Junction boxes installed in exterior walls to be installed with vapor barrier.
- .4 Flush Mounted Covers: 25 mm minimum extension all around.
- .5 Surface Mounted Covers: Screw-on flat covers.

2.3 CABINETS

- .1 Construction:
 - .1 Cabinets: Sheet steel, welded construction, phosphate and factory-painted, suitable for painting in the field.
 - .2 Lock: Same as distribution panels.
 - .3 Back panel: 19-mm plywood, one plywood to display back of cabinet. The plywood is supplied and installed by the Architectural Section.
- .2 Components:
 - .1 Surface or recessed cabinet with hinged door, lock, latch, and two wrenches, surface mounting frame, dimensions shown or to be determined on site.
 - .2 Surface or recessed cabinet with surround and hinged door, lock, and two keys, dimensions as indicated or in accordance with Canadian Electrical Code 2018, for a given number and diameter of ducts. The cabinet dimensions are in accordance with the Canadian Electrical Code 2018 for coiling, number of conductors, and number of splices inside cabinets. Keys must be identical to those of the electrical panels.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Mount plumb, true, and square to building lines.
- .2 Extend splitters full length of equipment arrangement, except otherwise indicated.

3.2 CABINETS, JUNCTION and PULL BOXES INSTALLATION

- .1 Junction Boxes and Pull Boxes:
 - .1 Provide all pull and junction boxes indicated on drawings or required for installation.

June 30, 2020

- .2 Boxes installed between studs in walls must be installed with minimal space.
 - .3 Install junction and pull boxes in concealed spaces, but easy access, overhead of accessible ceilings, in electrical rooms, utility rooms, or storage areas.
 - .4 Identify boxes with system name and circuit designation.
 - .5 Dimensions must be, at a minimum, in accordance with the Canadian Electrical Code 2018.
 - .6 All the junction or pull boxes must be of appropriate size, according to the number of conductors and the associated conduit diameter.
 - .7 Installer of draw boxes after a total bend of 270° between boxes.
 - .8 Only main junction and pull boxes are indicated. Install additional pull boxes in order to ensure the conduits between each box have a length inferior to 30 m and in such a way to not have more than three 90° bends, or the equivalent between distribution boxes and two 90° bends, or the equivalent for other empty network conduits
 - .9 All junction boxes and pull boxes must be correctly identified according to the number of conductors and the associated pipe diameters.
- .2 Cabinets:
- .1 Mount cabinets with top not higher than 1,980 mm above finished floor except where indicated otherwise. Coordinate the installation of panels, fire cabinets, and similar elements with masonry. Securely fix bottom plates inside cabinets.
 - .2 Install terminal blocks when indicated.

3.3 IDENTIFICATION

- .1 Equipment Identification: To Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: Size 2, indicating the name of the network, the power source, the allowable current, the tension, and the number of phases.
 - .1 Paint in red cabinets and fire alarm systems.
 - .2 Paint in blue cabinets and enclosures of telecommunications systems.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CSA C22.1-F15, Canadian Electrical Code, Part 1, 23rd Edition.
 - .2 CSA C22.2 No.40 (R2009), Short Circuit, Junction and Pull Boxes.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples for floor box in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 OUTLET AND CONDUIT BOXES - GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 Square 102-mm or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped in same location.
- .4 Galvanized-steel receptacle boxes, measuring at least 103 mm. on each side and oversized when the number of conductors exceeds the standard size. Concrete sockets with rear opening when installed in a slab. Cast-iron fittings when exposed and appropriate supports to retain fasteners.
- .5 The apparatus plates shall have a finished finish with that of the mains of the multi-tap system. Voltage and rated current of each receptacle appear on the recess of the cover. Outlets powered from a back-up source must be of the face type illuminated by an integrated neon lamp.
- .6 Blank cover plates for boxes without wiring devices.

June 30, 2020

- .7 Plates to cover switches, single outlets and multiple outlets are stainless steel, satin finish on recessed receptacle boxes, and galvanized covers installed at pressure on surface receptacles. Weatherproof plates that are fitted with a gasket with spring covers. The plates must be stainless steel in places that may have corrosive materials. Orifices with sockets. Finishing plates for electrical installations and wall socket boxes must match the finish of mechanical apparatuses.
- .8 All receptacle covers shall be identified according to panel and circuit breaker corresponding to that circuit.
- .9 For appliances inside cells, lids must have "safety screws".
- .10 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 OUTLET BOXES FOR METAL CONDUIT

- .1 Materials.
 - .1 One-piece electro-galvanized construction.
 - .2 Concealed surface or concealed installation: Die-cast steel, hot-dip galvanized, minimum zinc coating 350 g/m².
 - .3 Exposed surface mounting: With fixing brackets, cast metal for threaded conduit, covered with two corrosion-resistant topcoats.
- .2 Electro-galvanized steel sheet boxes for flush mounting in walls with matching extension frame and plaster frame as required.
- .3 Install pull boxes in concealed, accessible locations.
- .4 The security access box shall be fitted with a tamper-resistant 1.9-mm 304 stainless steel tamper-proof type cover.
- .5 The frame shall be 0.90-mm galvanized steel with a rear mounting flange and a reinforced flange at the front.
- .6 Single or gang boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102-mm square outlet boxes when more than one conduit enters one side, with extension and plaster rings, as required.
- .7 Distribution boxes for outlets connected to surface mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .8 102-mm square or octagonal outlet boxes for lighting fixture outlets.
- .9 Extension and plaster rings for flush mounting devices in gypsum walls, with coverings or ceramic tile finishes.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi-gang boxes for flush-mounted devices in exposed block walls.

June 30, 2020

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
 - .1 Pull boxes for luminaires must be flush mounted, completely hidden behind the luminaires.

2.5 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum face plate. Device mounting plate to accommodate short or long ear single or duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for the indicated conduits. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

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

2.7 FITTINGS - GENERAL

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

Part 3 Execution**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges, foam, or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armored cable connections. Do not install reducing washers.
- .5 Install all outlets flush or surface mounted, depending on installation.
- .6 Install surface outlet boxes above suspended ceilings or unfinished areas.
- .7 Adjust the position of the outlets in finished masonry walls along the lines of the building. Coordinate the cutting of masonry walls to achieve neat openings for all boxes.
- .8 Do not deform boxes during installation. If the boxes are deformed, replace them with new boxes.

- .9 Use plaster frames to correct depth of installation of boxes. Use 30-mm finishing frames for concrete blocks.
- .10 Do not use severed boxes.
- .11 Provide boxes of dimensions in accordance with the Canadian Electrical Code 2018.
- .12 Install vapor barrier material to surround and seal all exit boxes located on exterior walls of building. Maintain the wall insulation.
- .13 Boxes installed in party walls must be installed with a minimum space equivalent to the thickness of an amount between each box.
- .14 An outlet box shall be provided on the ceiling for each surface mounted fixture or row fixture mounted on suspended ceilings.
- .15 Install a ring in the termination box for cable connection.
- .16 Install a ring in the termination box for connection in a gutter.
- .17 For telecommunications conduits, provide a pull box when the length exceeds 30 m or where there are more than two 90° elbows.
- .18 The boxes of the fire alarm system must be painted red on their outside surfaces.
- .19 The boxes of telecommunications systems shall be painted blue on their outer surfaces.
- .20 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .21 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's printed product literature, specifications, and data sheets.
 - .1 Submit cable manufacturing data.

1.4 QUALITY INSURANCE

- .1 Test Report: Submit the testing reports delivered by independent and well-known laboratories.
- .2 Certification: Submit the signed documents from the manufacturer, certifying that the products and materials satisfy the required physical characteristics and performance criteria.
- .3 Instructions: Submit installation instructions supplied by the manufacturer.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.6 GENERAL

- .1 All conduits, tubes, and their paths are not necessarily on the drawings. Those that are present are represented schematically.

June 30, 2020

- .2 For communications and fire alarm, the entire length of all the cables must be painted in the factory. The color required per cable is as specified in Section 26 05 00 - Common Work Results for Electrical.
- .3 Conceal all conduits installed in finished areas. Conduits may be surface mounted only, at locations indicated or in service areas accessible only to authorized personnel.
- .4 Note special requirements for conduit routing.
- .5 Provide a polypropylene pull rope in all empty conduits.
- .6 All conduits required for Divisions 27 and 28 to be supplied and installed by Division 26 - Electrical.

Part 2 Products

2.1 CABLES AND REELS

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively DC applications.

2.2 CONDUITS

- .1 Rigid Metal Conduit: To CSA C22.2 No. 45, hot dipped galvanized steel.
- .2 Epoxy Coated Conduit: To CSA C22.2 No. 45, with zinc coating and corrosion-resistant epoxy finish, inside and outside.
- .3 Electrical Metallic Tubing (EMT): To CSA C22.2 No. 83, with couplings.
- .4 PVC Rigid Conduit: To CSA C22.2 No. 211.2.
- .5 Flexible Metal Conduit: To CSA C22.2 No. 56, liquid-tight flexible metal.
- .6 Conduits and tubes of minimal nominal diameter of 21 mm, unless otherwise indicated.

2.3 CONDUIT FASTENINGS

- .1 One-hole galvanized steel straps to secure surface conduits 27 mm and smaller.
 - .1 Two-hole steel straps for conduits larger than 27 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 "U"-Channel type supports for two or more conduits at 1.5 m intervals.
- .4 10-mm threaded rods, to support suspended channels.
- .5 Metallic Fasteners. Plastic fasteners are strictly prohibited.

June 30, 2020

2.4 CONDUIT FITTINGS

- .1 Fittings: To CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
- .2 Ensure factory "ells" where 90° bends for 25 mm and larger conduits.
- .3 EMT conduit fittings and connectors shall be of galvanized steel or die-cast zinc alloy. Fittings used for conduits containing fire-resistant cables shall be made of steel. Standard die-cast fittings and sleeves are not acceptable. Provide plastic sockets (isolated groove) for all connectors. All connectors will be waterproof type. Pressure screw connectors are prohibited.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings able to withstand a linear expansion of 19 mm and ensuring the continuity of the grounding network.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Polypropylene, length in accordance to each conduit and exceeding each conduit by 3 m.

Part 3 Execution**3.1 MANUFACTURER'S INSTRUCTIONS**

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

3.2 INSTALLATION

- .1 Use electrical metallic tubing (EMT) when not subjected to mechanical damage, except in cast concrete or otherwise indicated.
- .2 It is prohibited to use EMT conduits in dangerous locations where corrosive vapors can form.
- .3 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .4 Unless otherwise indicated on drawings, conceal conduits, except in unfinished areas, in mechanical and electrical service rooms. Do not conceal conduits in columns without permission, unless otherwise indicated.
- .5 Install the dissimulated conduits in the apparent concrete.
- .6 Use rigid galvanized steel threaded conduit, in explosion proof locations or when they risk undergoing mechanical damage. Rigid galvanized steel pipe is required for surface installations up to 1.5 m above the floor.
- .7 Use epoxy coated conduit in corrosive areas.

June 30, 2020

- .8 Use rigid PV conduits when the latter are installed under poured concrete or underground installations, outside of the building's foundation line.
- .9 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to LED lighting devices, connection to surface or recessed fluorescent fixtures, and fixtures or parts mounted in removable metal partitions.
 - .1 Unless otherwise indicated, the maximum length of this type of conduit is 1,000 mm.
- .10 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet, or corrosive locations, and for connection to transformers.
- .11 Use explosion proof flexible connection for connection to explosion proof motors.
- .12 Install conduit sealing fittings in hazardous areas.
 - .1 Fill with compound.
- .13 Minimum conduit size for lighting and power circuits: 21 mm.
- .14 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than $\frac{1}{10}$ th of its original diameter.
- .15 Mechanically bend steel conduit over 21-mm diameter.
- .16 Damaged conduits shall be repaired or replaced.
- .17 Field threads on rigid conduit, execution onsite, must be of enough length to draw conduits up tight.
- .18 Provide a polypropylene pull cord in empty conduits to facilitate installation of future wiring.
- .19 Seal openings with approved sealer where conduits, cables, or cable troughs are crossing fire separation.
- .20 Provide required seals when ducts pass through roof or waterproof membranes. Apply an approved sealant to maintain the integrity of the membrane
- .21 From each recessed panel, install from ceiling void and to floor space, four (4) 27-mm supply conduits for future use. Finish conduits in junction boxes, dimensions 152 mm x 152 mm x 102 mm, housed in ceiling; in case of an apparent concrete slab. They must end in boxes mounted onto the slab.
- .22 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .23 Completely dry out conduits before installing cabling. Clean exterior of conduits and carefully clean the interior of conduits before pulling wires and cables.
- .24 Install conduits to avoid interference with other work. Maintain a minimum 150-mm clearance with steam lines or hot-water and vent piping.
- .25 Install ducts to maintain maximum clearance in exposed locations while causing the least possible interference in the spaces they pass through. Schedule and coordinate work with other services before installation of conduits. Maintain the access to junction and pull boxes.

June 30, 2020

- .26 All conduits installed in finished areas must be free of labels and trademarks.
- .27 All conduits must be bored to ensure a smooth interior finish so as not to damage the wiring installation.
- .28 Provide continuity to earth in all conduit systems.
- .29 It is forbidden to imbed conduits in terrazzo structure or in concrete screeds, unless otherwise indicated.
- .30 Protect conduits to prevent entry of dirt and moisture during construction.
- .31 In case of conduits installed parallel to steam or hot-water pipes, provide a lateral clearance of at least 75 mm; also provide a clearance of at least 25 mm in case of crossings.
- .32 Conduits shall not pass through structural members, unless otherwise indicated and authorized by Departmental Representative.
- .33 Diameters of conduits indicated on drawings are minimal. Increase the diameter of the conduits for the use of alternative types of wiring or to comply with the Canadian Electrical Code 2018.
- .34 Conduits and sheath passing through building expansion joints shall have expansion joints approved for the type of conduit used.
- .35 Seal conduits with approved sealant where conduits are installed between heated and unheated areas.
- .36 When conduits are crossing walls, they shall be grouped and passed in the same opening. When conduits are installed, opening shall be closed with material compatible with the composition of the wall or to meet any fire-separation integrity.
- .37 When conduits designation is indicated on drawings, these conduits must be identified at each endpoint with labels.

3.3 SURFACE CONDUITS

- .1 Exposed conduits accepted in mechanical and electrical service rooms and in service spaces.
- .2 Run parallel or perpendicular to building lines.
- .3 Route conduits through steel frame members, if required.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Surface conduits not accepted in finished premises.
- .6 In the service space, install the ducts to the ceiling in the ribs of the steel deck over the transverse beams. Space is 30 m high x 100 wide for each rib.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls, unless otherwise indicated.
- .3 Do not install conduits in terrazzo or concrete toppings, unless otherwise noted.
- .4 Secure all dissimulated tubes and conduits, including those above the suspended ceiling.

June 30, 2020

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 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.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in Slabs: Minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25-mm concrete cover.
- .7 Organize conduits in slab to minimize crossovers.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encase in 75-mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.8 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CAN/CSA C22.1 No.126.2-02, Non-Metallic Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA VE 1-2002, Metal Cable Tray Systems.
 - .2 NEMA VE 2-2001, Cable Tray Installation Guidelines.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: Submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4 Identify types of cable troughs used.
- .5 Show actual cable trough installation details and suspension system.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products**2.1 CABLE TROUGHS**

- .1 Cable troughs and Fittings: To CAN/CSA C22.1 No. 126.1
- .2 Cable troughs for telecommunications room: Ladder type, Class A, to CAN/CSA C22.2 No. 126.1.
 - .1 Hot-dipped galvanized steel.
 - .2 Space between rungs to be 225 mm.
 - .3 100 mm height and 3,000 mm length.
 - .4 Width: According to indications in drawings.
 - .5 Steel caliber: 16, minimum.

June 30, 2020

- .3 Cable troughs type for hallways: Ladder type, Class A, to CAN/CSA C22.2 No. 126.1.
 - .1 Hot-dipped galvanized steel.
 - .2 Space between rungs to be 225 mm.
 - .3 100 mm height and 3,000 mm length.
 - .4 Width: According to indications in drawings.
 - .5 Steel: Size 16 minimum.
- .4 Fittings and Accessories: Horizontal elbows, end plates, drop-outs, vertical risers and drops, tees, wyes, expansion joints, and reducers where required, manufactured accessories for cable trough supplied.
 - .1 Radii on fittings: 305 mm minimum.
- .5 Ground cable trough with #2 AWG bare copper conductor attached to each tray section in accordance with Canadian Electrical Code 2018.
- .6 Fire-stop system at penetrations of fire separations in accordance with Section 07 84 00 - Fire Stopping.

2.2 SUPPORTS

- .1 Provide galvanized-steel splices, supports for a continuously grounded system as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Install complete cable trough system in accordance with NEMA VE 2.
- .2 Support cable trough on one side.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.
- .4 Ground each section of the cable trough with #2 AWG cable as per Canadian Electrical Code 2018 requirements.

3.2 CABLES IN CABLE TROUGH

- .1 Install cables individually.
- .2 Lay cables (telecommunications or physical security) into cable trough. Use rollers when necessary to pull cables.
- .3 Secure cables in cable trough at 6 m centre, with steel ties.
- .4 Identify cables every 30 m, with size 2 nameplates, in accordance with Section 26 05 00 - Common Work Results for Electrical.

3.3 GROUNDING

- .1 Supply and install a bare stranded copper grounding wire, caliber according to indications.

June 30, 2020

- .2 Connect the grounding conductor to the cable tray at 3-m intervals with the appropriate connectors.
- .3 Connect the grounding cables to the grounding bar.

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 33 65 73 - Concrete Encased Duct Banks and Manholes.
- .3 Section 33 65 76 - Direct Buried Underground Cable Conduits.

1.2 REFERENCE STANDARDS

- .1 Insulated Cable Engineers Association, Inc. (ICEA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect cables from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 CABLE PROTECTION**

- .1 Yellow indicator to locate buried conduits in soil or other protection as per indications on drawings.

June 30, 2020

Part 3 Execution**3.1 EXAMINATION**

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

3.2 CABLE INSTALLATION IN CONDUITS

- .1 Install cables in conduits, as indicated.
- .2 Do not pull spliced cables inside conduits.
- .3 Install all cables passing in same conduit simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of color coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into conduits and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
 - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short-circuits, and grounds.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance Tests:
 - .1 After installing cable, but before splicing and terminating, perform insulation resistance test with 1,000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested, and result of each test.
- .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.4 CLEANING

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

3.5 PROTECTION

- .1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 50 00 - Lighting.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations.
 - .2 Store and protect photoelectric devices from nicks, scratches, and blemishes.
 - .3 Protect metal accessories and trim from being bent or damaged.
 - .4 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse as specified in Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 PHOTOELECTRIC CONTROL INTEGRATED TO LIGHTING**

- .1 Photoelectric Lighting Controls: To CSA C22.1.
 - .1 Installation in the luminaire.
 - .2 Capable of commanding a lighting contactor.

June 30, 2020

- .3 Voltage variation: $\pm 10\%$.
- .4 Temperature range: $- 40^{\circ}\text{C}$ to $+ 70^{\circ}\text{C}$.
- .5 Rated for 5,000 operations.
- .6 Delayed start-up.
- .7 Switching time delay of 30 s.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for lighting control device installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install photoelectric controls in accordance with manufacturer's written instructions and to CSA C22.1.

3.3 CLEANING

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

3.4 PROTECTION

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 50 00 - Lighting.

1.2 REFERENCE STANDARDS

- .1 All the components described in the present Section shall comply with the following Standards and Codes, according to the latest governing version:
 - .1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast;
 - .2 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits;
 - .3 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners;
 - .4 ICES-005-07, Radio Frequency Lighting Devices;
 - .5 UL 508 - Standard for Industrial Control Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Shop drawings: Submit drawings stamped and signed by a professional engineer registered or licensed in the Province of Quebec.
- .3 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Quality Assurance Submittals: Submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Test reports:
 - .1 Submit certified test reports 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.
 - .3 Manufacturer's Instructions: Submit manufacturer's installation instructions.
 - .4 Manufacturer's Field Reports: Manufacturer's field reports specified.

June 30, 2020

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store, and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Waste Management and Disposal: Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 DESCRIPTION**

- .1 Provide a complete digital lighting management system with all cabinets, wiring, and components necessary to maintain a complete and functioning system as shown on drawings and specified here.
- .2 The lighting control and automation system, as defined in this Section, covers the following equipment:
 - .1 Local digital lighting management network: Open topology plug-in cabling system (Cat 5e) for power and data devices to rooms;
 - .2 Wired digital room controllers: Controllers with one, two, or three relays on the plenum side, with automatic configuration and digital addressing, for "On/Off" control. Selected models include 0-10 V or line voltage direct phase control dimming outputs and built-in current monitoring capabilities;
 - .3 Charge controllers with wired digital plug: Controllers specific to the plenum application, with automatic configuration, digitally addressable, with a single relay. Selected models include integral current monitoring capabilities;
 - .4 Wired controllers for digital devices: Controllers integrated into a relay, with automatic control and digitally addressable, for "On/Off"/0-10 V dimming control;
 - .5 Wired digital occupancy sensors: Configurable occupancy sensors with digital addressing and digital calibration with LCD screen and communications bidirectional active infrared (IR);
 - .6 Wired digital switches: Configurable auto switches, digital addressing "On/Off" dimming button, with two-way active infrared (IR) communication;
 - .7 Wired input and output interfaces.

June 30, 2020

- .3 Local Communication Network: Communication in the room is via a Cat 5e wired network.
 - .1 LMRJ series wired network: Local area network is a free topology lighting control communication and physical connection protocol designed to control a small area of a building.
 - .1 Wired LAN features are:
 - .1 Automatic configuration and "Plug n'Go" connection of occupancy detectors, switches, and lighting loads to the most energy-efficient operating sequence based on the attached device;
 - .2 Simple replacement of any device on the local network with a standard unit available without requiring commissioning, configuration or adjustment;
 - .3 To change the automatic configuration as well as the tool-less connection parameters, use the "Push n'Learn" button on the digital devices on the network;
 - .4 Two-way infrared communication to control by portable remote control, including adjustment of charge parameters, sensor configuration, and connection within a maximum of 9 m (30 ft) from a sensor, wall switch or an IR receiver.
 - .2 Digital devices connect to the local network using Cat 5e cables with RJ-45 connectors, which provide both data and power to the devices in the room. Systems that use RJ-45 cords that do not provide serial communication data from individual terminal devices are unacceptable.
 - .3 If the manufacturer's Cat5e cables are not used for installation, each cable must be individually tested by an authorized technician after installation.

2.2 WIRED DIGITAL LOAD CONTROLLERS

- .1 Digital Charge Controllers: The digital lighting zone, luminaire and/or outlet load controllers automatically connect the room charges to the control devices connected in the space without requiring any commissioning or tools. Provide controllers that meet the room lighting control requirements. Simple to install, the controllers do not have DIP switches/potentiometers and require no special configuration for standard "Plug n'Go" applications. The control units include the following features:
 - .1 Automatic room configuration according to the most energy efficient operating sequence, depending on the room devices;
 - .2 Simple replacement using the default automatic configuration capabilities. Room controllers can be replaced with ready-to-use devices;
 - .3 Device status indicators (LEDs) indicating the following states:
 - .1 Data transmission;
 - .2 Device under voltage;
 - .3 Status of each charge;
 - .4 Configuration status.
 - .4 Quick installation features, including the following:
 - .1 Installation on standard junction box;

June 30, 2020

- .2 Fast low voltage connections using standard RJ-45 connection cables.
- .5 According to each configuration, each load will be capable of the following behavior when powering up following an ordinary loss of power:
 - .1 100% ignition;
 - .2 Extinction;
 - .3 Last level ignition.
- .6 Each load will be configurable to operate according to the following sequences depending on the occupancy of the room:
 - .1 Automatic start/Automatic stop (Operate Start and Stop).
 - .2 Manual start/Automatic stop (Operate Stop only).
- .7 The polarity of each load output will be reversible through a digital configuration, so that "On" becomes "Off" and "Off" becomes "On".
- .8 Compliance with UL 2043 Standard for heat and smoke.
- .9 Manual override control and LED indicator for each charge.
- .10 "Zero-cross" circuit for each load.
- .11 All digital parameter data programmed into a room controller or an individual outlet charge controller should be stored in a non-volatile FLASH memory inside the controller/controller itself. The memory life should not be less than 10 years.
- .12 Dimming type room controllers will share the following functionality:
 - .1 Each load will have a preset level that can be independently configured for the "Normal office hours" and "Outside normal office hours" events in order to allow the establishment of different dimming levels at the start of the "Normal hours" and "Off" events.
 - .2 The speed of light variation of the loads will be specific to the connected switches and the load will keep a default value for all the connected buttons which do not specify a single value.
 - .3 The following dimming attributes can be changed or selected using a wireless configuration tool:
 - .1 Establishment of a preset level for each load between 0 and 100%;
 - .2 Definition of an upper threshold and a lower threshold for each load;
 - .3 Launch of a lighting duration for each charge of 0, 12, or 100 hours m.
- .13 A neutralization button for each charge provides the following functions:
 - .1 Press and release for on/off control
 - .2 Press and hold for dimming control
- .14 Each dimming output channel will have independently configurable minimum and maximum calibration threshold levels to define the dimming range based on the actual dynamic range of the ballast or connected pilot. LED level indicators located on the connected dimming switches will use these new minimum and maximum thresholds.

June 30, 2020

- .15 Each dimming output channel will have independently configurable minimum and maximum threshold levels to define the dynamic range of the output in the new gradation range of 0 to 100% defined by the minimum and maximum calibration thresholds.
- .16 The calibration and threshold levels must be defined per output channel. The devices that set calibration or threshold levels by controller (not by load) are not acceptable.
- .17 The configuration will be entirely digital. Devices that set calibration or threshold levels per output channel using potentiometers or DIP switches are not acceptable.
- .2 Optimized 0-10 V on/off/dimming room controllers will include the following:
 - .1 Double voltage (120/277 VAC, 60 Hz) or 347 VAC, 60 Hz. 120/277 V models designed for a total load of 20 A; 347 V models designed for a total load of 15 A;
 - .2 Integrated real-time intensity monitoring capability;
 - .3 One, two or three-relay configurations;
 - .4 250 mA intelligent power supply;
 - .5 Four RJ-45 LAN ports (provide built-in protection against constraints);
 - .6 A dimming output by relay:
 - .1 0-10 V dimming - When indicated, an analog 0-10 V relay output for controlling ballasts and compatible LED drivers. The 0-10 V output will automatically open upon loss of power to the room controller to provide full lighting output from the lighting.

2.3**DIGITAL PRESENCE DETECTOR MOUNTED ON WALL OR WIRED CEILING**

- .1 The digital presence detectors will provide a graphic liquid crystal display for digital calibration and electronic documentation. Features will include the following:
 - .1 Digital calibration and configuration by push button for the following variables:
 - .1 Sensitivity, 0 to 100% in increments of 10;
 - .2 Timeout, 1 to 30 minutes in 1-minute increments;
 - .3 Test mode, five-second delay;
 - .4 Detection, activation, and/or reactivation technology by PIR, ultrasonic, or dual technology;
 - .5 Passage mode.
 - .2 Charging parameters including automatic/manual ignition, flashing warning, and daylight activation/deactivation when photoelectric sensors are included in the local network.
 - .3 Programmable control functionality including the following:
 - .1 Each detector can be programmed to monitor specific loads within a local network;
 - .2 The detector will be able to activate one of 16 user-definable lighting scenes;
 - .3 Adjustable retrigger interval for loads with manual ignition. The load will automatically retrigger (light up) according to a configurable time interval (10 seconds by default) after it has been extinguished;
 - .4 On dual technology detectors, independently configurable trigger modes are available for the "Normal office hours" and "Outside normal office hours"

June 30, 2020

intervals. The retrigger mode can be programmed to use the following technologies:

- .1 Passive ultrasound and infrared;
 - .2 Passive ultrasound or infrared;
 - .3 Ultrasound only;
 - .4 Passive infrared only;
 - .5 Independently configurable sensitivity parameters for passive infrared and ultrasonic technologies (on dual technology detectors) for the "Normal office hours" and "Outside normal office hours" intervals.
- .4 One or two RJ-45 ports for connection to the local network.
 - .5 Device status indicators (LEDs) that can be disabled for specific applications and indicate the following states:
 - .1 IRP detection;
 - .2 Ultrasonic detection;
 - .3 Configuration mode;
 - .4 Load linking;
 - .5 Assignment of the presence detector to a specific load in the room without wiring or special tools.
 - .6 Manual neutralization of controlled loads.
 - .7 All digital parameter data programmed into an individual presence detector must be stored in a non-volatile FLASH memory inside the detector itself. The memory life should not be less than 10 years.

2.4 DIGITAL WALL SWITCHES WIRED PRESENCE DETECTORS

- .1 The digital presence detectors will provide a scrollable liquid crystal display for digital calibration and electronic documentation. Features will include the following:
 - .1 Digital calibration and configuration by push button for the following variables:
 - .1 Sensitivity: 0 to 100% in increments of 10;
 - .2 Timeout: 1 to 30 minutes in 1-minute increments;
 - .3 Test mode: Five-second time delay;
 - .4 Detection technology: Acti/vation and/or reactivation by PIR or dual technology;
 - .5 Passage mode;
 - .6 Charging parameters including automatic/manual ignition, flashing warning, and daylight activation/deactivation when photoelectric sensors are included in the local network.
 - .2 Programmable control functionality including the following:
 - .1 Each detector can be programmed to monitor specific loads within a local network;
 - .2 The detector will be able to activate one of 16 user-definable lighting scenes;

June 30, 2020

- .3 Adjustable retrigger interval for loads with manual ignition. The load will automatically retrigger (light up) according to a configurable time interval (10 seconds by default) after it has been extinguished.
- .4 On dual technology detectors, independently configurable trigger modes are available for the "Normal office hours" and "Outside normal office hours" intervals. The retrigger mode can be programmed to use the following technologies:
 - .1 Passive ultrasound and infrared;
 - .2 Passive ultrasound or infrared;
 - .3 Ultrasound only;
 - .4 Passive infrared only.
- .3 Independently configurable sensitivity parameters for passive infrared and ultrasonic technologies (on dual technology detectors) for the intervals "Normal office hours" and "Outside normal office hours".
- .4 Two RJ-45 ports for connection to the local network.
- .5 Device status indicators (LEDs) indicating the following states:
 - .1 IRP detection;
 - .2 Ultrasonic detection;
 - .3 Configuration mode;
 - .4 Load linking.
- .6 Assignment of the presence detector to any specific load in the room without wiring or special tools.
- .7 Assignment of local buttons to specific loads in the room without wiring or special tools.
- .8 Manual neutralization of controlled charges.
- .9 All digital parameter data programmed in an individual presence detector wall switch must be stored in a non-volatile FLASH memory inside the presence detector wall switch. The memory life should not be less than 10 years.
- .2 When connected to a single relay dimming or room controller, the two-button presence detector wall switches will operate by default in the following sequence:
 - .1 Left button:
 - .1 Press and release to switch on the load;
 - .2 Press and hold to increase the dimming load.
 - .2 Right button:
 - .1 Press and release to switch off the load;
 - .2 Press and hold to reduce the dimming load.

2.5 PORTABLE CONFIGURATION TOOLS

- .1 Provide a wireless configuration tool to facilitate personalization of local area networks using two-way infrared communication and/or PC software connected to each local area network via a USB interface.

June 30, 2020

- .2 The wireless configuration tool should include, but not be limited to, the following functionality:
 - .1 Bidirectional infrared (IR) communication with IR compatible devices over a range of approximately 9 m;
 - .2 High-visibility organic LED display (DELO), push button user interface, and control menus;
 - .3 Reading and modification of parameters for charge controllers, relay panels, presence detectors, wall switches, daylight detectors, as well as network bridges, and identification of devices by type and serial number;
 - .4 Ability to save up to eight presence detector setting profiles and apply the profiles to selected detectors;
 - .5 Temporarily adjust the light level of any LAN load and incorporate these levels into a scene setting. Room mode setting to test the "Normal office hours" and "Outside normal office hours" parameter settings;
 - .6 Setting or fine-tuning the daylight settings established during auto-configuration and entering light level data to complete the configuration of the open-loop daylight controls;
 - .7 Room mode setting to test the "Normal office hours" and "Outside normal office hours" parameter settings;
 - .8 Checking the status of building level network devices.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 CONDUITS

- .1 All the cabling shall be installed in conduits. All required cable splicing shall be done in junction boxes or in relay panels. The dimensions, quantity, and color coding of the cabling shall be in accordance with the manufacturer's recommendations.
- .2 Place and install the equipment elements in accordance to the manufacturer's recommendations and as indicated.
- .3 The dimensions, quantity, and color coding of the cabling shall be in accordance with the manufacturer's recommendations.
- .4 The manufacturer shall assign the groups, zones, and schedules according to the schedule supplied by the Departmental Representative.
- .5 Allow time for technical support to the Contractor for the bringing live activities and the system presentation.

3.3 PROGRAMMING

- .1 The programming and bringing live activities of the system shall be carried out by the manufacturer or his representative. The Manufacturer or his representative shall assign the

June 30, 2020

groups, zones, and schedules according to the information provided by the Contractor or the Departmental Representative.

3.4 FIELD QUALITY CONTROL

- .1 The Contractor shall confirm the installation the connections and the operation of each lighting relay according to the manufacturer's drawings.
- .2 The Contractor shall activate each individual command element, in presence of the Departmental Representative to demonstrate that the lighting circuits are indeed subjected to the command system, as per manufacturer's drawings.

3.5 SYSTEM VERIFICATION

- .1 In collaboration with the Contractor, the manufacturer or his representative shall confirm all the line diagrams as well as the local operation of each lighting relay and their control interfaces.
- .2 The Contractor shall activate each individual command element, in presence of the Departmental Representative to demonstrate that the lighting circuits are indeed subjected to the command system.
- .3 Allow for technical support to the Contractor for the bringing live activities and the system presentation. Once the tests are complete, the manufacturer will be responsible to train the facility operations and maintenance personnel. Allow for 4 hours on site for different personnel to detail the functioning of the lighting system.
- .4 All system verification shall be in accordance with the terms specified in Section 01 91 13 - Commissioning (Cx) - General Requirements and Section 01 79 00 - Demonstration and Training.

3.6 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 National Research Council Canada (NRC).
 - .1 NECB 2017, National Energy Code for Buildings.
- .2 CSA Group (CSA).
 - .1 CAN/CSA-C22.2 No.47-M90(R2007), Air-Cooled Transformers (Dry Type).
 - .2 CSA C9-02(R2007), Dry-Type Transformers.
 - .3 CAN/CSA-C802.2-06, Minimum Efficiency Values for Dry Type Transformers.
- .3 National Electrical Manufacturers Association (NEMA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dry type transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: In accordance with Section 01 74 19 - Waste Management and Disposal.

June 30, 2020

Part 2 Products**2.1 DESIGN DESCRIPTION**

- .1 All required transformers must come from a unique manufacturer. Transformers to comply with CSA C9-02 and CSA C802.2 Standards.
- .2 General Characteristics:
 - .1 Type: ANN.
 - .2 3-phase, 3 coils, 600 V or 480 V as indicated on drawings delta primary, 120/208 V star secondary, 60 Hz
 - .3 Single-phase 600 V or 480 V as indicated on drawings primary, 120/240 V secondary, 60 Hz.
 - .4 Voltage outlets: Four 2½% primary outlets (2FCAN, 2FCBN) on terminal block
 - .5 Insulation: Class 220, 150°C average temperature rise.
 - .6 Withstand voltage: Standard.
 - .7 Hipot: Standard.
 - .8 Copper windings.
 - .9 Core and coil must be insulated from the enclosure with neoprene rubber to reduce noise and vibration or to reduce noise and vibration damping effects based on core and coil weight.
 - .10 Finish: In accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .11 Average sound level: Standard.
 - .12 Impedance at 170°C: Standard.
 - .13 Enclosure: NEMA 3R.
 - .14 The flux density must be below the saturation point to avoid saturation caused by harmonic currents, even with a 10% overvoltage at the primary. The core of the transformer must be constructed with M6 grain-oriented or higher-grade silicon tab elements, high quality and non-aging.
 - .15 The neutral secondary level supporter the admissible time current leaders to secondary lead current driver and current driver leveler endless primary to capacity high performance limited.
 - .16 Transformers shall be tested (production tests) in accordance with CSA C802.2, including modifications.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size 7.
- .3 Plate labeled to match single-line diagram.

June 30, 2020

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for dry type transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Mount dry type transformers up to 75 kVA on floor, unless otherwise indicated.
- .2 Install transformers in level upright position.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Make primary and secondary connections in accordance with wiring diagram. Conductors must not enter the transformer from the top of the enclosure.
- .7 Make connections using flexible conduits on the sides of the primary and secondary transformers of the transformers.
- .8 Ground the transformers according to the Canadian Electrical Code 2018.
- .9 Energize transformers after installation is complete.
- .10 Comply with applicable seismic measures.

3.3 CLEANING

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

3.4 PROTECTION

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 28 16.02 - Moulded Case Circuit Breakers

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for panelboards, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec, Canada.
 - .2 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity, and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance (O&M) data for panelboards for incorporation into O&M Manual.

1.5 DELIVERY, STORAGE, AND HANDLING

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

- .4 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 FACTORY ASSEMBLY

- .1 Install circuit breakers in switchboards before sending.
- .2 In addition to the CSA nameplate, the nameplate must be corrected for failure to be supported by the switchboard and circuit breakers.
- .3 All boards must come from one manufacturer.

1.7 FINISH

- .1 Apply the final of table to the section 26 05 00 - Common Work Results for Electrical.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 PANELBOARDS – GENERAL

- .1 Panelboards: Product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 Panels raised and installed in sprayed areas shall be provided with water baffles. These deflectors must prevent water from entering the tables when triggering sprinklers. Seal all conduit outlets from distribution boards using waterproof connectors.
- .3 Arrange busbars in phase order so circuit breakers energize numbered circuits. Each circuit breaker must identify the circuit number indelibly.
- .4 Provide two keys for each panelboard.
- .5 Use copper sector busbars with neutral bars of same rated current as phase bars.
- .6 Gray enamel paint door and door frame baked in four, except in public areas where doors and door frames are coated with a layer of approval only. The interior of all switchboards must be painted white.
- .7 250 and 600 V panelboards: Bus and breakers rated for 14 kA (symmetrical) minimally for the 600 V panelboards and 10 kA (symmetrical) minimally for the 250 V panelboards, unless otherwise indicated.
- .8 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

- .9 Panelboards: Mains, number of circuits, and number and size of branch circuit breakers, as indicated.
- .10 Minimum of two flush locks for each panelboard.
- .11 Copper bus with neutral of same ampere rating of mains.
- .12 Suitable for bolt-on breakers.
- .13 Trim with concealed front bolts and hinges.
- .14 Trim and door finish, grey color baked enamel, type to be "door-in-door" to ease maintenance.
- .15 Ground bus.
- .16 Where the word "Espace" (Space) is used to denominate a circuit, no breaker should be installed. The word "Libre" (Vacant) is used to denominate a circuit, the Contractor should supply and install a breaker.

2.2 DISTRIBUTION PANELS

- .1 The voltage and capacity of the panels, the capacity of the circuit breakers, the number of taps, and the cut-off capacity of the panel shall be as shown in drawings and in schedules.
- .2 Where more than one section is required, the distribution panel shall consist of individual sections bolted together to form a complete table. All distribution panels must be completely closed. Distribution panels must be constructed of galvanized steel sheet of a code-compliant size. All panel fronts must be bolted.
- .3 Distribution panels must be accessible frontage and dimensions, as indicated. If required, distribution boards must be shipped in sections compatible with the available access routes.
- .4 The main busbars must be tinned copper and equipped with seamless type terminals. Copper bars should be thoroughly cleaned and pre-plated before final tinning. Busbars and mounting frames must be arranged in such a way that any other standard circuit breaker can be easily installed and connected. The width of the grommets and the wiring space must be sufficient to allow for the installation and connection of the branch conductors and the panel supply conductors for all intended breakers.
- .5 Circuit breakers must be bolted.

2.3 DERIVATION AND LIGHTING PANELS

- .1 Derivation or lighting panels to be suitable for molded case circuit breaker.
- .2 Panel type, mounting, system voltage, main bus, number of free circuit breakers, gaps, breaker amperage, number of poles, circuit breaker arrangement, type circuit breaker, the breaking capacity as well as the details of the special panels must be mounted as shown on the schedule of panels. The bars must be copper. Provide all jumpers, connectors and other items required for simple installation of future breakers. Provide, contactor, double lugs to double neutral conductors, insulated busbars, and other special features when required in panel schedules or as indicated.

- .3 All distribution panels must be equipped with a ground bar securely attached inside the housing and a length of copper bar with terminal for each branch circuit of the panel. The branch circuit grounding conductors must terminate at the ground bar.
- .4 Provide panels with door trim, latch and latch. If necessary, provide two latches per door to ensure panel doors are aligned with trim.
- .5 Provide surface mounted panels with trim designed for surface panels.
- .6 Recessed panels must have doors with hidden hinges. Panel trim should have no screws or bolt heads. The panel trim must be completely flat. An installation with a space between the panel cover and the wall will not be accepted.
- .7 Circuit breakers in all distribution panels must be from the same manufacturer.
- .8 Plug-in type circuit breakers are not accepted. Use bolted circuit breakers.
- .9 Two- and three-pole circuit breakers must have a common release mechanism and a single handle. Single pole breakers with links are not acceptable.
- .10 All equipment outlet circuits leading to cells must be powered from circuit breakers with differential earth fault protection.

2.4 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards, unless otherwise indicated.
- .3 Lock-on devices for fire alarm, life safety lighting, door supervision, intercom, stairway lighting, and exit lighting circuits.
- .4 Additional Locking Devices: Ten (10) for each circuit breaker rating, to be provided to the Departmental Representative.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard, size 5 (2 lines) engraved as indicated and including the designation of the table and of the voltage/phase.
- .3 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door. The nomenclature must indicate the table designation, the panel capacity, the voltage, the number of phases, the location and the load supplied by each circuit. Include in the maintenance manual a hard copy of each project table schedule.
- .4 Provide a plastified circuit board indicating the responsibility of each circuit and securing the card to the back of the panel door. The board must be designated by panel, panel capacity, voltage, number of phases, location, and fed load per circuit. Include, in the maintenance manual, a copy of each card of project.

Part 3 Execution**3.1 EXAMINATION**

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

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .3 Connect loads to circuits as indicated.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 For each panel, installer of empty supply lines. Refer to Section 26 05 34 - Conduits, Fasteners and Conduit Fittings.

3.3 CLEANING

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

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboard installations.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA).
 - .1 ANSI/NEMA WD1 1999: General Color Requirements for Wiring Devices.
 - .1 ANSI/NEMA WD 6- 2106: Wiring Devices - Dimensional Specifications.
- .2 CSA Group (CSA).
 - .2 CAN/CSA-C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware
 - .1 CAN/CSA C22.2 No.42.1-F00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national Standard, with UL 514D).
 - .3 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA C22.2 No.55-FM1986(R2008), Special Use Switches.
 - .3 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national Standard, with UL 20).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for wiring devices, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec, Canada.
 - .1 Indicate on drawings:
 - .1 The details surrounding the integration in the architectural elements.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance (O&M) data for wiring devices for incorporation into O&M Manual.

1.5 DELIVERY, STORAGE, AND HANDLING

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

- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 SWITCHES

- .1 20 A, 120 V, single pole, switches of "Industrial" specified grade.
- .2 Manually operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire;
 - .2 Silver alloy contacts;
 - .3 Urea or melamine molding for parts subject to carbon tracking;
 - .4 Suitable for back and side wiring;
 - .5 Toggle;
 - .6 Ivory or as per color selected by Architect.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 120% of rated capacity of motor loads.
- .4 Other Switches: Rated for voltage and allowable current, according to indications on drawings.
- .5 Switches of one manufacturer throughout Project.
- .6 Switches for detention zones:
 - .1 All the switches installed must be "Industrial" grade, with anti-vandal screws and of superior quality. All garnish plates must be stainless steel, mounted with two anti-vandal screws.
- .7 Acceptable Products: Pass & Seymour; Hubbell; Leviton and Kenall.

2.2 RECEPTACLES

- .1 Duplex receptacles of type "commercial/robust grade" specified "Industrial", CSA type 5-20R, 125 V, 15/20 A, "U" ground, with following features:
 - .1 Ivory urea moulded housing;
 - .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 rivetted grounding contacts.
- .2 Other outlets designed for allowable tension and ampacity: According to indications on drawings.
- .3 In cells, receptacles shall be of Tamper Resistant type (TR).
- .4 Single outlet receptacles for maintenance, specified "Industrial" quality allowing 15 and 20 A inputs, type CSA 5-20R, 125 V, 20 A.
- .5 Single outlet receptacles, twist-lock, specified "Industrial" quality, type CSA L5-20R, 125 V, 20 A.
- .6 Floor socket allowing an interface between power, communication, and audio/video (A/V) wiring in a concrete floor. These components consist of a material maintaining a fire resistance of the floor slab. These outlets must be compatible with the full range of workstation connection points for a variety of video/audio devices from most manufacturers, and other open system peripherals.
- .7 Other outlets conceived for admissible voltage and intensity, as indicated on drawings.
- .8 Receptacles of one manufacturer throughout Project.
- .9 Outlets in detention zones:
 - .1 All outlets installed must be robust commercial grade mounted with four (4) anti-vandalism screws, specified "Industrial" quality. The backing plate must be at least 12-gauge galvanized steel. All garnish plates must be 10-gauge cold-laminated stainless steel.
- .10 Outlets supplied from a back-up source shall be of the front type illuminated by a built-in neon lamp.
- .11 Acceptable Products: Pass & Seymour; Hubbell; Leviton and Kenall.

2.3 COVER PLATES

- .1 Provide all cover plates with Stainless-steel "Satin Finish".
- .2 All cover plates must originate from a single and same manufacturer for the secured areas (cells).
- .3 Cast sheet-iron cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .4 All installations must be provided by a single manufacturer.
- .5 Stainless-steel cover plates must be installed according to the specifications for the secured areas, mounted in built-in pull boxes.
- .6 Weatherproof during use, double lift spring-loaded cast aluminum cover plates, complete with gaskets for outdoor-rated duplex receptacles, as indicated.
- .7 Plates must be in stainless steel in places that may have corrosive materials.
- .8 Finishing plates for electrical installations and wall-mounted boxes shall match the finish of mechanical appliances. All receptacle covers must be identified according to the panel and circuit breaker corresponding to that circuit.
- .9 In the case of appliances placed inside cells, the covers must be equipped with "safety screws".

- .10 Galvanized-steel receptacle boxes, measuring at least 103 mm on each side and oversized when the number of conductors exceeds the standard size. Concrete sockets with rear opening when installed in a slab. Cast-iron fittings when exposed and appropriate supports to retain fastener.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .2 Receptacles:
 - .1 There are no NEMA 5-15R configuration in this project. "Standard" outlets are all NEMA 5-20R configurations.
 - .2 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .3 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .4 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Cover Plates:
 - .1 Protect the finish of plates covered with a sheet of paper or plastic film that has not been removed, while all painting and other work is completed.
 - .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.
 - .4 The screws for the installation of the cover plates must be of "Tork X" type vandal-proof type (except in places where the prisoners do not have access) Example: Mechanical room, electrical room, junction box in the ceiling space, etc.

3.3 CLEANING

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

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless-steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CSA C22.2 No.106-05(R2010), HRC-Miscellaneous Fuses.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size above 200 A. The supplied characteristics should also include the average fusion time at a given current.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec, Canada.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet installed in a place free of moisture.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Three spare fuses of each type and size installed above 600 A.
- .3 Six spare fuses of each type and size installed up to and including 600 A.

Part 2 Products**2.1 FUSES - GENERAL**

- .1 Fuse type, references L1, L2, J1, R1, etc., have been adopted for use in this specification.

- .2 Fuses: Product of one manufacturer.

2.2 FUSE TYPES

- .1 Class L fuses, 200 kA interruption capacity.
 - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type L2, fast acting.
- .2 Class J fuses, 200 kA interruption capacity.
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

Part 3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Install spare fuses in fuse storage cabinet.

3.2 QUALITY CONTROL ON THE WORKSITE

- .1 Perform tests in accordance with Section 26 05 00 - Electrical - General Requirements for Work Results.
- .2 Verify all protective equipment on the site according to coordination study provided.
- .3 Departmental Representative's test reports and certificate certify that all protection systems are installed.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 24 16.01 - Panelboards Breaker Type.
- .3 Section 26 28 20 - Ground Fault Circuit Interrupters – Class A.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national Standard with UL 489, and NMX-J-266-ANCE-2010).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for circuit breakers, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage and with an allowable ampacity of 200 A and more.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor shall submit three copies of a production certificate of origin from the manufacturer. Production certificate of origin shall be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet Standards and Regulations.
 - .1 Production certificate of origin shall be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the Contract, and to Contractor's expense.
 - .4 Production certificate of origin shall contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible shall sign and date certificate.

- .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
- .3 Contractor's name and address and person responsible for project.
- .4 Local manufacturer's representative name and address. Local manufacturer's representative shall sign and date certificate.
- .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title.
 - .2 End user's reference number.
 - .3 List of circuit breakers.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breaker from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse as specified in Section 01 74 19 - Waste Management and Disposal.

1.5 SUBMITTALS

- .1 Before proceeding with any installation of circuit breakers, the Contractor shall submit in three copies a certificate of origin of the manufacturer, signed by the factory and the local representative of the manufacturer, certifying that all circuit breakers are from it, that they are new and that they meet Standards and regulations in force. These certificates shall be submitted to the Departmental Representative for acceptance.
- .2 A delay in the production of the certificate of origin will not justify an extension of the contract or any additional compensation.
- .3 Any fabrication, erection or installation work shall commence only upon acceptance of the Certificate of Origin by the Departmental Representative. Failure to comply with this requirement, the Departmental Representative reserves the right to mandate the manufacturer registered on the circuit breakers to authenticate all new circuit breakers specified in the contract, at the expense of the Contractor.
- .4 In general, the certificate of origin shall contain:
 - .1 The name and contact information of the manufacturer and the person responsible for authentication. The responsible person shall date and sign the certificate.
 - .2 The name and contact information of the authorized distributor and the person of the distributor responsible for the Contractor's account.

- .3 The name and contact information of the Contractor and the person responsible for the project.
- .4 The name and contact information of the local representative of the manufacturer. The local representative shall date and sign the certificate.
- .5 The name and address of the building where the circuit breakers will be installed:
 - .1 The title of project.
 - .2 Customer User Reference Number (CSC).
 - .3 The list of breakers in form of schedules.

Part 2 Products

2.1 GENERAL REQUIREMENTS

- .1 Molded-case circuit breakers, circuit breakers, accessory high-fault protectors and ground-fault circuit-interrupters: To CSA C22.2 No. 5.
- .2 Bolt-on Moulded Case Circuit Breaker: Quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .3 Common-trip Breakers: With single handle for multi-pole applications.
- .4 Circuit breakers with interchangeable trip units as indicated.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .6 Circuit breakers to have minimally the same current interruption capacity as the panel it is installed in.
- .7 Circuit breakers over 100 A will be LSIG microprocessor trip type
- .8 At locations indicated on drawings, provide circuit breakers approved for 100% continuous use.

2.2 THERMAL MAGNETIC BREAKERS (DESIGN A)

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

2.3 MAGNETIC BREAKERS (DESIGN B)

- .1 Molded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short-circuit protection.

2.4 OPTIONAL FEATURES

- .1 Include:
 - .1 "On-Off" locking device for each breaker.

Part 3 Execution**3.1 EXAMINATION**

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

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.
- .2 Circuit breakers shall be factory installed by the manufacturer.

3.3 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 24 16.01 - Panelboards Breaker Type.
- .3 Section 26 28 16.02 - Moulded Case Circuit Breakers.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CAN/CSA C22.2 No.144-M91(R2006), Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA PG 2.2-1999(R2009), Application Guide for Ground Fault Protection Devices for Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for ground fault circuit interrupters, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec.
- .4 Test and Evaluation Reports: Submit test report for field testing of ground fault equipment to Departmental Representative and certificate that system as installed meets criteria specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance (O&M) data for ground fault circuit interrupters for incorporation into O&M Manual.

1.5 DELIVERY, STORAGE, AND HANDLING

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

June 30, 2020

- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect ground fault circuit interrupters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 MATERIALS**

- .1 Equipment and components for ground-fault circuit interrupters (GFCI): To CAN/CSA C22.2 No.144.
- .2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND-FAULT INTERRUPTER

- .1 Two-pole ground fault circuit interrupter for 15 A or 20 A, 120 V, single-phase, with testing and reset devices, as indicated.
 - .1 Transition device to detect ground faults, Class A.

2.3 GROUND FAULT PROTECTOR UNIT

- .1 Self-contained with 15 A or 20 A, 120 V circuit interrupter and duplex or single receptacle complete with:
 - .1 Solid state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 CSA Enclosure 1, flush mounted with stainless steel face plate.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for ground fault circuit interrupters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

June 30, 2020

3.2 INSTALLATION

- .1 Do not ground neutral on load side of ground fault relay.
- .2 Pass phase conductors, including neutral, through zero sequence transformers.
- .3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and co-ordinate with Section 01 45 00 - Quality Control, if required.
- .2 Arrange for field testing of ground fault equipment by the Contractor before commissioning service.
- .3 Demonstrate simulated ground-fault tests.

3.4 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 28 13.01 - Fuses - Low Voltage

1.2 REFERENCE STANDARDS

- .1 CSA Group.
 - .1 CAN/CSA-C22.2 No.4-04(R2009), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMJ-J-162-2004 and UL 98).
 - .2 CSA C22.2 No.39-13, Fuseholder Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 DISCONNECT SWITCHES**

- .1 Fused, and without fuse disconnect switch in NEMA 1 enclosure for interior use and NEMA 3R for exterior use.
- .2 Provision for padlocking in open position, by three (3) locks.

June 30, 2020

- .3 Mechanically interlocked door to prevent opening when handle in "ON" (closed position).
- .4 Fuses: Size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuse Holders: To CSA C22.2 No.39, relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 "ON-OFF" switch position indication on switch enclosure cover.
- .8 Construction to allow intensive use.
- .9 The switches installed on circuits for variable frequency drives and motors, as well as switches for elevator motors, must be equipped with an electrical lock with a N.O. and N.F. contact allowing to open the command circuit before the switch contacts open.

2.2 EQUIPMENT IDENTIFICATION

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

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

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

3.3 CLEANING

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

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA).
 - .1 CSA C22.2 No.14-10, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for control devices, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec.
 - .2 Include schematic, wiring, and interconnection diagrams.

1.4 QUALITY ASSURANCE

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance (O&M) data for control devices for incorporation into O&M Manual.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect control devices from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Control Relays: To CSA C22.2 No.14 and NEMA ICS 1.
- .2 Nominal Winding Characteristics: 120 V; contacts nominal characteristics: 120 V, 10 A.

2.2 RELAY ACCESSORIES

- .1 Standard Contact Cartridges: Normally-open - convertible to normally-closed in field.

2.3 SOLID STATE TIMING RELAYS

- .1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact.
- .2 Operation: "On"-delay or "Off"-delay.
- .3 Potentiometer: Self-contained to provide time interval adjustment.
- .4 Supply Voltage: 120 V, AC, 60 Hz.
- .5 Temperature Range: - 20°C to + 60°C.
- .6 Output Contact Rating: Maximum voltage 300 VAC or DC. Current: 10 A.

2.4 INSTANTANEOUS TRIP CURRENT RELAYS

- .1 Enclosure: CSA Type 1.
- .2 Contacts: NO, NC, automatic reset, with adjustable tripping point.
- .3 Control: 3-wire, with provision for shorting contacts during accelerating period of motor.
- .4 Contact Rating: 120 V, 10 A., AC, in accordance to NEMA ICS 1.

2.5 PUSHBUTTONS

- .1 Illuminated, Heavy duty, oil tight. Operator mushroom type, green for activation and red for stopping., with 1-NO and 1-NC, nominal tension and current: 120 V, 10 A, AC labels, as indicated.
- .2 Emergency stop button, mushroom type, red color, lockable in activated ("OFF") position, with indication "Arrêt d'urgence" (Urgent stop).

2.6 SELECTOR SWITCHES

- .1 Maintained, 2 or 3 positions, as indicated, heavy duty, oil tight, standard operation; contact arrangement as indicated, rated 120 V, 10 A, AC.

2.7 INDICATING LIGHTS

- .1 Oil tight, heavy duty, full voltage, LED lens color: Red, amber, green, as indicated, supply, and lamp voltage: 120 VAC.

2.8 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 600 V, 60 Hz, AC.
- .3 Secondary: 120 VAC.
- .4 Rating: 500 VA.
- .5 Secondary fuse: 10 A.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

2.9 THERMOSTAT (LINE VOLTAGE)

- .1 Wall mounted.
- .2 Full Load Rating: 8 A at 120 VAC.
- .3 Temperature Setting Range: From 0°C to 30°C.
- .4 Markings in 5° increments.

2.10 THERMOSTAT PROTECTION

- .1 Install plastic protectors for the thermostats located in public spaces. Protectors must be equipped with a keyed lock.

2.11 LOW-VOLTAGE RELAYS

- .1 Silent, thermal action.
- .2 Power Ratings:
 - .1 3,000 W at 120 V.
 - .2 5,000 W at 208 V.
 - .3 6,000 W at 240 V.
 - .4 6,000 W at 347 V.
- .3 Integrated transformer where required.
- .4 Use a transformer of enough capacity, independently, and installed in an appropriate space, when many relays are controlled from a single thermostat.

2.12 ELECTRONIC RELAYS

- .1 TRIAC type relays.
- .2 Integrated transformer when required.
- .3 Capacity: 25 A at 200 V or 347 V, as required on drawings.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install control devices and interconnect.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time, and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

3.4 CLEANING

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 29 03 - Control Devices.

1.2 REFERENCE STANDARDS

- .1 CSA/CSA International.
 - .1 CSA C22.2 No. 60947-4-1 - Low-Voltage Switchgear and Control Gear.
- .2 International Electrotechnical Commission (IEC)
 - .1 IEC 947-4-1-2002, Part 4, Electromechanical Contactors and Starters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications, and data sheets, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Provide shop drawings: In accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec, Canada.
 - .2 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout and components.
 - .4 Enclosure types.
 - .5 Wiring diagram.
 - .6 Interconnection diagrams.
 - .7 The bill of materials.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

- .3 Extra Materials:
 - .1 Provide listed spare parts for each different size and type of starter.
 - .1 Three (3) contacts, stationary.
 - .2 Three (3) contacts, movable.
 - .3 One (1) contact, auxiliary.
 - .4 One (1) control transformer.
 - .5 One (1) operating coil.
 - .6 Two (2) fuses.
 - .7 10% indicating lamp bulbs used.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Starters: To CSA C22.2 No. 60947-4-1.
 - .1 Half-power starters are not accepted.
 - .2 Obtain the motor's current from its identification plate to choose the ampacity of the overload heater.
 - .3 Starters shall withstand fault currents as indicated on drawings.

2.2 MANUAL MOTOR STARTERS

- .1 Three or single-phase manual motor starters of size, NEMA type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick-make and break;
 - .2 One overload heater, manual reset, trip indicating handle.
- .2 Accessories:
 - .1 Toggle switch: Standard labelled as indicated.
 - .2 Indicating light: LED type and color as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL-VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, NEMA type, rating, and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type;
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure;
 - .3 Circuit terminals for command and electrical supply circuits;
 - .4 Wiring and schematic diagram inside starter enclosure in visible location;
 - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused or not fused disconnect switch with operating lever on outside of enclosure to control and provision for:
 - .1 Locking in "OFF" position with up to three (3) padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Selector switches: Heavy duty, "MAN-STOP-AUTO".
 - .2 Push-button: "ON/OFF".
 - .3 Indicating lights: Green LED to indicate functioning and red LED to indicate emergency operation.
 - .4 2-N/O and 2-N/C spare auxiliary contacts, unless otherwise indicated.

2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 FINISHES

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

2.6 EQUIPMENT IDENTIFICATION

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

Part 3 Execution**3.1 INSTALLATION**

- .1 Install starters and control devices in accordance with manufacturer's instructions. Complete the wiring for power and command circuits according to indications.
- .2 Install and wire, starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 When the motor is not in plane of sight of the manual starter or the disconnect switch preceding the magnetic starter or the contactor, supply and install a disconnect switch within 1,500 mm from the motor.
- .5 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.
- .2 Waste Management: Separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 Institute of Engineering and Electronic Engineers (IEEE).
 - .1 IEEE C62.41.2-02, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
 - .2 IEEE C62.45-03, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- .2 Underwriters Laboratories, Inc. (UL).
 - .1 UL 1283-05, Electromagnetic Interference Filters.
 - .2 UL 1449-06, Surge Protective Devices.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for surge protective devices for incorporation into O&M Manual.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 ACCEPTABLE PRODUCTS AND MATERIALS

- .1 Where a particular brand name is stipulated, see Instructions to Bidders for procedure for requesting approval of substitute materials and products.

Part 2 Products**2.1 SURGE PROTECTIVE DEVICES**

- .1 Surge protective devices (SPD or TVSS) to IEEE C62.41 and UL 1449, in a dedicated sheet metal NEMA 1 enclosure.
- .2 SPD design to be based on metal oxide varistors (MOV).
- .3 Modular design with field-replaceable modules, or non-modular design.
- .4 Fuses: Rated at 200 kA interrupting capacity.
- .5 Bolted compression lugs for internal wiring.
- .6 Integral disconnect switch.
- .7 Redundant suppression circuits.
- .8 LED indicator lights for power and protection status.
- .9 Audible alarm, with silencing switch, to indicate when protection has failed.
- .10 Form-C contacts rated at 5 A and 250 VDC, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
- .11 Four-digit transient event counter.
- .12 Surge current per phase:
 - .1 Minimum 240 kA per phase for switchgear and 347/600 V panelboards.
 - .2 Minimum 120 kA per phase for 120/208 V panelboards.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for switchboard installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.

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

3.2 INSTALLATION

- .1 Field-installed SPD: Install SPD with conductors or buses between SPD and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- .2 Connect SPD to circuit breaker as a dedicated disconnecting means for SPD, as indicated, and lock the circuit breaker in the closed position.
- .3 Do not perform insulation resistance tests on switchgear, switchboards, panelboards, or feeders with the SPD connected. Disconnect SPD before conducting insulation resistance tests and reconnect SPD immediately after insulation resistance tests are complete.

3.3 CLEANING

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

3.4 ACTIVITIES ON WORK COMPLETION

- .1 Demonstration and training.
 - .1 Provide necessary training to familiarize the operating and maintenance personnel with the operation of the SPD.
 - .1 Training to be 2 hours.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 09 24 - Lighting Control Devices - Low Voltage.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI).
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 CSA Group (CSA).
 - .1 CSA C22.2 N° 250.13-17: Light Emitting Diode (LED) Equipment for Lighting Applications.
- .5 ICES-005-07, Radio Frequency Lighting Devices.
- .6 IESNA LM-79-08; IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
- .7 IESNA LM-80-08 An Overview of the Test Procedure and How it is Used for EnergyStar®.
- .8 Underwriters Laboratories of Canada (ULC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications, and data sheets, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review and approval by Departmental Representative.
 - .3 Photometric data to include:
 - .1 Polarity diagram for light intensity distribution;
 - .2 Light efficacy;
 - .3 Utilization coefficient;
 - .4 Type of louver and lens finish;
 - .5 Luminaire spacing criteria;

- .6 Photometric calculation from a software, if required.
 - .3 Quality Assurance Submittals: Provide following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's instructions: Provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning, and procedures.
- 1.4 QUALITY ASSURANCE**
 - .1 Provide mock-ups in accordance with Section 01 45 00 - Quality Control.
- 1.5 DELIVERY, STORAGE, AND HANDLING**
 - .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .3 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .4 Divert unused metal materials from landfill to metal recycling facility.
- Part 2 Products**
 - 2.1 LAMPS**
 - .1 Light Emitting Diode (LED) Lamps:
 - .1 The LED lighting components must be compliant to ANSI C78-377, NEMA SSL 3, and IES LM 79 and LM 80.
 - .2 The LED assembled lights must be replaceable independently from the luminaire.
 - .3 Power: As per indications.
 - .4 Initial luminous flux: As per indications.
 - .5 Total harmonic distortion of 20% or less, preferably.
 - .6 Power factor of at least 0.9.
 - .7 Photometric Data Records of the valid IES.
 - .8 Five-year warranty on all parts of fixtures.
 - .9 CRI: 86.
 - .10 Color temperature: 4,000 K.
 - .11 Lamp life: 50,000 hours.
 - .1 Luminous flux after 50,000 hours: 70 % of initial luminous flux.
 - .12 The color changing lamps must be able to supply a complete LED light spectrum using red, blue, green, and white colors.
 - .13 Dimmable control unit.
 - .14 UL1598 and UL2108 certifications.

2.2 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.3 OPTICAL CONTROL DEVICES

- .1 As indicated in Luminaire Schedule.

2.4 LUMINAIRES

- .1 As indicated in Luminaire Schedule on drawings.

2.5 MOUNTING ACCESSORIES

- .1 Supply the necessary mounting accessories to install the light fixtures, including hooks, clamps, rods, posts, chains, miscellaneous appropriate material for the specified mounting method. The suspended light fixtures have must be equipped with seismic restraint supports.

Part 3 Execution**3.1 INSTALLATION**

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

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires, as indicated.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling, according to the requirements of the local inspection organization.
- .2 For surface mounted luminaires on suspended ceiling tiles, provide a metallic bar designed for this use, to place over the suspension to fix the light fixtures avec appropriate wood screws.
- .3 In mechanical rooms, the light fixture suspension must be done with suspension chains at the exact location determined on site.
- .4 The installation of suspended luminaires shall meet seismic requirements of the NBC 2015. Their installation shall be certified by an engineer member of the OIQ specialized in seismic.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.
- .2 Waste Management: Separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 21 - Wires and Cables (0-1,000 V).
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCE STANDARDS

- .1 CSA Group.
 - .1 CSA C22.2 No.141-15, Emergency Lighting Equipment.
 - .2 CSA C860-11(R2016), Performance of Internally-Lighted Exit Signs.
- .2 International Organization for Standardization (ISO).
 - .1 ISO 3864-1 2011, Graphical Symbols - Safety Colours and Safety Signs - Part 1: Design Principles for Safety Signs and Safety Markings.
 - .2 ISO 7010 2011, Safety Colours and Safety Signs - Registered Safety Signs.
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 101-2015, Life Safety Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and data sheets, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Quality Assurance Submittals: Submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit required documents/elements in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Records: Provide instructions for the operation and maintenance of the emergency lighting fixtures, which will be incorporated into the Operations and Maintenance Manual.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

1.6 TRANSPORTATION, STORAGE, AND HANDLING

- .1 Transport, store, and handle materials and equipment in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance: Deliver materials and equipment to the site in their original packaging, which must be labeled with the name and address of the manufacturer.
- .3 Storage and handling.
 - .1 Store materials and equipment so that they do not rest on the ground, indoors, in a clean, dry, and well-ventilated area, as recommended by the manufacturer.
 - .2 Store safety lighting fixtures to protect them from marks, nicks, and scratches.
 - .3 Replace damaged materials and equipment with new materials and equipment.
- .4 Packaging Waste Management: Recover packaging waste in accordance with Section 01 74 19 - Waste Management and Disposal.

1.7 WARRANTY

- .1 For batteries covered by this Section, the warranty period of 12 months is extended to 120 months. Replacement must be done without charge for the first 5 years and prorated for the next 5 years.

1.8 VOLTAGE DROP

- .1 The power supply conductors of the luminaires must be of copper and of appropriate gauge so that the voltage drop does not exceed 5% of the nominal voltage, according to the manufacturer's recommendations.

Part 2 Products**2.1 EXIT LIGHT INDICATORS**

- .1 Refer to drawings.

Part 3 Execution**3.1 MANUFACTURER'S INSTRUCTIONS**

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

3.2 INSTALLATION

- .1 Install exit lights as indicated.
- .2 Connect the indicating devices to their respective circuits at 120 V.
- .3 Ensure that the circuit breaker of the output indicator circuit is locked in the closed ("On") position.

3.3 PROTECTION

- .1 Protect installed equipment and components from damage during construction.
- .2 Repair damage to adjacent materials and equipment caused by the installation of safety lighting fixtures.

3.4 CLEANING

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

END OF SECTION

DIVISION 27

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 28 - Grounding - Secondary.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute.
 - .1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA).
 - .1 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.
- .3 U.S. Department of Labor/Occupational Safety and Health Administration (OSHA).
 - .1 Nationally Recognized Testing Laboratory (NRTL).

1.3 SYSTEM DESCRIPTION

- .1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products**2.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)**

- .1 Predrilled copper busbar, approved by NRTL, electrolysis plated with 8-mm diameter holes for use with standard-sized lugs to: ANSI J-STD-607-A.
- .2 Dimensions 6 mm thick, 100 mm wide, 500 mm length (or 2 x 250 mm): To ANSI J-STD-607-A.

June 30, 2020

2.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- .1 Predrilled copper busbar, approved by NRTL, electrolysis plated with 8-mm diameter holes for use with standard-sized lugs to: ANSI J-STD-607-A.
- .2 Dimensions 6 mm thick, 50 mm wide, 500 mm length (or 2 x 250 mm): To ANSI J-STD-607-A.

2.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 Copper conductor, green, insulated, size as per indications.

2.4 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- .1 6AWG copper conductor, green, insulated.

2.5 SECONDARY GROUNDING CABLES

- .1 Copper conductors, under green sheath, insulated, and 6 AWG caliber.

2.6 WARNING LABELS

- .1 Non-metallic warning labels in English and French: To ANSI J-STD-607-A.
- .2 Identify labels with wording "If this connector is loose or must be removed, please call the Building Telecommunications Manager".

Part 3 Execution**3.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)**

- .1 Install TMGB in entrance room on insulated supports 50 mm high at location close to electrical power panel if one is installed in same room as indicated.

3.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- .1 Install TGB in main terminal/equipment room and each telecommunications room.

3.3 BONDING CONDUCTORS - GENERAL

- .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using 6 AWG copper conductor.

3.4 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 Install bonding conductor for telecommunications from TMGB to service equipment (power) ground.
- .2 Use exothermic welding, approved 2-hole compression lugs for connection to TMGB.

3.5 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- .1 Install TBBs from TMGB to each TGB as indicated.
- .2 Use approved 2-hole compression lugs for connection to TMGB and TGBs.

June 30, 2020

3.6 BONDING TO TMGB

- .1 Bond metallic raceways in telecommunications entrance room to TMGB using 6 AWG copper conductor, insulated green.
- .2 For cables within telecommunications entrance room having shield or metallic member, bond shield or metallic member to TMGB using 6 AWG copper conductor, insulated green.
- .3 Bond equipment cabinet or rack located in telecommunications entrance room to TMGB using 6 AWG copper conductor, insulated green.

3.7 BONDING TO TGB

- .1 Bond metallic raceways in telecommunications equipment room and telecommunications room to TGB using 6 AWG copper conductor, insulated green.
- .2 For cables within telecommunications room and equipment room having shield or metallic member, bond shield or metallic member to TGB using 6 AWG copper conductor, insulated green.
- .3 Bond equipment rack and cabinet located in telecommunications room TGB using 6 AWG copper conductor, insulated green.

3.8 LABELLING

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels: To TIA/EIA-606.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .5 Section 26 05 36 - Cable Trays for Electrical Systems.
- .6 Section 33 65 73 - Concrete Encased Duct Banks and Manholes.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations off ground, and clean, dry, well-ventilated area.
 - .2 Store and protect communication raceway systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 SYSTEM DESCRIPTION**

- .1 Empty telecommunications raceways system for telecommunications (data and communication), physical security (fire alarm, access and intrusion control and surveillance), and for audiovisual systems consists of outlet boxes, cover plates, cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.
- .2 Overhead cable tray distribution system.

2.2 MATERIAL

- .1 Conduits: EMT type in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .1 Minimal bend radius of 914 mm for conduits with a diameter that is equal or superior to 53 mm, for telecommunications.
- .2 Underground Cable Ducts: PVC in accordance with Section 33 65 76 - Direct Buried Underground Cable Ducts.
- .3 Junction Boxes and Cabinets: In accordance with Section 26 05 31- Splitters, Junction, Pull Boxes and Cabinets.
 - .1 The length of the box must be equal to 6 times the diameter of the largest duct entering the box.
- .4 Outlet Boxes: In accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .5 Fish Wire: Polypropylene type.
- .6 Mounting plywood backboard.
- .7 6-AWG green conductor or according to indication from each telephony room to the main ground bar.
- .8 A double 15/20 A, 120 V outlet in each telephony room or closet.
- .9 Each telecommunications room must be equipped with at least two reserved double sockets of 15/20 A and 120 V on a backup power supply. Sockets must be made available around the room at 1.8 m intervals.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communication raceway systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install empty raceway system, including overhead and underfloor distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous, and positioning material to constitute complete system.
- .2 There shall be a pull box at each two 90-degree bends.
- .3 All conduits shall be firmly installed and supported using an appropriate method.

- .4 Drill, bend, and cap all metallic conduits.
- .5 Install pull boxes in conduit sections where the trajectory is straight and not use it to replace an elbow.
- .6 Install pull boxes in easily accessible locations.
- .7 Unless otherwise noted, install a 21-mm conduit in the wall up to the ceiling space for each telephony and data outlet. The conduit shall be terminated with a 90-degree elbow with a radius as wide as possible.

3.3 CLEANING

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

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

DIVISION 28

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 21 - Wires and Cables (0 - 1,000 V).
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCE STANDARDS

- .1 National Research Council Canada (NRC).
 - .1 National Building Code of Canada 2015 (NBC).
- .2 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S524-14, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525-16 Audible Signal Devices for Fire Alarm.
 - .3 CAN/ULC-S52616, Visible Signal Devices for Fire Alarm Systems, Including Accessories.
 - .4 CAN/ULC-S527-11, Standard for Control Units for Fire Alarm Systems.
 - .5 CAN/ULC-S528-14, Manual Stations for Fire Alarm Systems, Including Accessories.
 - .6 CAN/ULC-S529-16, Smoke Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S53018), Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .8 CAN/ULC-S531-14, Standard for Smoke Alarms.
 - .9 CAN/ULC-S536-13, Inspection and Testing Of Fire Alarm Systems
 - .10 CAN/ULC-S537-13, Standard for the Verification of Fire Alarm Systems.
 - .11 CAN/ULC-S541-16, Speakers for Fire Alarm Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer s instructions, printed product literature, and data sheets for multiplex fire alarm system, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec, Canada.
 - .2 Indicate on shop drawings:
 - .1 Detail assembly and internal wiring diagrams for control units. Auxiliary cabinets.

- .2 Overall system riser wiring diagram identifying control equipment, initiating zones and signaling circuits; identifying terminations, terminal numbers, conductors and raceways.
- .3 Details for devices.
- .4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.
- .5 Step-by-step operating sequence, cross referenced to logic flow diagram.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Submit operation and maintenance data for fire alarm system for incorporation into manual.
- .3 Include:
 - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.

Part 2 Products

2.1 DESCRIPTION

- .1 Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.
- .2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating two-stage alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals. This system will be connected via a communication network to the building's alarm system 1 to allow them to be connected to the Cowansville Penitentiary Complex, which is connected to the Municipal Fire Department.
- .3 Zoned, two-stage, and coded.
- .4 Modular, in design to allow for future expansion.
- .5 Operation of system shall not require personnel with special computer skills.
- .6 System to include:
 - .1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.
 - .2 Power supplies.
 - .3 Initiating/input circuits.

- .4 Output circuits.
- .5 Auxiliary circuits.
- .6 Phone circuits.
- .7 Wiring.
- .8 Manual and automatic initiating devices.
- .9 Audible and visual signalling devices.
- .10 End-of-line resistors.
- .11 Remote and local annunciators.
- .12 Historic event recorder, chronologically.
- .13 Annunciating and command graphic interface with touchscreen and dynamic display.
- .14 The communication infrastructure between the fire alarm panels of Buildings 31 and 32 must be DCLC (formerly called type C).
- .15 The communication infrastructure between the fire alarm panels and the annunciator of Building 32 shall be DCLC (formerly called Type C).
- .16 The control station with annunciator with all functions must be installed in the central control room. This post must have a touch screen with a dynamic graphic display.
- .17 The audible signaling circuits shall be DCLA (formerly called Type A).
- .18 The visual signaling circuits must be DCLA (formerly called Type A).
- .19 The data link connecting the detection devices shall be DCLA (formerly called Type A).
- .7 Equipment and Devices: ULC listed and labelled and supplied by single manufacturer.
- .8 Power Supply: To CAN/ULC-S524.
- .9 Audible Signal Devices: To CAN/ULC-S524.
- .10 Visual Signal Devices: To CAN/ULC-S526.
- .11 Control Unit: To CAN/ULC-S527.
- .12 Manual Pull Stations: To CAN/ULC-S528.
- .13 Smoke Detectors: To CAN/ULC-S529.
- .14 Regulatory Requirements:
 - .1 To TBS Fire Protection Standard.
 - .2 System components: Listed by ULC and comply with applicable provisions of NBC and meet requirements of local Authority Having Jurisdiction.

2.2 **SYSTEM OPERATION: TWO-STAGE - SIGNALS ONLY**

- .1 The triggering of an alarm device must:
 - .1 Sound the audible alarm in the annunciators at the control room of the control room and the main fire alarm panel.
 - .2 Acknowledgment must be received within three (3) minutes and stop the audible signal. The alert condition will remain in the memory and will be displayed on the annunciator panels, the control station and the main panel.

- .3 If there is no acknowledgment within the time limits, the zone in alert mode must go into alarm mode and automatically:
 - .1 The sound signaling of the zone must be activated.
 - .2 Area lighting must be on.
- .4 Ventilation.
 - .1 Shutdown of all ventilation when fire detection system is in alarm (except for toilet evacuation).
 - .2 Immediate shutdown of the ventilation system with the smoke detector located in the supply duct on alert.
 - .3 Manual control of smoke evacuators, from central control or sector gate.
- .5 Pre-action double interlocking.
 - .1 The triggering of a detection condition and the opening of an automatic nozzle are necessary to cause the discharge of water.
 - .2 Manual control of sprinkler shutdown from central control or utility box.
- .6 Sprinklers.
 - .1 The triggering of an automatic nozzle is necessary to cause the discharge of water.
 - .2 Manual control of sprinkler shutdown from central control.
- .7 Manual alarm-evacuation control from central control.
 - .1 At all times, the central control room can activate the alarm and the evacuation control as well as the unlocking of the doors assigned to each sector; sector by sector or all sectors at the same time.
- .2 The triggering of a second stage alarm triggering device in the building shall do the following:
 - .1 Sound throughout the building, alarm sounding devices in TEMPORAL mode;
 - .2 Transmit a signal to the municipal fire department, through the central station;
 - .3 Cause the shutdown of the air conditioning and ventilation fans serving the building (with the exception of the toilet evacuation);
 - .4 Provide automatic closing of fire doors and smoke-tight doors, if normally open, in the building.
- .3 For the entire building, if the first stage alarm is not acknowledged after three (3) minutes, the system will automatically proceed to the second stage.
- .4 Acknowledgment of the alarm will be indicated to the central unit.
- .5 After 60 seconds, it must be possible to suppress sound signaling by means of a switch from the central unit.
- .6 The triggering of a monitoring device shall do the following:
 - .1 Provoke the locking of the monitoring status, by an electronic lock, to the central unit;
 - .2 Indicate its monitoring area on the display board of the central unit and all the annunciators;
 - .3 Sound a sound signal to the central unit;

- .4 Trigger a common sequence of monitoring actions.
- .7 The activation of a smoke detector placed in a ventilation duct must cause the immediate shutdown of the associated ventilation system.
- .8 The reset of the monitoring or alarm device shall not return the functions/indications of the system to their normal operating mode until the central unit has been reset.
- .9 A defect in the fire alarm system must do the following:
 - .1 Induce the indication of the defective circuit, to the central unit;
 - .2 Operate "trouble-system" indication, sound a buzzer and initiate a common sequence of fault actions. The acknowledgment of the fault signal must interrupt the sound signaling. Visual signaling remains on until the fault is corrected and the system returns to normal operation.
- .10 In the event of an alarm, the fault signal must be automatically canceled.
- .11 A fault in any circuit of the system must not trigger an alarm.

2.3 CONTROL PANEL

- .1 Central control unit (CCU).
 - .1 Suitable for DCLA communication style: To CAN/ULC-S524.
 - .2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
 - .3 Central unit with a capacity of at least 300 addressable surveillance points and at least 100 addressable control/signaling points. The points can be divided between two (2) communication channels operating independently of one another, in a decentralized system. A fault on one channel must not affect the operation of the other channel.
 - .4 Operation by signaling priority, the first priority being assigned to the fire alarm, the second to monitoring and control, the third to defects. It must be possible to assign priorities to control points to ensure a particular function or, in case of urgency, to prioritize one.
 - .5 Circuits with continuous monitoring of communication and data processing cycles. A circuit failure must cause an audible and visual fault signal.
 - .6 Supervised communications between the central unit and the data collection panels/transponders, by DCLA circuits. A communication failure between the central unit and the remote units must cause an audible and visual fault signaling to the central unit. Transmission of data in binary coded decimal, baseband, by time and half-duplex multiplexing. Possibility for each data channel to provide communications up to a distance of 3,000 m.
 - .1 Communications between cores, in networked systems, should be monitored; these communications must be provided by circuits of the DCLA type. In the event of a fault between two (2) cores, the communications must be maintained between all the other cores of the loop and their programmed functions must also be maintained.

- .7 System capable of supporting multiple RS-232-C I/O ports. CPU Output: Parallel port, ASCII, with adjustable baud rate to allow CPU interface with any commercially available microcomputer, terminal, or printer.
- .8 CPU equipped with subroutines that can be triggered by an event; the ability to schedule status changes of one or more monitoring points to operate some or all system control points.
- .9 Hardware and software designed to keep time of day, day of the week, day of the month, month, and year.
- .10 Printer controlled from the central unit, via EIA RS-232-C link, to produce a printed statement of all system activities.
- .11 The operating software must operate addressable smoke detectors with variable sensitivity; it must also cause the announcement, at control panel, the status of the smoke detectors and the adjustment of their sensitivity.
- .2 Operator interface and central microprocessor.
 - .1 A user interface shall act as the operator interface and central microprocessor for the alarm system. The user must be able to acknowledge events, control system notification device circuits, and reset the system. Detailed information on the nature and location of events may also be posted.
 - .2 The interface shall include the configuration of the site-specific program and provide all system logic and supervision.
 - .3 The interface shall be provided with a large 6 in. (1/4 VGA) monochrome LCD screen, a touch screen and LEDs to indicate the status of the system. An audible alarm will sound when events are unacknowledged.
 - .4 The interface will include several keys that will control the information displayed and navigate through the screens. These keys will provide access to the help function among menu features as well as control functions via illuminated command buttons to guide the user to the next available system operation (Acknowledge, Silence Alarm, Restore Alarm, Audible or Reset).
 - .5 The interface screen must divide events by type and must provide a separate tab for Alarm, Monitoring, Security and Fault events. The number of active events must be indicated in each tab. The screen will assign at least two (2) full lines of text to each event that will be associated with a 32-character custom message describing its location. In addition to the text message, the system must display the active event category: (eg - Smoke, Heat, Water Flow, Manual, etc.). Up to ten (10) events must be displayed simultaneously and up and down arrows must allow the user to scroll through the list of events. A progress indicator on the side of the list will demonstrate the size of the list and your location within it. New unacknowledged events must be marked with a flashing exclamation mark ("!"). Once acknowledged, the exclamation point becomes a hook ("√").
 - .6 The interface must include an "More Info" button to allow the display of additional information that can be configured for each event, including more than 200 additional text characters to describe the event, the symbols of protection Fire NFPA 170, Hazmat icons and other critical information about the event.

- .7 The interface shall display on the detailed screen a summary of the events of the zone according to their type. The name of a resource person and their telephone number for the building may also be indicated.
- .8 The interface must also provide a comprehensive menu to report system status, scroll through the entire system using physical or geographic views to locate the desired section of the system without having to it is necessary to know the addresses of the modules or devices.
- .9 The interface must also include 40 macro buttons \rightarrow commands or functions that can be programmed to perform a range of tasks.
- .10 Required Product: Siemens PMI-3.
- .11 Built-in power source, battery charger and batteries for backup power.
- .3 Network Interface Card.
 - .1 Network interface card to support communication between enclosures, network communications internal or external to the enclosure.
 - .1 Networks may be wired as "Class B" - Style 4 (DCLB) or "Class A" - Style 7 (DCLC).
 - .2 Communication card that can be configured to allow communication in:
 - .1 HNET between alarm panel cabinets on the same system. The maximum number of HNET cards may be up to fifty (50) unique nodes.
 - .1 The HNET communication card must be able to supervise the network to ensure its proper functioning
 - .2 The HNET network must be wired in Style 7 (DCLC) mode.
 - .2 XNET between main processing units of a system or a processing unit and a Network Control Center (NCC).
 - .1 The communication card shall also isolate a short circuit on each individual segment of the HNET network. Via an electrical repeater for each X-NET pair.
 - .2 Allow up to fifty-nine (59) X-NET cards on a networked peer-to-peer system.
 - .3 The HNET network must be wired in Style 7 (DCLC)
 - .4 Compatible with existing XNET communication network (MXL/XLS).
 - .3 CAN between alarm panel cabinets on a single system and an annunciator or remote LED control panel.
 - .1 CAN Link Supports Model LCM-8 CAN Modules | SCM-8 | FCM-6 | OCM-16 | SIM-16. Up to 99 addresses of CAN modules may be available per box.
 - .2 The CAN network will be wired according to "Class B" - Style 4 (BCLB).
- .3 The NIC shall have diagnostic LEDs that will indicate card failure, CAN, HNET or X-NET network failure, a ground fault or an A or B loop failure, and include also LEDs that will indicate power level, style, and active networks.
- .4 Required Product: Siemens NIC-C.

.4 Power Source.

- .1 Provide a system main power supply having the following characteristics:
 - .1 Total output power of 12 A at 24 VDC per block;
 - .2 Built-in charger for accumulators with a maximum capacity of 100 AH;
 - .3 Universal AC input 120 VAC at 50/60Hz;
 - .4 Offline power transfer;
 - .5 24 VDC filtered and regulated power supply;
 - .6 Alarm & Typical Failure Relay (Type "C", calibrated at 2 A);
 - .7 Two programmable relays (Type "C", calibrated at 2 A);
 - .8 Unpowered 12A power supply, 24 VDC output (for internal use);
 - .9 Output limited in power of 24 VDC, 4 A (for external use);
 - .10 Smart Module Monitored - Standard Decimal Addressing;
 - .11 Downloadable Module Firmware;
 - .12 Provides 24 VDC and 6.2 VDC power to all modules connected to the 60-wire BUS communication cable;
 - .13 Grounding detection circuit;
 - .14 Optional anti-tamper switch (HTSW-1) connection point on mounting box;
 - .15 PTB terminals for outdoor AC wiring connections;
 - .16 24 VDC system power expansion option with PSX-12 secondary power supply;
 - .17 Main and secondary power supply may share the same accumulators;
 - .18 Up to 3 secondary power supplies can be connected to one main unit;
 - .19 UL and ULC certified, CSFM, NYMEA and FM in force;
 - .20 Product Required: Siemens PSC-12C/PSX-12C.
- .2 Main System Power Supply: 120 V, 60 Hz. Provide two (2) 120 VAC/20 A supply circuits from emergency generator distribution panel.
- .3 Distribution of electrical energy, with voltage regulation and current limitation.
- .4 Main power failure or voltage drop (below 102 V) must trigger a common sequence of fault actions.
- .5 The battery-charger interface shall provide uninterrupted switching of the system to the emergency power supply, in the event of a failure or a voltage drop in the main power supply.
- .6 In normal operating mode, a malfunction in the battery charging circuit, a short circuit or an opening in the jump leads of the backup batteries must trigger a common sequence of fault actions and illuminate the fault indicator. emergency power.
- .7 Continuous monitoring of the wiring of the external alarm and tripping circuits in case of power failure.
- .8 Emergency power supply:
 - .1 The fire alarm system must be connected to a backup power source.
 - .2 The emergency power source must be a combination of a generator and rechargeable batteries.

- .3 The emergency power source must be capable of providing electrical monitoring for at least 24 hours; and subsequently, the emergency current at full load for 1 h.
 - .1 The required back-up power supply must be designed to automatically take over immediately if the normal power source is interrupted without loss of information.
 - .2 Backup power: Sealed batteries, maintenance free.
 - .3 Provide a reserve of 20% in the calculation of load of backup batteries.
- .5 Detection Loop Card:
 - .1 Receiving circuits for alarm-triggering devices, for example: manual alarm stations, smoke detectors, thermal detectors and fire water flow contactors; these devices are connected by DCLA circuits.
 - .2 Alarm receiving circuits (active and in reserve): circuits compatible with smoke detectors and with open contact devices.
 - .3 The triggering of an alarm device shall cause the operation of the system in accordance with the provisions of the section entitled "Operation of the system".
 - .4 Signal receiving circuits of monitoring devices with normally open contacts. Devices connected by DCLA circuits.
 - .5 The triggering of a monitoring device shall cause the operation of the system as specified in the section entitled "Operation of the system".
 - .6 Provide two (2) intelligent addressable circuits, 252 addresses per addressable module.
 - .7 Compatible with Series (H) & (O) Sensors and Devices.
 - .8 Insensitive Polarity with SureWire® Technology.
 - .9 Have twelve (12) diagnostic LED indicators to facilitate identification of a circuit.
 - .10 Built-in setting detection and short-circuit insulation.
 - .11 Integrated microprocessor for reliable and efficient communication of devices.
 - .12 Operation in degraded mode.
 - .13 Supports spinning Style 4 (Class B) or Style 6 (Class A), only DCLC link will be allowed for this project
 - .14 UL and ULC Listed, CSFM, and NYMEA.
 - .15 Required Product: Siemens DLC.
- .6 Signaling Circuits Card.
 - .1 Circuit card connected to the signaling devices and connected by DCLA class circuits to the central unit or to the data collection panels/transponders.
 - .2 Operation of the signaling circuits must adapt to the programming of the system; ability to operate strobes. Each signaling circuit must operate at 3 A, 24 VDC, and be fuse protected against overloads/over currents.
 - .3 Operation of the signaling circuits must adapt to the programming of the system; ability to sound signaling circuits in TEMPORAL mode (3-0-3-0), stroboscopic horns, fuse protected against overload/overcurrent.

- .4 Manual interruption of sound signaling, automatic interruption of sound signaling, and delayed prohibition of interruption of sound signaling, provided by the common system control.
- .5 Signaling circuit card having the following characteristics:
 - .1 Operate sound and visual signaling devices;
 - .2 Three (3) unique signals from each circuit;
 - .3 Four (4) Class A (Style Z) or Class B (Style Y) circuits;
 - .4 24 VDC, 4.0 A per circuit;
 - .5 Municipal link or exit for leased line;
 - .6 Trigger service;
 - .7 Fully programmable;
 - .8 Coded sound signal available;
 - .9 Integrated synchronization for strobe light;
 - .10 Bell tracking application available;
 - .11 Time code/Uniform Code 3;
 - .12 Operation selection in degraded mode;
 - .13 Silence option or not;
 - .14 Automatic/manual control;
 - .15 Integrated microprocessor;
 - .16 Integrated ground detection;
 - .17 Circuits limited in power according to NEC 760;
 - .18 UL, ULC, CSFM, and NYNEA Listed;
 - .19 Required Product: Siemens ZIC-4A.
- .6 Provide one (1) Class A 4-circuit signaling card for horns and two (2) Class A 4-circuit signaling cards for strobe lights.
- .7 Control Relay Card.
 - .1 Auxiliary contacts for control functions.
 - .2 Positive status indication (by return signal) of the controlled device.
 - .3 A surveillance alarm or malfunction must activate the auxiliary programmed output circuits.
 - .4 Two separate sets of contactors to control elevator recall on normal exit floor or other floor.
 - .5 After returning the system to its initial state, the auxiliary contacts must return to normal operating mode or operate according to their preprogramming.
 - .6 Fans: Should be gradually started when the system is restored to its original state; the delay circuit for the gradual start of each fan or fan train must be connected to an auxiliary contact of the system.
 - .7 The delay circuit must be controlled by the central unit.
 - .8 Control relay card having the following characteristics:
 - .1 Six independent SPDT contacts (Type "C");

- .2 Resistive load of 4 A at 30 VDC/1 20 VAC;
- .3 Induction load of 3.5 A à 120-V AC (0.6 P.F.);
- .4 Fully programmable;
- .5 Timed operation;
- .6 Automatic or manual control;
- .7 Relayed relay coils;
- .8 Integrated alarm and fault status LEDs;
- .9 Integrated microprocessor;
- .10 UL Listed, ULC Listed, FM approval in force;
- .11 Required product: Siemens CRC-6.

.8 Required Product: Siemens XLS.

2.4 ANNOUNCER TABLE AT THE GUARDhouse

- .1 Annunciator panel with LCD liquid crystals display and selection buttons, including the following features:
 - .1 4-line, 40-character alphanumeric LCD display with backlit display providing detailed information by device and by zone;
 - .2 Network announcer with RS-485 Style 7 links (DCLC);
 - .3 Alarm, supervision, security, and fault status LED display. Status indication of active and inactive system alarm signals;
 - .4 1550-event buffer memory;
 - .5 Key switch to activate or deactivate the auxiliary function control buttons on the alarm panel. The annunciator can be programmed as a simple display and not allow control of the alarm panel regardless of the position of the activation switch;
 - .6 Alarm panel control functions buttons, acknowledgment, silence signals and reset alarm signals, and system restore;
 - .7 Buttons for active event search scan;
 - .8 Piezo alarm or alarm panel failure.
- .2 Slim profile housing for surface mounting.
- .3 The annunciator panel will be installed at the guardhouse of the building.
- .4 Siemens SSD-C Model.

2.5 WIRING

- .1 Copper, twisted conductors; rated voltage of 300 V, FAS105 type installed in concealed galvanized conduits.
- .2 Alarm Trip Circuits: Conductors of at least 14 AWG, and as per manufacturer's requirements.
- .3 Signaling Circuits: Conductors of at least 14 AWG, and as per manufacturer's requirements.
- .4 Control Circuits: Conductors not less than 14 AWG, and as per manufacturer's requirements.

- .5 Outdoor link circuits must be pair-pair # -16 twisted-shielded pair/pair type XLPE - ISOS - FAS105 from Shaflex with properties according to usage or approved equivalent.

2.6 MANUAL ALARM STATIONS

- .1 Manual Alarm Station: Horns, with release lever, for surface-mounted, semi-recessed wall mounting; key switch for general alarm, on two-stage system; horns with bilingual display.
- .2 Guard for manual station with mini-alarm horn when specified.
 - .1 Required Product: STI-1130 or approved equivalent.
- .3 Required Product: HMS-2S from Siemens.

2.7 AUTOMATIC ALARM TRIGGER DEVICES

- .1 135°F (57°C) thermostatic microprocessor-based thermistor-based addressable heat detectors, complete with alarm LEDs.
- .2 Detector address must be field mounted, at pedestal at detector head.
- .3 The device shall be provided with a multicolored LED indicator indicating the alarm is red, the device is yellow and normal operation. This LED indicator must be able to operate regardless of whether the system is powered by mains power or by a back-up power source.
- .4 Required Product: Siemens HFPT-11.
- .5 Conventional Thermal Detectors:
 - .1 Thermal detectors with fixed temperature element at 57°C (135°F) and temperature rise rate 8.5°C, moisture-proof, to be connected to an addressable interface.
 - .1 Required Product: CDT-135RM.
 - .2 Compensation type conventional thermal sensors with fixed temperature element at 94°C (200°F) and temperature rise rate 8.5°C/min, moisture proof for medium showing variations. fast and temporary temperature, to connect to an addressable interface.
 - .1 Required Product: DT-135WP c/w Siemens S-1RD mounting plate.
- .6 Addressable multi-criteria fire detector including photoelectric and thermal sensors utilizing advanced software algorithms to combine thermo-velocity detection signals at 8.3°C/min (15°F/min) and a fixed maximum of 57°C (135°F) into a neural network, to create an intelligent multi-criteria detector with the following characteristics:
 - .1 Detector that can provide improved detection of a wide range of products of combustion, while providing superior immunity to harmful alarm sources;
 - .2 Advanced multi-criteria detection that allows the detector to recognize safe misleading phenomena and a real fire (avoids harmful alarms);
 - .3 Using advanced signal processing with proven detection algorithms;
 - .4 Responding to fire signatures of smoldering as well as flash fire;
 - .5 Polarity insensitive with Sure Wire™ Technology;
 - .6 3-color status LED with 360° viewing angle;
 - .7 Ability to measure distance sensitivity;

- .8 Automatic compensation for the environment;
 - .9 Field-selectable application profiles;
 - .10 Each detector capable of self-testing:
 - .1 Complete diagnosis done every ten seconds;
 - .2 Self-check to ensure sensitivity meets UL limits.
 - .11 RoHS compliant;
 - .12 Automatic compensation for the environment;
 - .13 Superior resistance to electromagnetic interference;
 - .14 RoHS compliant;
 - .15 Operating temperatures: 0°C (32°F) to 38°C (100°F);
 - .16 Maximum space: 30 ft. (900 ft.) Center to NFPA 72 and ULC-S524 approval;
 - .17 Input voltage range: 16 VDC - 30 VDC Alarm current: 410 uA max;
 - .18 Standby current: 250 uA, max. (on average);
 - .19 Detector sensitivity range: UL: 1.10% to 2.62%/ft ULC: 1.44 to 3.06%/ft pending;
 - .20 Tri-color status LED with 360° viewing angle;
 - .21 Torsion-based installation with DB-11C Series terminals;
 - .22 Approved and approved as a thermal detector;
 - .23 UL and ULC approved; approved by the CSFM;
 - .24 Required product: Siemens OH Series.
- .7 Photoelectric smoke detector with two (2) different alarm sources that can be individually selected ("ON" or "OFF") on the control panel.
- .1 Alarm Source 1 (Neural Network) - Combines smoke-heat with the following selectable profiles:
 - .1 Sensitive;
 - .2 Standard;
 - .3 Robust.
 - .2 Alarm 2 (thermistor) source - heat only, options are as follows:
 - .1 Static/set at 57°C (135°C), default setting;
 - .2 Thermo-velocimetric detection: 8.3°C/min (15°F/min).
 - .3 Required product: Siemens OH921.

- .8 Advanced multi-criteria fire detector for a very large number of fire types with dual thermal and optical sensors - providing extremely reliable and accurate fire detection with built-in redundancy - uses state-of-the-art multi-criteria detection technology. ASA (Advanced Signal Analysis) allows the detector to recognize misleading phenomena, which pose no danger.
 - .1 Improved detection thanks to forward and backward light scattering technology. Detector that can simultaneously use optical and thermal sensors to provide improved fire detection (multicriteria) and at the same time provide independent outputs for heat detection - that can use any combination of sensors.
 - .1 Extremely versatile detector capable of meeting the following standards:
 - .1 Multi-criteria fire detector (UL 268);
 - .2 Thermal detector (UL 521) offering five (5) field selectable temperature options and four (4) thermovelocimetric options;
 - .3 Detector directly in the pipe (plenum) (UL268A);
 - .4 Complies with NFPA 76 (telco standard) as a high sensitivity "early warning" (VEWFD) detector.
 - .2 UL/ULC approved and FM approved as a multi-criteria early warning fire detector ("VEWFD").
 - .3 Approved to IL 268A for use directly in air lines (1,220 m/min/4,000 ft/min).
 - .4 Maximum of 22 application profiles.
 - .5 Low-temperature warning at 4.4°C (40°F) for fire extinguisher systems in accordance with NFPA 25.
 - .6 Required Product: Siemens OH941.
 - .2 Multi-criteria detector, offering a universal solution to meet fire and CO detection requirements for the safety of people.
 - .1 Multicriteria fire/CO detector that can be programmed in the field to operate simultaneously or independently, according to the specific requirements of the Client and the application.
 - .2 Advanced multi-criteria fire detector shall allow the use of optical, thermal and carbon monoxide (CO) sensors to provide improved fire detection (multicriteria) and at the same time provide independent outputs for the safety of fire. people in terms of CO and heat detection. Any combination of sensors can be used. The detector must be extremely versatile and meets the following standards:
 - .1 Multi-criteria fire detector (UL 268);
 - .2 Carbon monoxide (CO) detector (UL2075);
 - .3 Thermal detector (UL 521) offering five (5) field selectable temperature options and four (4) thermovelocimetric options;
 - .4 Detector directly in the pipe (plenum) (UL268A);
 - .5 Monitoring of CO levels and temperature ranges;
 - .6 Complies with NFPA 76 (telco standard) as a VEWFD detector;
 - .7 Low temperature warning at 4.4°C (40°F) - for extinguisher systems in accordance with NFPA 25 and NFPA 72 Standards.
 - .3 Supervisory function for monitoring CO temperature and concentration limits.

- .4 Maximum of 26 application profiles.
 - .5 Complies with people's safety standards for CO, UL 2075, and NFPA 720.
 - .6 Complies with UL 268.
 - .7 Required product: Siemens OOH941.
- .9 Protector for Addressable Smoke Detectors.
 - .1 Protector compatible with smoke detectors and from the same manufacturer as the detectors.
 - .2 Supplied with mounting accessories.
 - .3 Fastened with vandal-proof screws.
 - .4 Certified ULC or a recognized organization.
 - .5 14-gauge housing and 6.25 mm 22-gauge open cell grid.
 - .6 Model DGH-11 from Siemens.
- .10 Addressable Smoke Detector for Ventilation Duct.
 - .1 The probe must be approved for use, in combination with a housing, equipped with a relay, which will cause the shutdown of the ventilation system in the event of an alarm of this sensor, or a general alarm or a defined alarm.
 - .2 No additional address must be used on the detection loop for this alarm relay function.
 - .3 Air Line Sensor Housings designed for use with Series (H) or (O) Detectors, installed directly on air supply ducts.
 - .4 National Fire Protection Association Standard (NFPA) 72 and 90A enclosure and UL/ULC listed.
 - .5 Operating temperature range: 0°C (32°F) to 49°C (120°F).
 - .6 Sampling tube pressure/range of differences: > 0.01 inches; <1.2 in. Water column.
 - .7 Relative humidity: 0-95%; without condensation.
 - .8 Air pressure/Altitude range: No effect/unlimited.
 - .9 Air speed range: 100-4,000 ft/min. (0.51-20 m/s).
 - .10 Required product: OP921 c/w FDBZ492-HR from Siemens.
- .11 Laser Smoke Suction Detection System.
 - .1 Aspiration Smoke Detector (ASD).
 - .1 Provide VESDA Early Warning Aspiration Smoke Detectors for cell areas to provide early warning of impending fire hazard. The detector will take the time to investigate an alarm and take appropriate action to prevent injury, property damage and business disruption. The detector must have the broadest sensitivity range in the industry and multi-level warnings, even minute levels of smoke that can be detected before a fire takes effect.
 - .2 The detector will take a sample of air from all sampling points of a network of microbore flexible tubes in the area to be protected, and then filter and analyze this combined sample in the laser detection chambers of the sensor module. of smoke. The detector can connect up to 40 addressable microbore tubes with separate sampling points.

- .3 When smoke particles are detected and the smoke level reaches the configured alarm thresholds, the system triggers the corresponding alarm condition. When a Fire 1 alarm is triggered, the system sequentially scans the sampling zones via the rotary valve to identify the different sampling locations for which the Fire alarm event has been triggered. To help locate the source of a fire, if the system is pre-alarmed, the user can initiate a smoke sweep from all sampling locations.
- .4 The detector will be equipped with a solid IP40 vacuum pump housing to accelerate fire detection time when the sampling network consists of long tubes up to 100 m. The system monitors the airflow in the installation, which can detect faults or obstructions of the points and sampling tubes. When such faults are detected, they are displayed on the monitor and monitoring equipment.
- .5 The detectors will be fully compatible with Xtralis VSC software, which will facilitate the commissioning and maintenance of the system. During the commissioning phase, the standardization process will determine the flow performance parameters. Local smoke test ports will verify proper operation of the unit during maintenance. The filter, the smoke sensor module, the pump and the rotary valve can be replaced directly on site.
- .6 Location of fire and alarms may be reported via relays and VESDAnet. Secondary monitoring and configuration of the device can be done via Ethernet or Wi-Fi, and a USB interface will provide on-site installation and maintenance. The StaX Relay Module should be used to identify and report fire sources on a fire alarm system detection loop.
- .7 Each detector will be equipped with a series of LEDs to display the status of the alarms, faults, deactivation and power supply of the detector. A button will allow the user to reset or disable the detector.
- .8 Each detector will have a 3.5" color display, which will display a large amount of status information, including fault and alarm conditions and smoke levels. A very simple navigation system provides access to various information screens available.
- .9 The network can be expanded to 60, 80, 100, or 120 sample points using expansion modules.
- .10 The detector must also have the following characteristics:
 - .1 Supply voltage: 18-30 VDC;
 - .2 Power consumption at 24 VDC:
 - .1 Standby - 27 W;
 - .2 In alarm (average) -27 W;
 - .3 Power Point (Sweep Mode) 3.5 A;
 - .4 Dimensions (LHP) 352 mm x 336 mm x 135.5 mm;
 - .5 Weight: 10 kg;
 - .6 Operating conditions:
 - .1 Ambient temperature: 0°C to 39°C;
 - .2 Air withdrawn: 0°C to 50°C;
 - .3 Tested at 0°C to 49°C;

- .4 Humidity: 10% to 95% relative humidity, non-condensing;
- .7 Size of microbore tubes: Normal diameter: DE: 6 mm;
- .8 Length of microbore tubes: Normal diameter: Up to 100 m;
- .9 Flow Control: Detection of rupture and obstruction of sampling points or tubes;
- .10 Relays: 7 programmable relays (locked or unlocked state) Contacts calibrated at 2 A at 30 V DC (resistive);
- .11 IP Class 40 Box;
- .12 Cable access: 4 cable entries of 25 mm;
- .13 Terminal blocks:
 - .1 Screw terminal 0.2-2.5 mm² (24 - 14 AWG).
- .14 Pre-Alarms: Alert and Action - Two Pre-Alarm Levels;
- .15 Sensitivity: 0.020% / m (0.006% / ft) - 16% / m (4.88% / ft);
- .16 Fire alarm threshold 1 at the sampling port:
 - .1 High: 1.6% / m;
 - .2 Superior: 4.0% / m;
 - .3 Standard: 8.0% / m;
- .17 Communication Interfaces:
 - .1 USB 2.0, Ethernet (RJ45), WiFi (802.11 b / g / n).
- .18 Software Features:
 - .1 Event Log: Up to 20,000 events. Smoke level, user actions, alarms and faults with time stamp.
- .19 Required Product: XTRalis VEA-040-A10 (VESDA).
- .2 Relay Interface Module:
 - .1 Provide for each vacuum detector a StaX local relay module to signal the location of alarms from the detector via relays and allows the installation of fire control loop input modules inside the housing. The module will be directly powered and controlled by the detector. Depending on the configuration, a VEA detector can power and control up to three (3) StaX relays. Each StaX relay provides 40 relay connections corresponding to 40 tubes on a VEA detector providing complete selective identification.
 - .2 Each relay will be classified, Contacts classified 2A @ 30 VDC (resistive) Programmable to lock or not
 - .3 Required Product: VER-A40-40-STx from Xtralis / Vesda.
- .3 Aspiration Smoke Detector (ASD) for Level 2 circulation area (single zone areas).
 - .1 The detector must include an air intake duct, this air will then be conveyed to an analysis chamber by a high efficiency centrifugal pump. Suction lines, vacuum and relay filters must be housed in a mounting box and must be arranged in such a way that the air is drawn from the fire hazard and a sample passes through the filter double stage and the detector by the vacuum cleaner.

- .2 The detector shall have four independently programmable on-site smoke alarm thresholds throughout the sensitivity range, with adjustable delays for each threshold between 0 and 60 seconds.
- .3 The detector must also include functions to transmit the following faults:
 - .1 Detector in alarm;
 - .2 Airflow;
 - .3 Filter;
 - .4 System;
 - .5 Zone;
 - .6 Network;
 - .7 Power;
 - .8 Urgent and minor defects.
- .4 Minor defects should be considered maintenance or maintenance signs. Urgent errors indicate that the device may not be able to detect smoke.
- .5 The filter must be a two-stage disposable filter cartridge. The first step must be able to filter particles larger than 20 microns from the air sample. The second step should be ultrathin, removing more than 99% of the contaminant particles by 0.3 microns or more, to create a clean air barrier around the detector optics to prevent contamination and increase lifetime.
- .6 The vacuum cleaner must be a rotary vane air pump designed for this purpose. It must be able to accommodate several sampling lines up to 200 m in total (4 pipes per detector) with a transport time of less than 90 seconds or according to the appropriate Codes.
- .7 Assembly must contain relays for alarm and fault conditions. The relays must be software programmable for the required functions. Relays must be provided for 2 AMP at 30 VDC. Remote relays must be offered as an option and must be configured to reproduce those of the detector or programmed differently.
- .8 The assembly shall be surface mounted on a wall or recessed into the wall cavity (both may be reversed).
- .9 Assembly must include event logging and built-in smoke. It must store smoke levels, alarm conditions, operator actions and faults. The date and time of each event must be recorded. Each detector must be able to store up to 18,000 events and does not require a screen to do so.
- .10 Range of sensitivity:
 - .1 0.005% -20% obs / m (0.0016% -6.25% obs / ft).
- .11 Alarm threshold setting range:
 - .1 Alert: 0.005% -1.990% obs / m (0.0016% -0.6218% obs / ft).
 - .2 Action: 0.010% -1.995% obs / m (0.0031% -0.6234% obs / ft).
 - .3 Fire 1: 0.015% -2.00% obs / m (0.0046% -0.625% obs / ft).
 - .4 Fire 2: 0.020% -20.00% obs / m (0.0063% -6.25% obs / ft)
 - .5 Limited to 12% obs / m (4% obs / ft) in UL mode.
- .12 Required Product: Xtralis VEP-A00-1P (VESDA).

- .4 VESDAnet Network.
 - .1 Provide the connection of ASD Aspirators on a dedicated VESDAnet communication network.
 - .1 Provide a "closed", complete and fault-tolerant two-wire communication loop that will connect VESDA detectors, displays, timers and remote relay modules on a daisy-chained loop.
 - .2 The VESDAnet network will allow multiple units to be programmed together from one or more locations and automatically detect communication failures.
 - .3 The network will interface easily with off-grid systems, such as intelligent fire alarm panels and Building Management Systems.
 - .2 Software for Calibration and Programming of ASD Detectors.
 - .1 Calibration and Commissioning shall be performed with VESDA ASPIRE2 programming software latest version of VESDA sampling line design and modeling software. It will facilitate the design and evaluation process for very complex basic pipe layout drawings. Key features, such as design wizards, 3D isometric views, an automated design verification process, and a new AutoBalance feature will make it easy to create a custom-made layout.
 - .2 The Installation Data Pack (IDP) will generate a series of reports containing the required parameters, materials, and system performance, so that installation and commissioning engineers clearly receive this information.
 - .3 Calibration and commissioning shall be performed by a qualified Xtralis Accreditation Certificate Technician in the design, application, installation and maintenance of Xtralis Suction Systems.
 - .3 Accessories:
 - .1 All conduits, elbows, single unions in (T) etc., must be supplied by the same manufacturer to ensure an integrated installation. Ducts and accessories must comply with local codes and standards.
 - .4 ASD Vacuum Smoke Detector Power Supply:
 - .1 Provide a 24 VDC power supply with lockable enclosure and batteries to allow the supply of ASD detectors for each sector (Wings A, B, C, D).
 - .2 Power supplies shall provide detector supervision for a 24-hour period followed by a 1-hour alarm period and a safety factor of 1.15 for each set.
 - .3 The power supplies must be connected to a 120 VAC circuit of the emergency generator considering a reserve of 15% on the calculation of load.
 - .5 Power supplies shall be supervised in the event of a failure of operation by the building fire alarm panel.
 - .6 Required Product: VPS-VEA-115UL from Xtralis Vesda.

2.8 AUXILIARY POWER SUPPLIES

- .1 Provide auxiliary power supplies as required for signaling devices operating at 24 VDC and having a capacity of 6 A.
- .2 Four (4) Class A (Z style) or Class B (Y style) monitored output circuits with a maximum capacity of 3A, independently selectable through two different inputs.
- .3 Two inputs used to control the activation of the four (4) outputs. The programming can be configured so that an input stops the audible signal on a Siemens "AS" or "ZH" series audible or visual/audible warning horn while the visual alarms remain active.
- .4 Optional integrated strobe tuning - Supports coded sound signals, including Temporal 3 and Temporal 4 tones.
- .5 Battery monitoring and control.
- .6 "Form C" problem/Factor general failure monitoring contact.
- .7 Power supplies support NAC power supply:
 - .1 Up to 6 Used with FP2011-U1.
 - .2 Up to 9 Used with Model FP201 2-U1.
- .8 Grounding Detectors.
- .9 Support battery.
- .10 Failure contact. Auxiliary output of 24 VAC at 3 A.
- .11 Product required: Siemens PAD-4.

2.9 SOUND AND VISUAL SIGNALING DEVICES

- .1 Electronic Alarm Horn.
 - .1 Electronic horn and strobe with tone selection (continuous or temporal) with selective sound intensity in three (3) intensity levels of 90dBA, 95dBA or 99dBA and white strobe with 15/30/75/selection. 110 candelas with "FIRE-FIRE" indication should be provided when shown on the plans.
 - .2 Strobe Lights:
 - .1 Typical coverage according to the signal strength:
 - .1 15 cd for corridor and area of approximately 6 m x 6 m.
 - .2 30 candelas: Area of 9 m x 9 m;
 - .3 75 candelas Area of 13 m x 13 m.
 - .4 110 candelas: Area of 15 m x 15 m.
 - .5 135 candelas: Area of 18 m x 18 m.
 - .6 185 candelas: Area of 21 mx 21 m.
 - .3 Siemens MTH-MC-R-B model.
 - .4 For semi-recessed mounting on standard 4 "square electrical box or surface box, Model MT-SUR-BOX-R from Siemens.
 - .5 Wall type strobe light with bilingual "FIRE / FIRE" indication, 75 cd signal strength.
 - .1 Siemens ST-75-R-WP model.

- .2 For semi-recessed mounting on standard 4 "square electrical box with Siemens WFPS weather-resistant mounting plate or Siemens WPBBS-W white weather-proof housing.
- .6 Protective guards.
 - .1 Lexan Protective Guard with Vandal-proof Screw for Horns / Strobe.
 - .1 STI-1217 model for semi-recessed installation.

2.10 AUXILIARY DEVICES

- .1 Module serving as an interface between alarm contact devices (N.O.) or (N.F.) and an addressable detection loop.
 - .1 Monitored interface module, including 2-zone model HTRI-D circuit-breaker contact or 1-zone Siemens HTRI-S circuit breaker contact circuit.
 - .2 Supervised relay for control of auxiliary functions, model HTRI-R with 1 detection area & 1 alarm relay from Siemens. Relay contact at 120 VAC/30 VDC of 3 A.
- .2 Isolator module on detection and signal loops installed so that a fault in one zone does not prevent the normal operation of other input or output devices in another zone. Model: HLIM from Siemens.
- .3 Provide an isolator module for each detection loop serving more than one floor or more of a sector separated by a fire wall or more than 2,000 m² (maximum) of floor area to be served or area described in article 3.2.4.9 of the CCQ Code (amended CNB-2015).

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for fire alarm installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

- .1 Install the fire alarm system in accordance with CAN/ULC-S524
- .2 Install the central unit and connect it to the main power supply, in AC, and to the emergency power supply, in AC.
- .3 Install manual alarms and connect to fire alarm system.
- .4 Install detectors where indicated and connect to fire alarm circuits. It is forbidden to put the detectors within 1 m of the air outlets. In the case of ceiling mounted detectors, leave a clearance of at least 60 mm radius around and below the detector. Air duct detectors must be installed in a section of straight conduit.
- .5 Connect fire alarm circuits to main control board.
- .6 Install sound signaling devices, in accordance with ULC S525, and visual signaling devices in accordance with CAN/ULC S526, and connect to signaling circuits.

- .7 Connect the signaling circuits to the main control board.
- .8 Install the horns with visual signaling devices at the indicated locations and connect them to the signaling circuits.
- .9 Install the end of line resistors at the end of the alarm and signaling circuits.
- .10 Install remote annunciators and connect to annunciation circuits.
- .11 Install Door Closing Devices.
- .12 Install remote relays used to shutdown fans.
- .13 Sprinkler System: Wire alarm and monitoring contacts and connect to master control board.
- .14 Detection System.
 - .1 Install sector detectors. Make the necessary connections between the mains detection board and the main control panel of the fire alarm system.
 - .2 Install sound signaling devices and visual signaling devices where indicated.
- .15 Connect extinguishing systems to main control board.
- .16 It is forbidden to make connections using splices.
- .17 Provide cable trays, cables, and wires required to interconnect to junction boxes, annunciators, and central unit as required by the equipment manufacturer.
- .18 Before testing the system and submitting it to the Departmental Representative, make sure that the wiring does not have any open circuit, short circuit, or earth leakage.
- .19 Circuitry and associated wiring must be marked at the central unit, annunciators, and junction boxes.

3.3 QUALITY CONTROL ON SITE

- .1 Perform tests in accordance with Section 26 05 00 - Electrical - General Requirements for Work Results and CAN/ULC-S537.
- .2 Fire Alarm System.
 - .1 Test all alarm devices and circuits to ensure that manual alarms, thermal detectors, sprinkler system, smoke detectors transmit alarm signal to master control board and trigger auxiliary devices, a first-stage alarm and a general alarm.
 - .2 Check the annunciators to ensure that the areas are correctly indicated.
 - .3 Simulate ground leaks and openings on alarm and signaling circuits to ensure system is operating properly.
 - .4 DCLA type adressable circuit system.
 - .1 Verify that each conductor of all DCLA addressable links can transmit at least three (3) consecutive alarm signals on either side of a deliberate circuit opening near the midpoint of each link. Press the "Acknowledge/Interrupt signaling" button after receiving each of the three (3) signals. Correct the defect after the completion of each series of tests.

- .2 Verify that each conductor of all addressable DCLA links can transmit at least three (3) consecutive alarm signals during a deliberate ground fault near the midpoint of each link. Press the "Acknowledge/Interrupt signaling" button after receiving each of the three (3) signals. Correct the defect after the completion of each series of tests.
- .3 Provide Departmental Representative with final reprogramming of PROM, including any changes made to program during system completion.

3.4 CLEANING

- .1 Cleaning during work: Perform cleaning according to section 01 74 00 - Cleaning.
 - .1 Leave the premises clean at the end of each working day.
 - .2 Final Cleaning: Evacuate surplus materials/equipment, waste, tools and equipment from site, in accordance with Section 01 74 00 - Cleaning.

3.5 PROTECTION

- .1 Protect installed equipment and components from damage during construction.
- .2 Repair damage to adjacent materials and equipment by installation of the fire alarm system.

3.6 ACTIVITIES RELATED TO THE COMPLETION OF WORK

- .1 Arrange for the manufacturer of fire alarm equipment to give on-site training and demonstrations to the operations personnel on the operation and maintenance of the system.

3.7 DEMONSTRATION AND TRAINING

- .1 Arrange for the manufacturer of the fire alarm equipment to give on-site training and operational demonstrations to operating personnel within one month of the operation and maintenance of the system. Upon receipt with reserve of work after the complete installation of all system components:
 - .1 The programming of these trainings must be established at least one month in advance with the authorities of the Ministry of Public Security.
 - .2 During the training, each participant must have documentation in French language.
 - .3 Operation and maintenance supervision manuals will be provided in French and English.
 - .4 The Contractor must include in the cost of its bid 24 hours of on-site training by engineers of the system manufacturer.
- .2 The training must include a complete demonstration and practice system including an alarm centralizer (NCC), an annunciator (such as booths) and the various detection and signaling components.

END OF SECTION

DIVISION 31

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 00 – Cleaning
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 31 05 16 – Aggregates for Earthwork
- .5 Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .6 Section 32 11 16.01 – Granular Sub-base
- .7 Section 32 12 16.01 – Asphalt Paving - Short Form
- .8 Section 32 16 00 – Curbs, Gutters and Sidewalks
- .9 Section 32 91 19.13 – Topsoil Placement and Grading
- .10 Section 32 92 23 – Sodding

1.2 REFERENCE STANDARDS

- .1 Ministère des Transports du Québec:
 - .1 CCDG, Cahier des charges et devis généraux, édition 2019.
- .2 All standards mentioned in relevant sections.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples: no later than one week prior to backfilling or infilling, submit to the designated testing agency a sample of 25 kg of backfill material proposed for the work.
- .3 Do not proceed with backfilling or infilling until Departmental Representative has approved proposed material for work.

PART 2 - PRODUCTS**2.1 MATERIALS**

- .1 Backfill material must be approved by the Departmental Representative prior to use and will be in accordance with Section 31 05 16 - Aggregates for Earthwork.

2.2 SOURCES OF MATERIALS

- .1 The Contractor must provide the address of the supplier of backfill material.

PART 3 - EXECUTION**3.1 EXAMINATION**

- .1 Evaluation and Assessment:
 - .1 Examine soil report annexed to these technical specifications.
 - .2 Before commencing work verify locations of buried services on and adjacent to site.

3.2 PREPARATION

- .1 This work must be performed in accordance with the requirements of Section 31 23 33.01 - Excavation, Trenching and Backfilling.

3.3 PROTECTION OF IN-PLACE CONDITIONS

- .1 This work must be performed in accordance with section 31 32 33.01 Excavating, Trenching and Backfilling.

3.4 EARTHWORKS AND LEVELING

- .1 Earthworks and leveling consist of, but are not limited to, providing the equipment and labor required to perform, in accordance with the standards, earthworks and site grading according to specifications on plans including:
 - .1 The loading, transportation and disposal of surplus excavation to a site in accordance with the guidelines of the MELCC Intervention Guide - Soil Protection and Contaminated Sites Rehabilitation,
 - .2 Supply and placement of backfill material approved by Departmental Representative.

3.5 EXCAVATION AND BACKFILLING

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling.

3.6 BACKFILLING

- .1 Perform the backfilling in accordance with section 31 32 33.01 Excavating, Trenching and Backfilling.

3.7 GRADING

- .1 Grade so that water will drain away from buildings, walls and paved areas, to catch basins and other disposal areas approved by Departmental Representative.
- .1 Grade to be gradual between finished spot elevations shown on drawings.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Dispose of cleared and grubbed material off site daily.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for organics and recycle or reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 00 – Cleaning
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 31 00 00.01 – Earthwork – Short Form
- .5 Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .6 Section 32 11 16.01 – Granular Sub-base
- .7 Section 32 12 16.01 – Asphalt Paving - Short Form
- .8 Section 32 16 00 – Curbs, Gutters and Sidewalks

1.2 REFERENCE STANDARDS

- .1 Bureau de normalisation du Québec (BNQ):
 - .1 Norme 2560-114 (latest edition) – Civil Engineering Work - Aggregates
 - .1 Partie II: Sub-base course, capping layer, surface course and shoulder (aggregates used for roadways)
 - .2 Partie III: Aggregates used as a cushion, coating, separation layer and filtering medium
- .2 Ministère des Transports du Québec:
 - .1 Cahier des charges et devis généraux du Québec - Infrastructures routières, Construction et réparation (CCDG edition 2019).
 - .2 Cahiers des Normes, Ouvrages Routiers, Tome VII « Matériaux »:
 - .1 Norme 2101 (latest edition) - Granulats.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for aggregate materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit a 25 kg sample of each type of aggregate.
 - .2 Provide Departmental Representative with access to source and processed material for sampling.
 - .3 Supply new or clean sample bags or containers according appropriate to aggregate materials.
 - .4 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Erosion and Sedimentation Control: submit copy of erosion and sedimentation control plan.

1.4 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Aggregates must meet the technical requirements set out in NQ Standard 2560-114 (2014), Part II and III and in Standard 2101 of the Roadworks of M.T.Q., Volume VII, 2007 edition.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.

- .2 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.
- .3 Advise Departmental Representative 4 weeks minimum in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.
- .5 Sources of supply must show concentrations that meet the Residential criteria as recommended by the Canadian Council of Ministers of the Environment (CCME).

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- .1 Stockpiling:
 - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.
 - .2 Stockpile aggregates in sufficient quantities to meet project schedules.
 - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
 - .4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.
 - .5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
 - .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 hours of rejection.

- .7 Stockpile materials in uniform layers of 1.5 m thickness.
- .8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
- .9 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.3 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 02 41 13 - Selective Demolition

1.2 DEFINITIONS

- .1 Clearing consists of cutting off trees and brush vegetative growth to not more than specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.
- .2 Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps and embedded logs, removing at, or close to, existing grade and disposing of fallen timber and surface debris.
- .3 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees, and disposing of felled trees and debris.
- .4 Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, [and trees smaller than 50 mm trunk diameter]and disposing of fallen timber and surface debris.
- .5 Grubbing consists of excavation and disposal of stumps and roots [boulders and rock fragments of specified size]to not less than specified depth below existing ground surface.
- .6 EAB refers to Emerald Ash Borer a non-native, invasive beetle that is highly destructive to ash trees where it occurs.
 - .1 Woodchips in the context of EAB consist of untreated, raw bark and wood fragments broken or shredded from logs or branches. Woodchips are to be less than 2.5 cm in at least any two dimensions.
 - .2 Firewood in the context of EAB consists of non-manufactured, solid wood material, with or without bark, cut into sizes less than 1.2 metres long and less than 25 cm in diameter which may be handled manually.
 - .3 Logs in the context of EAB consist of untreated, raw wood greater than 1.2 metres in length and greater than 25 cm diameter.
 - .4 Enclosed vehicle in the context of EAB consist of any vehicle transporting regulated wood material that is equipped to prelude the loss of materials or the escape of EAB while in transit.
- .7 Erosion: deterioration, displacement, or transportation of land surface by wind or water, intensified by land clearing practices related to construction work.

- .8 Sediment: particulate matter transported and deposited as a layer of solid particles within a body of water.

1.3 REFERENCE STANDARDS

- .1 Canada Labour Code, Part 2, Canada Occupational Health and Safety Regulations.
- .2 Canadian Environmental Protection Act.
- .3 United States Environmental Protection Agency (EPA)/Office of Water.
 - .1 EEPA-833-R-06-004, Developing Your Stormwater Pollution Prevention Plan, A Guide for Construction Sites

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Arrange for a Site meeting, before Work starts, with Departmental Representative in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Examine existing Site conditions and adjacent areas to construction's work, before Work starts.
 - .3 Identify potential environmental impact on existing Site conditions.

1.5 HEALTH AND SAFETY

- .1 Perform clearing and grubbing work in accordance with the CNESST.
- .2 Safety Requirements: worker protection.
 - .1 Ensure workers are wearing personal protective equipment while performing clearing and grubbing activities.

1.6 QUALITY CONTROL

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

PART 2 - PRODUCTS**2.1 MATERIALS**

- .1 Not applicable.

PART 3 - EXECUTION**3.1 PROTECTION**

- .1 Erosion and Sediment Control Measures
 - .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 temporary erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove temporary erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PREPARATION

- .1 Inspect the site and locate the elements to be preserved. Advise public utility companies before beginning clearance and uprooting work.
- .2 Locate and protect utility lines: preserve in operating condition active utilities traversing Site.
 - .1 Notify Departmental Representative immediately of damage to or when unknown existing utility lines are encountered.
 - .2 When utility lines which are to be removed are encountered within area of operations, notify Departmental Representative in ample time to minimize interruption of service.
- .3 Keep roads and walks free of dirt and debris.

3.3 CLOSE CUT CLEARING

- .1 Close cut clearing to within 100 mm of ground surface.

.2 Cut down trees overhanging area cleared as directed by Departmental Representative.

.3 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.

3.4 ISOLATED TREES

.1 Cut off isolated trees as directed by Departmental Representative at height of not more than 300mm above ground surface.

.2 Grub out isolated tree stumps.

.3 Prune individual trees as indicated.

3.5 GRUBBING

.1 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots, and designated stumps from indicated grubbing areas.

.2 Grub out stumps and roots to not less than 200 mm below ground surface.

.3 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

3.6 REMOVAL AND DISPOSAL

.1 Carry cleared materials off site to disposal area in conformity with Soil Protection and Rehabilitation of Contaminated Sites policies of MDDELCC,

.2 Any ash wood materials or firewood which is removed from the site is to be transported in an enclosed vehicle and disposed of at an authorized disposal facility.

.3 The Contractor is responsible for monitoring all cut ash wood and firewood until it is properly disposed of as determined by Departmental Representative.

3.7 FINITION

.1 Leave the ground surface in such conditions allowing the immediate topsoil removal to the Departmental Representative's satisfaction.

3.8 CLEANING

.1 Perform cleaning in accordance with Section 01 74 00 - Cleaning.

- .2 Clean and remove debris and sediment from work area drainage devices and dispose of to an approved landfill site as directed by Departmental Representative.
- .3 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .4 Do not clean equipment in the waterbody or where the wash-water can enter the waterbody.
- .5 Maintain tidy Work area, free from accumulation of waste products and debris.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 35 29.06 - Health and Safety Requirements
- .3 Section 01 35 43 – Environmental Procedures
- .4 Section 01 45 00 – Quality Control
- .5 Section 01 56 00 - Temporary Barriers and Enclosures
- .6 Section 01 74 19 – Waste Management and Disposal
- .7 03 10 00 – Concrete forming and accessories
- .8 03 30 00 – Cast in place concrete
- .9 Section 31 00 00.01 – Earthworks – Short Form
- .10 Section 31 05 16 – Aggregates for Earthwork
- .11 Section 32 11 16.01 – Granular Sub-base
- .12 Section 32 12 16.01 – Asphalt Paving - Short Form
- .13 Section 32 16 00 – Curbs, Gutters and Sidewalks
- .14 Section 32 91 19.13 – Topsoil Placement and Grading
- .15 Section 32 92 23 – Sodding
- .16 Section 33 05 16 – Maintenance Holes and Catch Basin Structures
- .17 Section 33 14 16 – Site Water Utility Distribution Piping
- .18 Section 33 31 11 – Public Sanitary Sewerage Gravity Piping
- .19 Section 33 41 00 – Storm Utility Drainage Piping
- .20 The Contractor is responsible for obtaining a copy of all sections of this specification even if it seems to him irrelevant to his specialty, otherwise it will be acknowledged that he accepts the clauses and prescriptions of all sections of this specification. The Contractor must consult the table of contents of the specifications for the complete list of sections.

1.2 REFERENCE STANDARDS

- .1 Bureau de normalisation du Québec (BNQ):
 - .1 NQ 1809-300 (2018): Construction Work – Drinking Water and Sewer Lines – General Technical Specifications
- .2 Ministère des Transports du Québec:
 - .1 Cahiers des Normes, Ouvrages Routiers, Tome VII « Matériaux », dernière édition.
 - .1 Norme 13101 (latest edition) - Géotextiles.
- .3 MELCC
 - .1 Intervention Guide - Soil Protection and Contaminated Sites Rehabilitation of MELCC;
 - .2 Excavated soil management plan in Appendix 5 of the MELCC Intervention Guide - Soil Protection and Contaminated Sites Rehabilitation;
 - .3 Regulation respecting the burial of contaminated soils;
 - .4 Regulation respecting the landfilling and incineration of residual materials (EQA);
 - .5 Dangerous Goods Regulations
 - .6 All other relevant publications
- .4 Canadian Council of Ministers of the Environment (CCME)
 - .1 Canadian Environmental Quality Guidelines;
 - .2 Canadian Soil Quality Guidelines: Environment and Human Health;
 - .3 All other relevant publications.
- .5 American Society for Testing and Materials (ASTM):
 - .1 ASTM C117-13, Standard Test Method for Materials Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing;
 - .2 ASTM C136/C136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates;
 - .3 ASTM D422-63 (2007), Standard Test Method for Particle-Size Analysis of Soils;

- .4 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³);
- .5 ASTM D1557/12e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³));
- .6 ASTM D4318-10e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .6 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1-88, Wire mesh test sieves, non-metric;
 - .2 CAN/CGSB-8.2-M88, Wire mesh test sieves, metric.
- .7 Canadian Standards Association (CSA):
 - .1 CAN/CSA-A3000-08, Compendium of binding materials;
 - .2 CSA-A23.1-14/A23.2-14, Concrete: Constituents and Construction Work / Standard Test Methods and Practice for Concrete.
- .8 National Research Council of Canada (NRC) and Régie du bâtiment du Québec:
 - .1 Quebec Building Code - Chapter I, Building, and National Building Code of Canada 2015 (as amended) and the 2015 NBC User's Guide: Structural Design Comments (Part 4 of Division B) .

1.3 DESCRIPTION

- .1 Excavation, trenching and backfilling include the supply of all materials, equipment, supplies, services, labor, equipment, machinery and transportation required to complete the work as indicated the drawings and this section. The works also include, but are not limited to:
 - .1 Mass excavation for foundation work;
 - .2 Detail excavation for wheelbases and slab runs;
 - .3 Backfill foundations and pipes under slabs;
 - .4 Excavation and backfilling of underground services;
 - .5 Excavation and backfilling of exterior landscaping;
 - .6 Installation of geotextile membranes and French drains;
 - .7 Protective work on existing structures;

- .8 Temporary support, underpinning and pumping work.

1.4 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; class B excavation and rock excavation.
 - .1 Rock: solid material in excess of 1.00 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m³ bucket. Frozen material not classified as rock.
 - .2 Class B excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .6 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials.
- .7 Undisturbed soils: Soils whose geotechnical properties have not been altered by previous interventions on the site or the work of the Contractor.
- .8 unshrinkable fill: A very weak blend of Portland cement, concrete aggregates and water that will not settle when placed in trenches intended for receiving drains, utilities, and that one can excavate without prior preparation.
- .9 Criteria for the Management of Contaminated Soils that May Remain on the Site: Canadian Council of Ministers of the Environment (CCME) Residential Criteria

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Control: in accordance with Section 01 45 00 - Quality Control:
 - .1 Submit condition survey of existing conditions as described in EXISTING CONDITIONS article of this Section.
 - .2 Submit for review by Departmental Representative proposed dewatering and heave prevention methods as described in PART 3 of this Section.
 - .3 Submit to Departmental Representative written notice at least 7 days prior to excavation work, to ensure cross sections are taken.
 - .4 Submit to Departmental Representative written notice when bottom of excavation is reached.
 - .5 Submit to Departmental Representative testing results as described in PART 3 of this Section.
- .3 Preconstruction Submittals:
 - .1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
 - .2 Submit records of underground utility locates, indicating: location plan of relocated and abandoned services, as required and location plan of existing utilities as found in field.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill and unshrinkable fill materials and provide access for sampling and approval.
 - .3 Submit to the Departmental Representative granulometric analyzes of proposed backfill materials.
 - .4 Provide Departmental Representative with laboratory analysis that embankment aggregates do not contain pyrite and are DB certified.
 - .5 All documents will be submitted in one (1) electronic copy. One (1) annotated electronic copy will be returned to the Contractor.

- .6 Submit 25 kg samples of each type of backfill material as well as representative samples of excavation material. In the case of coarse gravel or large pieces of crushed stone, submit 70 kg samples.
- .7 Provide samples to Departmental Representative in tightly closed containers to prevent contamination and exposure to weather.
- .8 At least four (4) weeks prior to commencement of work, notify Departmental Representative of proposed source of fly ash, and submit samples to Departmental Representative.
 - .1 Do not change source of fly ash without the written permission of the Departmental Representative.

1.6 QUALITY INSURANCE

- .1 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .2 Design and supporting data submitted to bear stamp and signature of qualified professional engineer member in good standing of the Ordre des Ingénieurs du Québec (OIQ).
- .3 Keep design and supporting data copy on site.
- .4 Engage services of qualified professional Engineer who is member in good standing of the Ordre des Ingénieurs du Québec (OIQ) in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .5 Do not use soil material until written report of soil test results are approved by Departmental Representative.
- .6 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling or reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Divert excess aggregate materials from landfill to local recycling for reuse as directed by Departmental Representative.

1.8 EXCAVATION SLOPES, SHRINKAGE, PUNCHING, SUPPORTING STRUCTURES AND UNDERWAY RECOVERY

- .1 Prevent excavation walls from collapsing or sinking. Prevent movement or settlement of soils in and around the excavations, and in the vicinity of existing or existing buildings, facilities and services.
- .2 During excavations, construct required slopes and / or provide and place all temporary retaining structures, cofferdams, props, or other supports necessary for proper excavation. All this work is the sole responsibility of the Contractor.
- .3 Follow the recommendations of the annexed geotechnical study and comply with the Construction Safety Code and local bylaws in determining slope gradients and in the design of land support systems.
- .4 If retaining structures are required on the Departmental Representative's plans; design, supply and place walls at these locations. Also design, supply and install the additional walls or shoring required according to the excavation method chosen by the Contractor.
- .5 The Contractor is solely responsible for the calculations and design of the earth retaining structures. The structures must be designed to withstand the thrust of soil, water, overburden due to building foundations adjacent to the work, road overload and overload due to the machinery required during construction of the basin. In addition, their design must comply with the Construction Code of Québec - Chapter 1, Building, and National Building Code of Canada 2015 (amended), particularly Parts 4 and 8 and the supplement to the 2015 National Building Code.
- .6 The retaining structures required near the water mains must be constructed with the help of drilled piles (see plans and geotechnical study). No threshing work will be allowed near these pipes.
- .7 The Contractor shall confirm the location of these watermain by carefully excavating their location. The watermain should be taken out of service before the excavation work and a drinking water supply and fire protection network must first be installed, tested and disinfected
- .8 The Contractor is solely responsible for damage to persons or existing buildings, installations and services that may be caused as a result of the absence or weakness of retaining structures or cofferdam and as a result of the use of incorrect slopes, caused by incorrect placement, poor maintenance or removal.
- .9 When demolition or partial dismantling of retaining structures is required, the Contractor must ensure that work is performed in accordance with applicable standards and local regulations.
- .10 Protect the excavations.
- .11 In cold weather, protect slopes from freezing effects so that backfilling operations can progress without interruption.

- .12 Retain the services of an engineer member in good standing of the Ordre des Ingénieurs du Québec (OIQ), for the design and inspection of retaining walls, cofferdams, sheet piles and bracing, bracing and underpinning required for the work, or for determining the slopes to be given to the embankments of the excavations to ensure their stability in accordance with the Canadian Construction Safety Code, latest edition, and local regulations.
- .13 At least two (2) weeks prior to start of work, submit design documents and related technical data for verification. All documents will be submitted in one (1) electronic copy. One (1) annotated electronic copy will be returned to the Contractor.
- .14 Design documents and associated technical data submitted must bear the seal and signature of a recognized Engineer in the province of Quebec.
- .15 The Engineer responsible for the design of temporary structures and slopes must provide proof that he holds a professional liability insurance policy, unless the Engineer is employed by the Contractor. In such a case, the Contractor must provide proof that the work of his Engineer is covered by his insurance policy.
- .16 The excavation limits must not exceed the property boundaries and / or permanent easements and / or construction easements.
- .17 Consider the recommendations of the geotechnical flare study to be considered in the calculations when designing the support systems that are expected to be used.

1.9 EXISTING CONDITIONS

- .1 Review soil analysis report, geotechnical investigation report and rapport de caractérisations des eaux souterraines presented in appendix of this specification.
- .2 Protect the bottom of the excavations against softening, if this occurs, then remove the softened soil and replace with compacted class "A" granular soil.
- .3 Protect bottom of excavations and structures against freezing.
- .4 Take the necessary measures to eliminate the dust produced.
- .5 Properly protect existing facilities, buildings and services and existing equipment located on site so that they are not damaged during construction.
- .6 Never pile excavated material in a place where it could interfere with the work or drainage of the land.
- .7 Buried services:
 - .1 Before commencing work verify location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.

- .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
- .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
- .5 Prior to beginning excavation Work, notify applicable authorities having jurisdiction and/or Departmental Representative establish location and state of use of buried utilities and structures. The Contractor must clearly mark such locations to prevent disturbance during Work.
- .6 Confirm locations of buried utilities by careful test excavations.
- .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.
- .8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing. Costs for such Work to be paid by Departmental Representative.
- .9 Record location of maintained, re-routed and abandoned underground lines.
- .10 Confirm locations of recent excavations adjacent to area of excavation.
- .8 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
 - .3 Where required for excavation, cut roots or branches as directed by Departmental Representative.
- .9 Comply with municipal requirements and the Safety Code for Construction, S-2.1, r.4, Province of Quebec, regarding safety standards for excavation and worker protection.
- .10 Protect level markers, alignment markers, survey markers and geodetic markers on site.
- .11 Take all necessary precautions to prevent property damage and personal injury.
- .12 Set up protective barricades around any excavation.

1.10 BASEMENT CONDITION

- .1 The following reports on surveys conducted at the work site are attached to the Contract Documents:

- .1 Report prepared by Journeaux Assoc on February 2016 under file number 075-P- L-15-1847;
- .2 Report prepared by Englobe on October 2019 under file number 025-P-0019200-0-01-001-GE-R-0001-00.
- .3 Technical note prepared by Journeaux Assoc, dated April 2020, number L-20-2253.
- .2 Read and interpret this report to determine the nature, condition and extent of excavation work to be performed.

1.11 CHOICE OF EXCAVATION METHODS

- .1 The Contractor is solely responsible for the choice of excavation methods used. Submit these methods in advance to the Departmental Representative for review and comment. Take into account the indications given in the geotechnical survey reports. Particularly, in order to avoid disturbance of the cohesive deposit, excavations in this layer must be carried out with a toothless bucket equipped with a plate.

1.12 WORK OF DYNAMITAGE

- .1 No blasting will be allowed during the work.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Backfill materials in accordance with Section 31 05 16 - Aggregates.
- .2 Class B backfill material: unfrozen material from excavation or other source, authorized by the Departmental Representative for the proposed use, and free from stones larger than 75 mm, of clinker, ashes, sod, waste or other harmful material. These materials must meet the CCME Residential Guidelines
- .3 Stabilization of soils with geotextiles: geotextiles type III according to standard 13101 (2018), Volume VII "Materials" of the MTQ.
- .4 Crushed stone 20-0:
 - .1 Crushed stone or gravel clean, hard, resistant and free from shale, clay and loose, organic or deleterious materials; the particle size of the materials must remain within the limits indicated below when they are laid, according to ASTM C136 and ASTM C117 standards, and the granulometric curve drawn on a semi-logarithmic diagram must be continuous and progressive. The embankment must be certified as a DB 0-20 embankment.

ASTM% passing sieve

31,5	mm	100
20	mm	90-100
14	mm	68-93
5	mm	35-60
1,25	mm	19-38
315	µm	9-17
80	µm	2-7

.5 Class "A" Granular Soils:

- .1 Compactable soils, consisting mainly of granular, hard and strong non-plastic materials, such as MG-112 sand, gravel or crushed stone. These soils must be free from shale, clay, loose, organic or deleterious materials and contaminated materials. These soils must be non-freezing. These soils must not contain blocks greater than 100 mm in diameter.

.6 Class "B" Common Soil:

- .1 All compactable and unfrozen materials may be used except organic soils. Soil components must be mineral, free from rocks greater than 150 mm in size, from clinker, ash, refuse, sod or other harmful material:
- .1 When authorized by Departmental Representative, reusable rubble soils may be considered Class "B" Common Soils if they meet all Class "B" criteria.

.7 Filter fill:

- .1 Crushed stone, 19 mm in diameter, clean, hard and durable, free of dust, foreign matter, organic or vegetable matter and flat or elongated fragments;
- .2 Crushed stone, type BC 5-20, durable, free of dust, foreign matter, organic or vegetable matter and flat or elongated fragments, in accordance with NQ 2560-114.

.8 Stone Dust:

- .1 Clean, hard, resistant stone screen, free of shale, clay and loose, organic or deleterious materials; conform to the following particle size (ASTM C136 and ASTM C117):

ASTM% passing sieve

10	mm	100
5	mm	75-100
160	µm	4-25
80	µm	0-10

- .9 Unshrinkable fill:
 - .1 Maximum compressive strength 0.4 MPa at 28 days;
 - .2 Maximum Portland cement content of 25 kg / m³, consisting of 40% fly ash as replacement material: to CAN / CSA A3000 Type GU;
 - .3 Minimum resistance of 0.07 MPa at 24 hours;
 - .4 Concrete Aggregates: to CAN / CSA A23.1 / A23.2;
 - .5 Portland cement: GU type;
 - .6 Sag: 160 to 200 mm.
- .10 Anti shear reinforcement:
 - .1 Biodegradable, 100 mm thick cellular boards treated to adequately support poured concrete in place until hardened.
- .11 Geotextile membrane:
 - .1 Nonwoven needleless polypropylene geotextile for separation. Tensile strength can 148.1 No. 7.3 550 N and 250 N at tear can 4.2 no.12.2
- .12 French drain piping:
 - .1 Perforated corrugated HDPE hose with 210 kPa filter. Made of high resistance polyethylene with geotextile membrane, 150 mm diameter
- .13 Prior to use, have all fill materials approved by the Departmental Representative. After this approval, always stock up with the same materials from the same sources.
- .14 Before using the borrowing materials, the Contractor may use the materials from the excavations, if they meet the requirements of this section and if they are approved by the Departmental Representative and according to the recommendations of the geotechnical report. In-situ soils can not be used as Class "A" granular soils. They may be considered as Class "B" common soil if they meet the requirements for this type of fill.
- .15 Provide, from an external source of supply, additional fill materials suitable for the work.

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.

These temporary means may include: erosion control fence, straw or hay bales, geotextiles, drainage structures, berms, terraces, temporary drainage pipes, sedimentation ponds, vegetation cover, dikes and any other required structures to prevent erosion and migration of silt, mud, sediment and other debris from the site or to other areas of the site where they may cause damage, and any other means that may be required by law or regulation.

- .2 Set up a truck wash area to prevent the saturated soils that will be transported from causing dust and mud on the Institution's roads and public roads. The Contractor must have the Departmental Representative's approval for the wash water management measures prior to commencement of work.
- .3 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .4 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.
- .3 The Contractor shall construct a working platform of granular materials to ensure the circulation of heavy machinery to the work site.
- .4 Prior to excavation and throughout the duration of the work, the groundwater level must be lowered and maintained on all excavated areas 0.6 m below the level of the bottom of the granular foundation of structures (see geotechnical study).

3.3 PREPARATION/PROTECTION

- .1 Protect existing features in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .2 Protect excavations against freezing.
- .3 Keep excavations clean, free of standing water, and loose soil.
- .4 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .5 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .6 Protect buried services that are required to remain undisturbed.

3.4 STRIPPING OF TOPSOIL

- .1 Do not handle topsoil when wet or frozen, or in any way that could alter the soil structure.
- .2 Begin topsoil stripping of areas as indicated after area has been cleared of weeds, brush and grasses and removed from site.
- .3 Strip topsoil to depths as indicated.
 - .1 Do not mix topsoil with subsoil.
- .4 Stockpile in locations as directed by Departmental Representative.
 - .1 Stockpile height not to exceed 2 m and should be protected from erosion. Place the excavated material on polythene membranes and cover with polyethylene membranes at the location indicated by the Departmental Representative.
- .5 Dispose of unused topsoil off site.

3.5 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 The excavation surplus may temporarily be stored inside the construction area. Stockpiles should be at least 12m away from the fences and should not be higher than 2.5m. It is, however, preferable that the excavation surplus be removed from the site of the establishment at the location designated by the Departmental Representative.
 - .2 Stockpile granular materials in manner to prevent segregation.
 - .3 Deposit excavated material on polythene membranes and cover with polyethylene membrane at location indicated by Departmental Representative.
- .2 Aggregates should be stockpiled on level, well-drained land with sufficient bearing capacity and stability to support heaped material and material handling equipment.
- .3 Unless the materials are stacked on an acceptable stabilized surface, the base of the pile shall consist of a layer of compacted sand at least 300 mm thick to prevent contamination of aggregates. Put the aggregates in a heap on the ground, but do not incorporate the layer of 300 mm thick material at the base of the pile into the structure.
- .4 To avoid aggregate mixtures, sufficiently separate the piles of different aggregates or separate them by means of robust and full height partitions.
- .5 It is forbidden to use mixed or contaminated materials. Remove and dispose of rejected materials within 48 hours of refusal, as directed by the Departmental Representative.
- .6 Place materials in piles forming uniform layers not exceeding 1.5 m thick.

- .7 Unload the aggregates brought to the pile by truck in uniform heaps and shape the heaps as prescribed.
- .8 During winter work, prevent ice and snow from mixing with heaped material or extracted from heap.
- .9 Protect fill materials from contamination.
- .10 The Contractor is responsible for maintaining the geotechnical properties of backfill materials until they are put in place. He will have to take all necessary measures to protect the materials that will be used as backfill material. All direct and indirect costs related to deterioration of material properties will be borne by the Contractor.
- .11 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 29.06 - Health and Safety Requirements and the Health and Safety Act for the Province of Quebec.
 - .1 Where conditions are unstable, the Contractor must have the Departmental Representative approve the methods to be used to correct the situation.
- .2 Construct temporary Works to depths, heights and locations as approved by Departmental Representative.
- .3 During backfill operation:
 - .1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
 - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .4 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .5 Upon completion of substructure construction:
 - .1 Remove cofferdams, shoring and bracing.
 - .2 Remove excess materials from site.

3.7 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Departmental Representative's approval details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures and in manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.
- .7 Take precautions to avoid lifting and ensure bottom stability of deep excavations. Have an engineer member in good standing of the Ordre des Ingénieurs du Québec (OIQ), design the method of pumping and have the Engineer prepare the anticipated flow rates and the number of pumps required to achieve this end. Submit this method in advance, outlined on a blueprint with supporting calculations, for review and comments by the Departmental Representative, prior to commencement of work.
- .8 Maintain pumping when applicable throughout construction to ensure stability and avoid lifting of structures.
- .9 The Contractor remains fully responsible for groundwater control as well as ensuring stability and avoiding the lifting of structures during construction.
- .10 The principles to be followed for deep pumping are as follows:
 - .1 The water level throughout the duration of the work must be maintained on all excavated areas 0.6 m lower than the level of the bottom of the granular foundation of the foundation of the structures (see geotechnical study);
 - .2 Pumping equipment in excavations must be operational at all times, even in cold weather or during power outages. Provide emergency measures to restore, repair or replace any defective equipment without delay. Maintain at the site a complete replacement pumping system in case of breakage.

- .11 Quickly remove all water, mud and debris that may enter or accumulate in structures constructed under this contract.
- .12 All expenditures incidental to the above drainage requirements must be included in the bid price.

3.8 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.
- .2 Carry out excavation work according to the dimensions, routes, dimensions and levels indicated to allow the installation, construction, inspection and drainage of the required works.
- .3 Remove paving, demolished foundations and rubble, walks, concrete, masonry and other obstructions encountered during excavation.
- .4 Dig to precise lines and levels to minimize the amount of backfill needed.
- .5 Excavation must not interfere with bearing capacity of adjacent foundations.
 - .1 If the bearing capacity of the soil is unsatisfactory, additional excavation work will be authorized in writing.
- .6 Dig trenches to provide uniform and continuous support and lift to a layer of bedding material on solid and undisturbed soil.
- .7 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open at end of day's operation.
- .8 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .9 Restrict vehicle operations directly adjacent to open trenches.
- .10 Dispose of surplus and unsuitable excavated material off site.
- .11 Do not obstruct flow of surface drainage or natural watercourses.
- .12 All areas of the site must be permanently dry during the work, as required in section 3.7 of this technical specification.
- .13 In areas of future building, excavate to required levels under foundations. The excavated area must consist of undisturbed soil and be free of rock or loose rock exceeding 300 mm in any of its dimensions, earth or other debris. Profiling, during excavation, surfaces in continuous slopes towards catchment points. Elsewhere excavate to the required level of paving or terracing infrastructure for seeding.

- .14 Earth bottoms of excavations must be undisturbed soil, free from loose, soft or organic matter.
 - .1 Excavations beyond specified depths, without the written permission of the Departmental Representative, shall be filled with backfill concrete at the expense of the Contractor.
- .15 If the bottom soil of the excavations appears inappropriate, notify the Departmental Representative and proceed as directed.
- .16 Notify Departmental Representative when bottom of excavation is reached.
- .17 For slabs and hard-surfaced surfaces, dig to the bedding level.
 - .1 Remove topsoil, organic material, debris and other loose or deleterious material encountered at this level.
- .18 Obtain Departmental Representative approval of completed excavation.
- .19 Soil samples will be taken from the final walls and bottoms of the excavation. The analytical results of the walls and funds will be compared to the federal recommendations.
- .20 Clear the bottom of trenches and areas to be backfilled of any unsuitable material, stone or rock fragments, deleterious material, snow and ice, construction debris, organic matter and materials. Stagnant water in or at any point in the flow, including materials below the required grade, over the extent and depth determined by the Departmental Representative.
- .21 Correct unauthorized over-excavation as follows:
 - .1 Place Class B backfill and compact to at least 95% of maximum dry density according to modified Proctor test.
- .22 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.
- .23 Install geotextiles according to MTQ standard 13101 (2018), Volume VII "Materials".

3.9 EVACUATION OF EXCAVATED MATERIALS

- .1 Preserve and protect reusable excavation materials for backfilling on site.
- .2 Transport off-site, unsuitable material, waste and surplus materials, in accordance with all applicable laws.

- .3 Materials resulting from deforestation and cleaning of the area affected by the work (such as trees, shrubs, shrubs, branches, brush, stumps, dead wood, other plant debris and materials containing demolition debris) or demolition of existing pavements, curbs, sidewalks or underground facilities must be located in an authorized site for dry materials.
- .4 Excavation materials from granular foundations may not be reused as backfill material in the building and at the outer perimeter of the foundations. The Contractor must plan his backfilling work using new backfill material.

3.10 DISPOSITION OF CONTAMINATED EXCAVATION SURPLUS

- .1 The management of the materials to be excavated and disposed must be based on the results of the soil environmental characterization report appended to this specification.
- .2 Criteria for the management of contaminated soils that may remain on the site is the CCME Residential Criteria. As a result, all soils with contamination exceeding the CCME guideline values for a residential site must be excavated and disposed off site. These soils must then be arranged and treated according to the requirements of MELCC.
- .3 Even if they have a contamination lower than the values recommended by the CCME, surplus excavations that are contaminated must be disposed and treated according to the requirements of the MELCC.
- .4 The choice of disposal sites for dry materials and surplus excavation is the responsibility of the Contractor, but must be submitted to the approval of the Departmental Representative. The Contractor is solely responsible for the consequences that the refusal of materials might have on the disposal or treatment sites he has chosen. The Contractor must ensure that the criteria of acceptability of materials, disposal sites or treatment he has chosen are met and if necessary, assume the costs incurred to ensure it.

3.11 FILL TYPES AND COMPACTION

- .1 Use types of fill as indicated on drawings.
- .2 Compaction densities are percentages of maximum densities obtained from ASTM D1557 and ASTM D698.
- .3 Use backfill materials in accordance with the types defined in section 2.1.
- .4 The limits prescribed in the Departmental Representative's drawings for the different layers of backfill material are the minimum limits of backfill after compaction.
- .5 Around constructed works, backfill to the levels indicated on the plans with the different layers of backfill material specified therein.
- .6 Unless otherwise indicated in the drawings, compact the different materials to obtain the densities indicated below:

- .1 Crushed stone 20-0: 95% of modified Proctor
- .2 Grade "A" Granular Soils: 95% Modified Proctor
- .3 Class "B" Class Common Soil: 90% Modified Proctor
- .7 Take steps to ensure that Class "B" Common Soil maintains a degree of moisture so that it can be compacted to the specified density.
- .8 When authorized by Departmental Representative to use site excavation surplus as backfill material, Contractor must provide at its expense a certificate of compliance which indicates that the re-used excavation surplus meet the criteria referred to in section 2.1. and the applicable environmental standards.
- .9 Use 20-0 crushed stone or Class "A" granular soils for embankment inside the building and 1m on the exterior perimeter of the building foundations.
- .10 Take care not to damage membranes, insulation of walls and slabs during backfilling.
- .11 Install backfill material in uniform horizontal layers not exceeding 150 mm. Add the amount of water required to obtain the specified density.
- .12 If, during the course of the work, the tests prove that the materials do not comply with the requirements set out in this specification, remove and replace, at no additional cost, the unacceptable materials and resume the work.
- .13 After backfilling, perform rough grading on the entire lot respecting the levels and slopes required for surface water to drain away from the building. Topsoil and turf can be made respecting the slopes and levels required.
- .14 Compact the existing subgrade beneath the walkways, and hard surfaces until the specified density for the fill material is achieved.
 - .1 Backfill excavated areas with class B material compacted to density specified for filler materials.

3.12 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as specified in Section 33 41 00 - Storm Utility Drainage Piping, Section 33 14 16 - Site Water Utility Distribution Piping, Section 33 31 11 - Public Sanitary Sewerage Gravity Piping and according to the NQ 1809-300 (2018) standard of the BNQ.
- .2 Place bedding and surround material in unfrozen condition.

3.13 BACKFILLING

- .1 Notify Departmental Representative no later than 48 hours prior to commencing backfilling or refilling with approved materials to allow the designated test laboratory to perform the necessary compaction tests.
- .2 Perform backfilling along walls only after construction of structural slabs and concrete has reached specified compressive strength.
- .3 Do not proceed with backfilling operations until completion of following:
 - .1 The materials have been approved for use for this purpose by the Departmental Representative.
 - .2 Completion of drainage, waterproofing and insulation work.
 - .3 Inspection and approval of facilities by the Departmental Representative, including sampling of the bottoms and walls of the excavation.
 - .4 The removal of shoring and bracing works; backfilling of voids with acceptable soil.
- .4 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .5 Do not use backfill material which is frozen or contains ice, snow or debris.
- .6 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .7 Backfilling around installations:
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading.
- .8 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 28 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Departmental Representative:
 - .2 If approved by Departmental Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Departmental Representative.
- .9 For seeded or sodded areas, use excavations surplus to topsoil level, except in trenches and within 600 mm of foundations.

- .10 For backfilling in class B materials, use excavations surplus or borrow material containing no stone greater than 200 mm in diameter.
- .11 Unless otherwise specified by Departmental Representative, remove shoring works from excavations as backfilling progresses.
- .12 During backfilling:
 - .1 Do not remove struts until backfill material has reached the level where these struts have been removed;
 - .2 Remove sheet piles to maintain compacted backfill at least 500 mm above their lower end.
- .13 Place unshrinkable fill in areas as indicated.
- .14 Consolidate and level unshrinkable fill with internal vibrators.

3.14 INSPECTION AND TESTING

- .1 Material and compaction analyzes will be performed by an expertise and testing laboratory designated by the Departmental Representative.

3.15 PROTECTION AGAINST FREEZING

- .1 When backfilling is carried out during frost, thaw and reheat the material before depositing and densifying. Protect the soil against freezing until backfilling is complete.

3.16 SNOW MANAGEMENT

- .1 The Contractor must clear all areas necessary for access to his work when there is a snow accumulation of more than 5cm on the ground.

3.17 INSTALLATION OF THE FRENCH DRAIN

- .1 Bedding of pipes: place a layer of at least 150 mm of class "A" granular soils; to compact up to the indicated levels, up to 95% of the maximum density, modified Proctor. Then dig the final surface slightly in order to immobilize the drain.
- .2 Installation of pipes:
 - .1 Ensure that pipes and fittings are clean inside before putting them in place;
 - .2 Lay pipes downhill to the connection points shown on the mechanical drawing (minimum slope: 2 mm per meter);
 - .3 Do not use concrete, masonry, stones, pieces of wood, or any other kind of shim to give the pipes the desired slope;

- .4 Connect hoses with fittings of the type recommended by the manufacturer;
 - .5 Mount ends of plug drains;
 - .6 Whenever work is interrupted, protect pipe ends against damage and prevent foreign objects from entering.
- .3 Installation of the filter backfill:
- .1 Install the filter backfill after having approved the installation of pipes by the Departmental Representative;
 - .2 Place on each side of pipe a layer of 150 mm of filter fill and a layer of 300 mm above the pipe;
 - .3 Fill the backfill by 150 mm layers by hand. Strengthen by slightly damaging. Take care not to move the pipes;
 - .4 The backfill must be covered with the geotextile membrane according to 2.1.8. Membrane seals must be overlapped by 300 mm.

3.18 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 19 - Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as directed by Departmental Representative.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

DIVISION 32

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 00 – Cleaning
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 31 00 00.01 – Earthworks – Short Form
- .5 Section 31 05 16 – Aggregates for Earthwork
- .6 Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .7 Section 32 12 16.01 – Asphalt Paving - Short Form
- .8 Section 32 16 00 – Curbs, Gutters and Sidewalks

1.2 REFERENCE STANDARDS

- .1 Bureau de normalisation du Québec (BNQ):
 - .1 Norme 2560-114 (latest edition) – Civil Engineering Work - Aggregates
 - .1 Partie II: Sub-base course, capping layer, surface course and shoulder (aggregates used for roadways)
- .2 Ministère des Transports du Québec:
 - .1 Cahiers des Normes, Ouvrages Routiers, Tome I « Conception routière », latest edition.
 - .2 Cahiers des Normes, Ouvrages Routiers, Tome VII « Matériaux ».
 - .1 Norme 2101 (latest edition) - Granulats.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.

- .2 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Granular sub-base materials should meet the requirements of Section 31 05 16 - Aggregates and meet the technical requirements of NQ 2560-114 (2014), Part II and Standard 2101 (2007). Road Works of the MTQ, Volume VII.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL:

- .1 Implement temporary erosion and sediment control measures in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling.

3.3 PLACING

- .1 Place granular sub-base after subgrade is inspected and approved by Departmental Representative.
- .2 Construct granular sub-base to depth and grade in areas indicated.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place granular sub-base materials using methods which do not lead to segregation or degradation.

- .7 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
- .8 Place material to full width in uniform layers not exceeding 300 mm compacted thickness.
- .9 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .10 Remove and replace portion of layer in which material has become segregated during spreading.

3.4 COMPACTION

- .1 Compaction equipment must be capable of obtaining required material densities.
- .2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Departmental Representative before use.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.5 CLEANING

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

3.6 SITE TOLERANCES

- .1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.7 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Departmental Representative.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 00 – Cleaning
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 31 00 00.01 – Earthwork – Short Form
- .5 Section 31 05 16 – Aggregates for Earthwork
- .6 Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .7 Section 32 11 16.01 – Granular Sub-base
- .8 Section 32 16 00 – Curbs, Gutters and Sidewalks

1.2 REFERENCE STANDARDS

- .1 Ministère des Transports du Québec:
 - .1 Cahier des charges et devis généraux (CCDG) du Ministère des Transports du Québec, édition 2019.
 - .1 Section Revêtement de chaussée en enrobé.
 - .2 Cahiers des Normes, Ouvrages Routiers, Tome I « Conception routière », latest edition.
 - .3 Cahiers des Normes, Ouvrages Routiers, Tome VII « Matériaux », latest edition.
 - .1 Norme 2101 (latest edition) - Granulats.
 - .2 Norme 4101 (latest edition) - Bitumes.
 - .3 Norme 4105 (latest edition) - Émulsions de bitume.
 - .4 Norme 4202 (latest edition) - Enrobés à chaud formulés selon la méthode de formulation du Laboratoire des chaussées.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Submit to Departmental Representative copies of freight and waybills for asphalt cement as shipments are received.
 - .1 Departmental Representative reserves right to check weights as material is received.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Aggregates: CCDG 2019 compliant.
- .2 Tack coat: type SS-1, complies with Standard 4105 (2015) - Bitumen Emulsions from the MTQ.
- .3 Asphalt concrete: in accordance with CCDG 2019.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 FOUNDATIONS

- .1 Granular foundations to be completed in accordance with Section 31 11 16.01 - Granular Sub-base.

3.3 PAVEMENT CONSTRUCTION

- .1 Surface preparation: CCDG 2019.
- .2 Application of tack coat: CCDG 2019.
- .3 Construction of asphalt concrete: CCDG 2019.

3.4 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 00 – Cleaning
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 02 81 00 - Hazardous Materials
- .5 Section 31 00 00.01 – Earthwork – Short Form
- .6 Section 31 05 16 – Aggregates for Earthwork
- .7 Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .8 Section 32 11 16.01 – Granular Sub-base
- .9 Section 32 12 16.01 – Asphalt Paving - Short Form

1.2 REFERENCE STANDARDS

- .1 Bureau de normalisation du Québec (BNQ) :
 - .1 BNQ 1809-500 (latest edition) : Concrete sidewalks and Curbs.
 - .2 NQ 2501-255 (latest edition) : Soils – Determination of the Water Content-Dry Density Relation – Modified Compaction Effort Test (2 700 kN.m/m³).
 - .3 NQ 2560-114 (latest edition) : Civil Engineering Works - Aggregates : Part I to Part VI.
 - .4 NQ 2621-900 (latest edition) : Bétons de masse volumique normale et constituants.
- .2 Ministère des Transports, de la Mobilité durable et de l'Électrification des Transports du Québec :
 - .1 Cahier des charges et devis généraux du Québec - Infrastructures routières, Construction et réparation (édition 2019).
 - .2 Cahiers des Normes, Ouvrages Routiers, Tome VII « Matériaux »
 - .1 Norme 2101 (latest edition) - Granulats.
 - .2 Norme 3101 (latest edition) - Bétons de masse volumique normale.
 - .3 Norme 5101 (latest edition) - Armature pour les ouvrages en béton

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit WHMIS SDS in accordance with Section 02 81 00 - Hazardous Materials.
 - .2 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, and limitations.
- .3 Inform Departmental Representative of proposed source of materials and provide access for sampling minimum 4 weeks prior to commencing work.
- .4 If materials have been tested by an accredited testing laboratory approved by the Departmental Representative within previous 2 months and have passed tests equal to requirements of this specification, submit test certificates from testing laboratory showing suitability of materials for this project.

1.4 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS**2.1 MATERIALS**

- .1 Concrete mix for curb and sidewalk: Type IV, 35 MPa in accordance with the specifications of the 3101 (2018) standard of Volume VII "Materials" of the MTQ road structures standards.
- .2 Concrete mix for poured curbs with concrete profiler (molded in place): type VI, 35 MPa in accordance with the specifications of standard 3101 (2018), Volume VII "Materials" of MTQ Standards and road structures.
- .3 Reinforcement steel, lattice and studs: in accordance with BNQ 1809-500 (2017) and standard 5101 (2018) - Reinforcement for concrete structures, Volume VII "Materials" of the MTQ Standards and Road Works.
- .4 Granular Base: Materials in accordance with Section 31 05 16 – Aggregates for Earthwork and the following requirements.
 - .1 Type: Crushed stone type MG-20.
- .5 Form release oil: chemically active release agent, containing products that react with free lime and give a water-soluble soap.

- .6 Backfill Materials: Materials in accordance with Section 31 05 16 – Aggregates for Earthwork.
- .7 Cure product: in accordance with the standards NQ 1809-500 (2017) and 3501 (2015) of Volume VII "Materials" of the MTQ road structures standards.
- .8 Expansion joint gasket: asphaltic board in accordance with BNQ 1809-500 (2017).

PART 3 - EXECUTION

3.1 GRADE PREPARATION

- .1 Do grade preparation work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.2 GRANULAR BASE

- .1 Obtain Departmental Representative's approval of subgrade before placing granular base.
- .2 Place granular base material to lines, widths, and depths as indicated.
- .3 Compact granular base in maximum 300 mm layers to minimum 95 % of maximum density according to BNQ 1809-500 (2017).

3.3 CONCRETE

- .1 Obtain Departmental Representative's approval of granular base and reinforcing steel prior to placing concrete.
- .2 Do concrete work in accordance with the BNQ 1809-500 standard (2017)
- .3 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom side to side across sidewalk in accordance with BNQ 1809-500 (2017).
- .4 Provide edging as indicated.
- .5 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Departmental Representative can be demonstrated. Hand finish surfaces when directed by Departmental Representative.

3.4 TOLERANCES

- .1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

3.5 CONTRACTION JOINTS

- .1 Contraction joints must be done in accordance with BNQ 1809-500 (2017)

3.6 DOWELLED EXPANSION AND CONSTRUCTION JOINTS

- .1 Dowelled expansion joints and construction joints shall be realized in accordance with BNQ 1809-500 (2017).
- .2 Install dowelled expansion joints around manholes, catch basins and permanent works.
- .3 Seal doweled expansion joints with sealant specified on plans.

3.7 UNCOUPLING JOINTS

- .1 Uncoupling joints must be made in accordance with BNQ 1809-500 (2017)

3.8 CURING

- .1 Cure concrete by continuously exposing finished surfaces to a humid atmosphere in accordance with the requirements of BNQ 1809-500 (2017).
- .2 Where burlap used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
- .3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

3.9 BACKFILL

- .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material indicated on drawings.
 - .1 Compact and shape to required contours as indicated on drawings.

3.10 CLEANING

- .1 Proceed in accordance with Section () 4 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 31 00 00 - Generalities
- .2 Section 31 14 11 - Earthwork and Levelling
- .3 Section 31 23 11- Excavation and Backfilling - Underground Services
- .4 Section 31 91 21 - Topsoil and earthworks
- .5 Section 31 92 22 - Hydroseeding
- .6 Section 31 92 23 - Sodding

1.2 SCOPE OF WORK

- .1 Ensure the supervision of the work and provide all labor, equipment, tools, materials, transport and other services needed to carry out and complete the work described and specified in this section and in the contract documents, including, without limitation: supply and installation of new fencing, gates and barriers including excavation, supply and laying of concrete foundations, the installation of prefabricated Jersey, fixing accessories, backfilling, repair of surfaces etc.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM) latest edition:
 - .1 ASTM A123/A123M-02 : Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM C260-06 : Standard Specification for Air-Entraining Admixtures for Concrete.
 - .3 ASTM C494/C494M-05a : Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C1017/C1017M-03 : Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .2 Canadian Standards Association (CSA) latest edition :
 - .1 CSA-A3000-98 : Cimentitious Materials Compendium.
 - .2 CSA-A23.1-00 : Concrete Materials and Methods of Concrete Construction.
 - .3 CSA-A23.2-00 : Methods of Test for Concrete.
 - .4 CAN/CSA-G164 : Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 Canadian General Standards Board (CGSB) latest edition :
 - .1 CAN/CGSB 1.181-99 : Ready-Mixed Organic Zinc-Rich Coating.

- .2 CAN/CGSB 138.1-96 : Fabric for Chain Link Fence.
- .3 CAN/CGSB 138.2-96 : Steel Framework for Chain Link Fence.
- .4 CAN/CGSB 138.3-96 : Installation of Chain Link Fence.
- .5 CAN/CGSB 138.4-96 : Gates for Chain Link Fence.

1.4 SHOP DRAWINGS

- .1 Provide shop drawings for fences, all doors and gates and accessories.
- .2 Submit for approval to the Engineer the concrete mixture formula and the results on this mixture at least two (2) weeks prior to the beginning of the work.
- .3 Shop Drawings to clearly indicate:
 - .1 All work related to fence (concrete foundation, hydraulic equipment, electrical work, security system, fixations accessories, etc.).
 - .2 Section cuts, grooves, assemblies, openings, threaded anchors, rivets, welds and other necessary elements. Use AWS symbols to describe weld.
 - .3 The general arrangement, the quality of the product, the dimensions, the finishes, spare parts, the reinforcement, the anchors, and the hooks necessary.
- .4 For all shop fabricated items, and whenever deemed necessary by Engineer to explain the proposed work, the Contractor will allow for ample time for the approval of all the shop or assembly drawings or diagrams.
- .5 The Engineer will not be responsible for verifying the number, quantity, or dimensions indicated on the shop drawings : this remains the responsibility of the Contractor. The Engineer will not be responsible for the dimensions noted on the drawings: these will be verified on site by the Contractor

1.5 HANDLING AND STORAGE

- .1 Materials will be delivered undamaged in their original containers. Labels and seals will remain intact. Use extreme care in the handling and storage of pre-finished items to avoid inadvertent damage.
- .2 Store material so as to avoid physical injury, difficulty in the progress of the work and any damage to the work already completed.

1.6 WARRANTY

- .1 The Contractor will guarantee the finish, the quality and solidity of his work for a period of five (5) years from the date of substantial completion of the work.

1.7 SHIPPING

- .1 Each roll of wire mesh must show the following particulars:

- .1 The coating quality.
- .2 Nominal size.
- .3 Length and nominal height of the fence.
- .4 Number of standard CAN/CGSB-138.1-96.
- .5 The name of the manufacturer.

1.8 REMOVAL OF EXISTING FENCES

- .1 Work related to the removal of existing fences consists in, but is not limited to, the supply of materials and manpower required for the removal, according to good engineering practices, of existing fences, including:
 - .1 The excavation, loading, transportation and disposal of excavation surplus and waste to a site complying with the requirements of the MELCC's Soil Protection and Contaminated Sites Rehabilitation Policy;
 - .2 Precautions to not cause them damage; the transport of these materials at locations designated by the Engineer,
 - .3 The levelling of the ground and surfacing with the adjacent surfaces.
 - .4 The site clean-up and disposal of non-usable materials.

1.9 INSTALLATION OF NEW FENCES, DOORS AND GATES

- .1 Work related to the installation of new fences, doors and gates consists in, but is not limited to, the supply of materials and manpower required for the installation, according to good engineering practices, of new fences, doors and gates, including:
 - .1 The excavation, loading, transportation and disposal of excavation surplus and waste to a site complying with the requirements of the MELCC's Soil Protection and Contaminated Sites Rehabilitation Policy,
 - .2 The supply and installation of:
 - .1 Chain link fences with barbed wire,
 - .2 Doors and Swing Gates,
 - .3 Sliding gate.
 - .3 The concreting of the posts bases,
 - .4 The supply and installation of:
 - .1 All the corner posts, reinforcement, ties,
 - .2 Reinforcements, clips and cable-stayed and all other accessories,
 - .5 The levelling of the ground and surfacing with the adjacent surfaces.
 - .6 The site clean-up and disposal of non-usable materials.

PART 2 - PRODUCTS**2.1 FENCES**

- .1 Chain link fence fabric :
 - .1 Height : As indicated on drawings.
 - .2 Fail at point of rupture : 10 000 N minimum.

2.2 CONCRETE

- .1 Materials:
 - .1 Cement: conform to standard CSA-A5/A8/A362-98.
 - .2 Water: in conformity with standard CSA-A23.1-00.
 - .3 Coarse aggregates and fine aggregates: in conformity with standard CSA-A23.1-00.
 - .4 Air-entraining agent: conform to standard ASTM C260-06.
 - .5 Chemical additives: in conformity with standard ASTM C494/C494M-05a.
 - .6 Pozzolanic mineral additives: conform to the requirements of standard ASTM C1017/C1017M-03.
- .2 Concrete dosage:
 - .1 Concrete: Prepare the normal voluminal mass concrete in accordance with standard CSA-A23.2-00 (1st choice) in order to obtain the following mixture:
 - .1 Use Portland cement of the type 10.
 - .2 Minimal resistance to the compression of 25 MPa at 28 days
 - .3 Exposure class: C-2.
 - .4 Nominal size of the coarse aggregate: 20 mm.
 - .5 Slump at the time and the point of discharge: 80 mm with a tolerance of ± 30 mm.
 - .6 Air content: 5 to 8%.
 - .7 Chemical additives: according to standard ASTM C494/C494M-05a.

2.3 METAL FABRIC

- .1 Chain link must be in conformity with standard CAN/CGSB 138.1-96.
- .2 Chain link type:
 - .1 Galvanized steel chain link:

- .1 In conformity with standard CAN/CGSB 138.1-96 type 1, category A and type 1 class 3, with steel wire of 3.5 mm (gauge 6) diameter with an average surface mass of zinc coating; at least 610 g/m² and with size of the meshes of 50 mm (gauge 6).
- .3 The higher edge has twisted and pointed ends, the lower edge has folded up ends. Each strand must be able to support a traction test of 552 MPa. Chain link must be attached to the higher rail and the braces using an appropriate tying wire with approximately 0,5 m interval between the intermediate posts. It must also be fixed to the intermediate posts with 0,3 m interval..
- .4 Bottom tension wire : Single strand electrogalvanized (610 g/m²) steel wire calibre 6, fasten at 0,5 m intervals.

2.4 METALLIC FRAME

- .1 The metal framework (posts, spacer and rails) must be made up of forged pipes galvanized of series 40, welded uninterrupted with a minimal weight of 5,44 kg/m in conformity with standard CAN/CGSB 138.2-96 as well with the following indications. The minimum weight of the end, gates barrier and corner posts is of 11,22 kg/m. In all the case, pipe or tubes with open joint is prohibited.
- .2 Intermediate posts:
 - .1 The pipe must be a standard schedule 40 continuously welded, galvanized, of an external diameter of 60,3 mm pipe, its length is 840 mm longer than the height of the fence and its minimum weight per metre is 5,44 kg. The use of open pipe or tube is prohibited. The maximum spacing is 3 m.
- .3 Terminal posts:
 - .1 End, angle and brace posts are in continuous welded, galvanized schedule 40 standard pipe with an external diameter of 89 mm with a length of 1 070 mm longer than the height of the fence. The minimum weight per metre is 11,22 kg The use of open pipe or tube is prohibited.
- .4 Ties and braces:
 - .1 Series 40 galvanized steel pipes, of an external diameter of 43 mm with single ends of common, standard length with continuous weld or high-resistance of 2,54 mm.
 - .2 The top rails are in tubular galvanized, of an external diameter of 43 mm with simple tips, common, schedule 40, standard length, with continuous weld or high-resistance hollow of 2,54 mm, with mechanical properties similar to ASTM standard A 36. The use of open pipe or tube is prohibited.
 - .3 Galvanized fittings of the outer sleeve type and a length of at least 180mm are used to join two sections of top rail. The top rail should go in the cap of the intermediate post and form a continuous element for each fence section. In addition, this brace must be tie to each terminal post with a fitting.

- .4 The braces have an external diameter of 43 mm, are galvanized and have the same specifications as for the top rail.
- .5 Horizontal brace is installed in the middle between the fence top and bottom rail and connects the terminal post to the first adjacent intermediate post. The end and barrier posts must have one brace compared to two for the corner and straining posts.
- .5 Framework with lower metal rail on all the fence sections (PWGSC).

Table 32 31 13-1: Metal framework (external diameter in mm).(PWGSC)

Line posts (intermediate)	End posts (traction)	Angle and Gate posts	Rail
60.3	88.9	114.3	42,2

- .6 Door frames: forged pipes galvanized hot in conformity with the requirements of to standard CAN/CGSB 138.4-96. The use of open pipe or tube is prohibited. The diameters of the required elements are in tables 1 and 2.
- .7 The doors must be manufactured according to the indications with electric welded joints, and being galvanized by hot immersion after welding
- .8 The fence chain link must be fixed at the gate so that the twisted edge is placed on top.
- .9 The doors must be provided with hinges latches and cams, all out of galvanized malleable cast iron, lockable. The direction of swiveling is indicated on drawings.
- .10 The double doors must be provided with a chain hook to keep open, and a central support with vertical bolt to maintain them in closed position. The hinges must make it possible for the gate to swivel from 180 degree to join the fence if necessary. The gate intermediate rail, if they are required, must be steel pipe galvanized of a external diameter of 33,3 mm
- .11 The barbed spiral (BS) must be made out of galvanized ribbons of 20 x 0,5 mm tightened around a heart of galvanized steel wire of 2,5 mm in diameter in conformity with standard CAN/CGSB 138.2-96., to form a spiral whose external nominal diameter must be of 710 mm. The spiral, when installed, must have a minimum diameter of 635 mm. The barbed spiral must be equipped with 20 mm length barbed blades from point to point, and the groups of barbed must be spaced approximately by 45 mm from center in center. The spiral must be formed, joining together with grips, adjacent loops of simple helicoids whorls in at least three (3) points of the circumference. The grips must be galvanized. The formed spiral must be cylindrical when it is stretched. The spacing of the whorls should not exceed 230 mm Two barbed wire must be fixed at the post outriggers to support the spirals at the upper part of the fence. The barbed wire will consist of two strands of wire gauges 12 with 4 points barbed wires spaced by 130 mm, all galvanized.
- .12 Ensure supply and installation of bolts, latches and robust hasps out of galvanized steel to lock simple or double doors

- .13 Overhang tops to provide waterproof fit, to hold top rails and an outward projection to hold barbed wire overhang as detailed.

2.5 COATING

- .1 Galvanizing: the zinc sheets used for galvanization must be of quality in conformity with standard ASTM A123/A123M-02. The surface mass of the elements must respect the following quantities:
- .1 For chain link fabric; 610 g/m² CAN/CGSB 138.1 grade 2.
 - .2 For pipe; 600 g/m² minimum to ASTM A 90.
 - .3 For doors; 550 g/m²
 - .4 For gates; 550 g/m².
 - .5 For barbed wire; 244 g/m² conforme à la norme CAN/CGSB 138.2.
 - .6 For other fittings; 550 g/m² conforme à la norme CAN/CSA-G164.

2.6 GATES

- .1 The gate will be of swiveling type, installed as specified on the gate detail.
- .1 The clear span of the barriers will be of 2,4 m or 1,5 m.
 - .2 The gate will be manufactured in a workshop, with the heights and openings indicated on drawings.
- .2 Posts and stop: galvanized steel pipes of specified size.
- .3 Frameworks of gate: forged pipes galvanized hot in conformity with the requirements of to standard CAN/CGSB 138.4-96. In all the case, the use of pipes or tubes with open joint is prohibited.
- .1 The gates must be manufactured according to the indications with electric welded joints, and being galvanized by hot immersion after welding.
 - .2 The fence chain link must be fixed at the gate so that the twisted edge is placed on top.
 - .3 The gates must be provided with hinges latches and cams, all out of galvanized malleable cast iron, lockable. The direction of swiveling is indicated on drawings.
 - .4 The double gates must be provided with a chain hook to keep open, and a central support with vertical bolt to maintain them in closed position. The hinges must make it possible for the gate to swivel from 180 degree to join the fence if necessary. The gate intermediate rail, if they are required, must be steel pipe galvanized of a external diameter of 43,0 mm.
 - .5 Gate chain link must match the fence on which it is assembled.
 - .6 The barrier must be equipped with three hinges of conform quality.

.4 Table 32 31 13-2: Swiveling gate.

Gate type And opening	Framework external diameter (mm)	Weight (kg/m)
--------------------------	--	------------------

(m)		
One panel, 1,5	43,0	3,40
Two panel, 2,4	43,0	3,40

2.7 ACCESSOIRES

- .1 Tie wire :
 - .1 Single strand galvanized steel wire to CAN/CGSB 138.1 and other requirements regarding Chain link fences, 3,5 mm diameter (gauge 9).
- .2 Sleeves :
 - .1 Galvanized connection with a length of at least 180 mm being used to link two transversal sections
- .3 Tension bar :
 - .1 To ASTM A653/A653M, 6 mm x 20 mm minimum galvanized steel.
- .4 Tension bars flange:
 - .1 Galvanized steel of minimum section 3 x 20 mm.
- .5 Bottom tension wire :
 - .1 Single strand, electrogalvanized steel wire (610 g/m²) calibre 6.
- .6 Assembly parts and hardware :
 - .1 Made out of moulded aluminum alloy, galvanized steel, or malleable cast or ductile iron.
 - .2 Post caps to provide waterproof fit, to fasten securely over posts.
- .7 Touch-up galvanization liquid product :
 - .1 Organic zinc rich coating to CAN/CGSB 85.10-99, CAN/CGSB 1.181-99 and ASTM A123/A123M-02.

PART 3 - EXECUTION

3.1 GENERALITIES

- .1 Unless otherwise specified, build the fences and gates according to the requirements of standards CAN/CGSB 138.3-96 and CAN/CGSB 138.4-96.

3.2 EXCAVATION AND BACKFILLING

- .1 Carry out excavation and backfilling according to the requirements of the section 31 23 11 - Civil - Excavation and Backfilling - Underground Services.

3.3 GRADING

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance of 30 mm to 50 mm between bottom of fence and ground surface. Provide no clearance between bottom of fence and ground surface.

3.4 ERECTION OF FENCE

- .1 Erect fence along line as indicated on drawings. Assemble fences squared, balanced, levelled, and uniformly aligned.
- .2 For posts, dig holes to prescribed dimensions. Pour concrete into the holes, and then push in the posts. The concrete bases must be rounded and finished with a trowel or razed under the pavements, and respect, unless otherwise noted, the dimensions in the following table

Table 3 : Concrete base.

Metal posts external diameter (mm)	Concrete base external diameter (mm)	Concrete base depth (mm)
48,3	250	1525
60,3	250	1525
73,0	300	1525
88,9	350	1525
114,3	450	1525

- .3 The metal posts Les poteaux métalliques doivent être placés dans les bases de béton aux profondeurs suivantes :
 - .1 900 mm pour les poteaux de ligne.
 - .2 1 200 mm pour les poteaux de coin et d'angle.
 - .3 1 400 mm pour les poteaux de bout et de barrière lorsque la hauteur de la clôture est égale ou supérieure à 1,8 m.
- .4 Allow a minimum of 5 days for the concrete to cure before proceeding with the installation of the wire mesh on the fence

- .5 Unless otherwise specified, install posts every 2,4 m c/c measured parallel to ground.
- .6 Install end posts at the ends of the fence and close to the buildings and every 30 m straight with two intermediate braces.
- .7 Install corner posts with two intermediate braces where there is a deviation of more than 250 mm and/or significant change in inclination of more than 750 mm.
- .8 Install intermediate rail (spacer) between the posts, at the middle height of the fence, parallel to the principal rail in the following cases:
 - .1 Between the end and the line, gate and corner posts.
 - .2 Between the gate posts and the line or corner posts.
 - .3 Between the corner posts and the line posts. The corner posts must be braced in the two directions.
 - .4 Between straining and line posts at every 30 m c/c posts.
 - .5 Between the posts in the case of marked change of inclination.
 - .6 Between the corner and line or corner posts. The corner posts must be braced in both directions.
 - .7 Between all posts when the height of the fence exceeds 2,1 m.
- .9 Install on the posts the overhang connections and the caps.
- .10 Install the higher rail between the posts and fix firmly on the posts and fix the overhang connections and the watertight caps.
- .11 Install the bottom chain link and tie to the fence at an interval of approximately 500 mm. Tie it to end, corner, gate and straining posts to maintain the following heights above the finished floor.
 - .1 50 mm over the paved surfaces.
 - .2 30 to 50 mm over grassed areas.
- .12 Deploy chain link on the fence, strongly tend to the tension recommended by the manufacturer and attach it to the end, angle, gate and reinforcement posts, with the tension bar fixed at the post by means of supports posed to 350 mm interval. Place the folded edge down and the twisted edge on top
- .13 If required, tie the mesh to the top rails, intermediate brace and bottom wire using tie wire placed at intervals of 500 mm. Make at least two twists on the wire clip. It must be attached to the end posts using tie wire placed at 300 mm intervals.
- .14 Border fences: mesh of fence of 1,5 m in height and less must be twisted and pointed tips at the top and bottom edge. For mesh of fence more than 1,5 m in height, the upper edge must be twisted and sharp and the bottom edge must be folded tips.

3.5 GATE INSTALLATION

- .1 Install the gates where indicated on the drawings
- .2 Adjust the grade between posts to 50 mm below the bottom edge of the gate
- .3 Hang the gates and position the hinges so that when they are in an open position, they are folded back against the fence where the hinges are located.
- .4 The gates are equipped with latches with lock accessible from both sides of the fence.
- .5 In the case of two panel gates, determine the location of the central support. Anchor the central support in concrete. Lay out the concrete in form of dome above the ground-level to prevent any water accumulation around the support.
- .6 When required, install barrier bumpers as indicated.
- .7 Provide secured locks.

3.6 TOUCH-UP

- .1 Repair damaged galvanized surfaces. Clean the damaged surfaces with a metal brush removing the detached or cracked layers of zinc. Apply on damaged surfaces two layers of a galvanization product rich in zinc or treat them in accordance with the manufacturer's instructions.

3.7 CLEANING

- .1 Clean and level ground surfaces stirred up during work. Get rid of the surplus of excavation material and repair damaged surfaces.
- .2 Seed (with new topsoil if required) the areas affected by the installation of the new fence. Refer to sections 32 91 21 and 32 92 22 for this work. The costs related to the hydraulic seeding work must be included in the fence works or in the other items of the Contract submission.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 00 – Cleaning
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 31 00 00.01 – Earthworks – Short Form
- .5 Section 32 92 23 – Sodding

1.2 REFERENCE STANDARDS

- .1 Fertilizers Act (RS, 1985, cF-10).
- .2 Ministère des Transports du Québec:
 - .1 Cahier des charges et devis généraux du Québec - Infrastructures routières, Construction et réparation (édition 2019).
 - .2 Cahiers des Normes, Ouvrages Routiers, Tome VII « Matériaux »:
 - .1 Norme 9101 (latest edition) – Matériaux pour l'aménagement paysager.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse/recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Divert unused soil amendments from landfill to official hazardous material collections site approved by the Departmental Representative.

- .3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 TOPSOIL

- .1 Topsoil for seeded areas: The mixture must comply with MTQ standard 9101 (2018) - Materials for landscaping. The mixture should be mixed (very evenly), crushed and finely sifted to 10 mm and below. It must not contain woody debris.

2.2 SOIL AMENDMENTS

- .1 Fertilizer:
 - .1 Complies with the Fertilizers Act and the Fertilizer Regulations of Canada
 - .2 Fully synthetic, slow release, containing 35% nitrogen, the latter to be in a form rendering it insoluble in water.
- .2 Peatmoss:
 - .1 Complies with the 9101 (2018) standard - Materials for the landscaping of the MTQ.
- .3 Sand: washed coarse silica sand, medium to coarse textured.
- .4 Organic matter: compost Category A in accordance with the Canadian Council of Ministers of the Environment (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 Agricultural limestone compliant with the 9101 (2018) standard - Materials for the landscaping of the MTQ.

2.3 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 Implement temporary erosion and sediment control measures in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling.

3.2 PREPARATION OF EXISTING GRADE

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

3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after Departmental Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.
- .3 For sodded areas keep topsoil 15 mm below finished grade.
- .4 Spread topsoil as indicated.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.4 SOIL AMENDMENTS

- .1 Incorporate amendment materials in prescribed quantities and determined from soil test results.

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 footprinting.

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 not required off site.

3.8 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 31 00 00 - Generalities
- .2 Section 31 14 11- Earthwork and leveling
- .3 Section 32 31 13 - Chain Link Fences and Gates
- .4 Section 32 91 21 - Topsoil and earthworks
- .5 Section 31 92 23 - Sodding

1.2 REFERENCES

- .1 Bureau de normalisation du Québec (B.N.Q.) latest edition.
 - .1 NQ 0605 - 100 : Landscaping using vegetation.

1.3 SCOPE OF WORK

- .1 The Contractor will ensure, in compliance with plans and other documents, the supervision of the work and supply all manpower, equipment, tools, materials, transportation and other services required to carry out and complete all work described and specified in this section and contract documents including, but not limited to: the supply and application of seeds, mulch, the application and preparation of the mix, and maintenance work related to hydraulic seeding of the specified areas.

1.4 TECHNICAL SHEETS

- .1 Provide technical sheets for the following products:
 - .1 Seed,
 - .2 Mulch,
 - .3 Adhesives,
 - .4 Fertilizer.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in writing 7 days prior to commencing work:
 - .1 Volume capacity of hydraulic seeder in litres.
 - .2 Amount of material to be used per tank based on volume.
 - .3 Number of tank loads required per hectare to apply specified slurry mixture per hectare.

1.6 WORK SCHEDULE

- .1 Establish the hydroseeding schedule to coincide with preparation work on the surfaces to be treated.
- .2 Plan hydroseeding between the dates recommended by the provincial ministry of agriculture.
- .3 Seeding must take place between August 20th and September 30th or before June 10th of the following year.

1.7 DELIVERY AND STORAGE

- .1 Deliver and store seeds in their original containers, which must carry the following information:
 - .1 Composition of the seed mix,
 - .2 Year of production,
 - .3 Net mass,
 - .4 The date and place of packaging,
 - .5 Germination percentage,
 - .6 Supplier's name and address.

1.8 HYDROSEEDING

- .1 Hydroseeding work consists in, but is not limited to, supplying the materials and manpower required to carry out hydraulic seeding, according to good engineering practices, including:
 - .1 The supply and application of slurry mixes, mulch, adhesives and erosion-control blanket,
 - .2 Supply and application of mixes,

- .3 Supply and application of fertilizer
- .4 Mechanical weed control,
- .5 Maintenance during the establishment and warranty period.

PART 2 - PRODUCTS

2.1 SEEDS

- .1 Seeds: complying with the Government of Canada's Seeds Act and Regulations. The bags of seed grass must be sealed by the company and do not is open in the presence of the Engineer, who attends the proportional seed mixture.
 - .1 Mix 1: Herbio Stable mix by GLOCO Inc. (tel.: 514-322-1620), or approved equivalent, at an application rate of 320 kg/ha.
 - .1 30 % Creeping red fescue,
 - .2 22 % Tall fescue,
 - .3 20 % English ryegrass,
 - .4 15 % Canadian bluegrass,
 - .5 8 % Colonial bentgrass,
 - .6 5 % White clover.
 - .2 Mix of stabilizing hydrophile plants: seeds of the type Herbio Fossé by GLOCO Inc. or approved equivalent, at an application rate of 230 kg/ha
 - .1 25 % creeping red fescue,
 - .2 25 % Tall fescue,
 - .3 18 % Bromegrass,
 - .4 15 % Canadian bluegrass,
 - .5 7 % Colonial bentgrass,
 - .6 5 % white Clover,
 - .7 5 % Birdsfoot trefoil.

2.2 MULCH

- .1 Mulch: produced specifically for spreading using a hydraulic seeder, non-toxic, water-activated and giving the mix a green color, free of germination and growth inhibitors, and offering the following characteristics:
 - .1 Type I:
 - .1 Chemical wood pulp fiber,
 - .2 Organic materials content: 95 %, \pm 0,5 %,
 - .3 pH level: 6,0,
 - .4 Water absorption capacity: 900 %.
 - .2 Type II: for use on land with a slope whose ratio is below 1 V : 3 H.
 - .1 Consisting of recycled newsprint, raw cotton and straw fiber, with the addition of an adhesive at the time of seeding.
 - .2 Application rate:
 - .1 1 200 kg/ha for the fiber mix,
 - .2 120 kg/ha for the adhesive.

2.3 STRAWS

- .1 Straw: natural weed-free straw for use with a mechanical seeding process. Mattress-type mulch consisting of straw and coconut could also be accepted.

2.4 SOIL

- .1 Soil: mix for the area to be seeded, complying with the requirements of Section 32 91 21 - Civil - Topsoil and Finish Earthwork.

2.5 WATER

- .1 Water: free of impurities that could impede germination and growth.

2.6 FERTILIZER

- .1 Complying with the Canadian government's Fertilizers Act and Regulations as well as prevailing municipal regulations.

- .2 Fertilizer with proportion of 1-3-1, supply a maximum of 25 kg/ha of nitrate (N), 75 kg/ha of phosphorus (P_2O_5) and 25 kg/ha of potassium (K_2O).

PART 3 - EXECUTION

3.1 EXECUTION QUALITY

- .1 Do not spray products on the structures, signs, guardrails, fences, plants, utilities and other surfaces, which are not to be treated.
- .2 Immediately remove products sprayed onto the structures and other surfaces, which are not to be treated, to the satisfaction of the Departmental Representative.
- .3 Do not carry out work under unfavorable conditions, for example, in winds of more than 10 km/hr, or when the ground is frozen, covered in snow, ice or stagnant water.
- .4 Keep seeded areas traffic free until the vegetation is well established.

3.2 SOWING PERIOD

- .1 The most favourable sowing periods are from August 15th to October 15th and from the end of thawing period to June 15th.

3.3 PREPARATION OF SURFACES

- .1 Level areas to be seeded to eliminate dips and mounds. Ensure that surfaces are free of deleterious materials and waste. Loosen designated surfaces.
- .2 Carry out the final grading of the surfaces to be sown in order to eliminate hollows and bumps. Make sure that surfaces have no noxious and waste materials. Make sure to loosen designated surfaces.
- .3 Apply a 150 mm layer of topsoil in compliance with Section 32 91 21 - Civil - Topsoil and Finish Earthwork.
- .4 Using stakes and paint, mark the boundaries approved by the Departmental Representative for the different mixes on the site.
- .5 Ensure that areas to be seeded are moistened to a depth of 150 mm before starting to seed.
- .6 Have the preparation of the surfaces and thickness of the topsoil approved by the Departmental Representative before starting to seed.

3.4 FERTILIZATION PROGRAM

- .1 Fertilize during the establishment period until final acceptance, according to a program approved by the Departmental Representative, at a rate of 3 applications per year.

3.5 APPLICATION OF THE SLURRY MIX

- .1 Spread a slurry mix consisting of the following components. (Quantities shown are for 1 hectare):
 - .1 Seeds: as per application rates specified in the “Materials” section,
 - .2 Mulch: type II, 1 400 kg,
 - .3 Adhesive: at least 900 L,
 - .4 Water: in the quantity recommended by the manufacturer.
- .2 Spread the slurry mix evenly, directing the spray at the optimal angle for ensuring the seeds’ adherence to the surfaces and their germination.
- .3 Spread the slurry where the mix’s application is not even.
- .4 Removed sprayed product from structures and surfaces, which are not to be treated.
- .5 Keep seeded areas traffic free, to the satisfaction of the Departmental Representative.
- .6 Remove protective barriers, as directed by the Departmental Representative.

3.6 MAINTENANCE DURING THE ESTABLISHMENT PERIOD

- .1 Carry out the following maintenance work between the seeding date and the date on which the work is accepted by the Departmental Representative:
 - .1 Repair and reseed bare, damaged or insufficiently covered surface, allowing the seeding to become well established before acceptance of the work.
 - .2 Mow the grass to 40 mm as soon as it has reached a height of 60 mm. Remove grass clippings that could choke the lawn, as directed by the Departmental Representative.
 - .3 Ten (10) weeks following germination and when the vegetation’s blades have reached maturity, fertilize the seeded areas in compliance with the established fertilizing schedule. Spread half the required fertilizer in one direction and the other half perpendicularly. Water well to ensure the fertilizer’s penetration into the soil.

- .4 Water seeded zones to maintain the optimal moisture level required to ensure germination and continued growth. Set watering equipment to ensure that the soil is not washed away.
- .5 Weed mechanically, using methods that comply with prevailing regulations.

3.7 ACCEPTANCE OF THE WORK

- .1 Seeded areas will be accepted by the Departmental Representative if the following conditions are respected:
 - .1 The vegetation is well established and uniform,
 - .2 Seeded areas are free of erosion, bare or dead patches as well as ruts and weeds,
 - .3 The grass has been mowed at least twice,
 - .4 Seeded areas have been fertilized.
- .2 Areas seeded in the fall will be definitively accepted the following spring, one month after the start of the growth period, provided conditions for acceptance have been met.

3.8 GUARANTEE

- .1 The Contractor must guarantee, for a full year from the date of the provisional acceptance by the Departmental Representative, the full and complete establishment of seeding on the site. He shall be required to replace, at his expense, any seeded area not considered, by the Owner, to be in perfect condition.

3.9 MAINTENANCE DURING THE GUARANTEE PERIOD

- .1 Carry out the maintenance work listed hereafter, from the date of the work's acceptance to the end of the guarantee period.
 - .1 Water seeded areas to maintain the optimal moisture level needed to ensure the grass's continued growth. Set watering equipment to ensure that the soil is not washed away.
 - .2 Repair and reseed bare patches, to the satisfaction of the Departmental Representative.
 - .3 Mow seeded areas to 40 mm as soon as they reach 60 mm and remove surplus grass clippings to the satisfaction of the Departmental Representative.
 - .4 Fertilize seeded areas according to the established fertilization program. Spread half the required fertilizer in one direction and the other half perpendicularly, and water well to ensure the fertilizer's penetration into the soil.
 - .5 Weed mechanically, using methods that comply with prevailing regulations.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 35 29.06 – Health and Safety Requirements
- .3 Section 01 74 00 – Cleaning
- .4 Section 01 74 19 – Waste Management and Disposal
- .5 Section 31 00 00.01 – Earthworks – Short Form
- .6 Section 32 91 19.13 – Topsoil, Placement and Grading

1.2 REFERENCE STANDARDS

- .1 Fertilizers Act (RS, 1985, cF-10).
- .2 Ministère des Transports du Québec:
 - .1 Cahier des charges et devis généraux du Québec - Infrastructures routières, Construction et réparation (édition 2019).
 - .2 Cahiers des Normes, Ouvrages Routiers, Tome VII « Matériaux »:
 - .1 Norme 9101 (latest edition) – Matériaux pour l'aménagement paysager.

1.3 SCHEDULING:

- .1 Schedule sod laying to coincide with preparation of soil surface.
- .2 Schedule sod installation when frost is not present in ground.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

- .3 Samples.
 - .1 The following samples must be approved by the Departmental Representative:
 - .1 Sod for each type specified.
 - .1 Install approved samples in 1 square metre mock-ups and maintain in accordance with maintenance requirements during establishment period.
 - .2 0.5 kg container of each type of fertilizer used.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements of seed mix, seed purity, and sod quality.
- .5 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties of seed mix, seed purity, and sod quality.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with supplier's recommendations.
 - .2 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse of packaging materials, padding, crates, pallets, in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Number one grown turf in accordance with 9101 (2018) - Materials for landscaping by the MTQ.
- .2 Products favoring the establishment of the lawn
 - .1 Stakes complying with the 9101 (2018) standard - Materials for the landscaping of the MTQ.
- .3 Water:
 - .1 Supplied by Departmental Representative at designated source.

.4 Fertilizer:

- .1 In accordance with Canada Fertilizers Act and Fertilizers Regulations.
- .2 Complete, synthetic, slow release with 35 % of nitrogen content in water-insoluble form.

2.2 SOURCE QUALITY CONTROL

- .1 Obtain written approval from Departmental Representative of sod at source.
- .2 When proposed source of sod is approved, use no other source without written authorization from Departmental Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- .1 Verify that grades are correct and prepared in accordance with Section 32 91 19.13 - Topsoil Placement and Grading. If discrepancies occur, notify Departmental Representative and commence work when instructed by Departmental Representative.
- .2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .3 Fine grade to achieve a smooth and uniform slope, free from hollows and asperities, according to the levels indicated, to 15 mm, favoring the natural drainage of surfaces.
- .4 Remove and dispose of weeds; debris; stones 50 mm diameter and larger; soil contaminated by oil, gasoline and other deleterious materials off site in accordance with Section 01 74 19 - Waste Management and Disposal.

3.3 SOD PLACEMENT

- .1 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.

- .2 Lay sod sections in rows, joints staggered. Squeeze sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .3 Roll sod as directed by Departmental Representative. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

3.4 SOD PLACEMENT ON SLOPES AND PEGGING

- .1 Start laying sod at bottom of slopes.
- .2 Drive pegs in sod sections placed on steep slopes and within 3 m of manholes and within 1 m of channels and ditches. Arrange the pegs as follows:
 - .1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.
 - .2 Not less than 3-6 pegs per square metre.
 - .3 Not less than 6-9 pegs per square metre in drainage structures.
 - .4 Drive pegs to 20 mm above soil surface of sod sections.

3.5 FERTILIZING PROGRAM

- .1 Fertilize during establishment and warranty periods.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
 - .1 Clean and reinstate areas affected by Work.
- .3 Waste Management: separate waste materials for recycling/reuse and compost in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Remove recycling and compost containers and bins from site and dispose of materials at appropriate facility.
 - .2 Divert unused fertilizer from landfill to official hazardous material collections site.

3.7 PROTECTION BARRIERS

- .1 Protect newly sodded areas from deterioration with snow fence on rigid frame.
- .2 Remove protection after inspection as directed by Departmental Representative.

3.8 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following operations from time of installation until acceptance.
 - .1 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.
 - .2 Cut grass to 50 mm when or prior to it reaching height of 75 mm.
 - .3 Maintain sodded areas weed free at 95%.
 - .4 Fertilize 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 Temporary barriers or signage to be maintained where required to protect newly established sod.

3.9 ACCEPTANCE

- .1 Turf Grass Nursery Sod areas will be accepted by Departmental Representative provided that:
 - .1 Sodded areas are properly established.
 - .2 Sod is free of bare and dead spots.
 - .3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm.
 - .4 Sodded areas have been cut minimum 2 times prior to acceptance.
- .2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.
- .3 When environmental conditions allow, all sodded areas showing shrinkage cracks shall be top-dressed and seeded with a seed mix matching the original.

3.10 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period:
 - .1 Water sodded Turf Grass Nursery Sod areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.

- .2 Repair and resod dead or bare spots to satisfaction of Departmental Representative.
- .3 Cut grass and remove clippings that will smother grass as directed by Departmental Representative to height as follows:
 - .1 Turf Grass Nursery Sod:
 - .1 50 mm during normal growing conditions.
 - .2 Cut grass at intervals so that approximately one third of growth is removed in single cut.
 - .3 Fertilize 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.
 - .4 Eliminate weeds by chemical or mechanical means in accordance with the requirements of provincial regulations.

END OF SECTION

DIVISION 33

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 45 00 – Quality control
- .3 Section 01 74 00 – Cleaning
- .4 Section 01 74 19 – Waste Management and Disposal
- .5 Section 31 00 00.01 – Earthworks – Short Form
- .6 Section 31 05 16 – Aggregates for Earthwork
- .7 Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .8 Section 33 14 16 – Site Water Utility Distribution Piping
- .9 Section 33 31 11 – Public Sanitary Sewerage Gravity Piping
- .10 Section 33 41 00 – Storm Utility Drainage Piping

1.2 REFERENCE STANDARDS

- .1 Gouvernement du Québec, Ministère des Transports:
 - .1 Cahier des charges et devis généraux (CCDG) (2019).
- .2 Bureau de normalisation du Québec (B.N.Q.):
 - .1 BNQ 1809-300 (latest edition): Construction – General Technical Clauses – Water and Sewer Pipes.
 - .2 NQ 2622-420 (latest edition): Precast Reinforced Concrete Sewer Manholes, Catch-Basins, Gate Houses and Pumping Stations.
 - .3 NQ 3221-500 (latest edition): Grates, Covers, Frames, Catch Basin Traps and Valve Boxes – Grey-Iron and Ductile-Iron Castings for Civil Engineering Work – Characteristics and Test Methods.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for maintenance holes and catch basin structures and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Recycled Content:

- .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of content, and total cost of materials for project.

1.4 QUALITY ASSURANCE

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

.2 Certifications:

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

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
- .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect maintenance holes and catch basin structures from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse of padding, crates, packaging materials, pallets, in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS**2.1 MATERIALS**

- .1 Precast manhole: in accordance with the requirements of NQ 2622-420 (2009), circular or rectangular.
 - .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
- .2 Precast catch basin sections: in accordance with the requirements of NQ 2622-420 (2009).
- .3 Joints: in accordance with the requirements of NQ 2622-420 (2009).
- .4 Ladder rungs: in accordance with the requirements of NQ 2622-420 (2009).
- .5 Adjusting rings: in accordance with the requirements of NQ 2622-420 (2009).
- .6 Galvanized iron sheet: in accordance with the requirements of NQ 1809-300 (2018).
- .7 Frames, gratings, covers: in accordance with the requirements of NQ 3221-500 (2003).
- .8 Granular bedding and backfill: in accordance with Section 31 05 16 - Aggregate Materials and requirements on drawings.

PART 3 - EXECUTION**3.1 EXAMINATION**

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

3.2 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling and as indicated.

- .2 Obtain approval of Departmental Representative before installing outfall structures, manholes or catch basins.

3.3 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Complete units as pipe laying progresses.
- .3 Set precast concrete base on granular bedding, in accordance with the requirements of NQ 1809-300 (2018).
- .4 Precast units:
 - .1 Make each successive joint watertight with Departmental Representative's approved gaskets in accordance with the requirements of NQ 2622-420 (2009).
 - .2 Clean surplus joint compounds from interior surface of unit as work progresses.
 - .3 Plug lifting holes in accordance with the requirements of NQ 2622-420 (2009).
- .5 For sewers:
 - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
 - .2 Bench to provide smooth U-shaped channel.
 - .1 Side height of channel to be 0.5 times the diameter of sewer.
 - .2 Slope adjacent floor at 1 in 20.
 - .3 Curve channels smoothly.
 - .4 Slope invert to establish sewer grade.
- .6 Compact granular backfill in accordance with the requirements of NQ 1809-300 (2018).
- .7 Installing units in existing systems:
 - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
 - .2 Make joints watertight between new unit and existing pipe.
- .8 Place frame and cover on top section to elevation as indicated.
 - .1 If adjustment required use concrete ring.

- .2 Covers: Drill on the top perimeter three equidistant 20 mm holes to accommodate the 16 mm hex bolts in stainless steel. Recess washers and bolt heads to obtain a flush finish;
- .3 Frame: Drill and tap the frame to receive the bolts from the cover. Provide mounting brackets for this purpose as needed.
- .9 Clean units of debris and foreign materials.
 - .1 Remove fins and sharp projections.
 - .2 Prevent debris from entering system.
- .10 Install safety platforms in maintenance holes having depth of 6 m or greater, as indicated, in accordance with the requirements of NQ 1809-300 (2018).

3.4 ADJUSTING TOPS OF EXISTING UNITS

- .1 Remove existing gratings, frames and I beams and store for re-use at locations designated by Departmental Representative.
- .2 Sectional units:
 - .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
 - .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.
 - .1 When amount of raise is less than 600 mm use standard modular or grade rings.
- .3 Monolithic units:
 - .1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with cast-in-place concrete.
 - .2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.
 - .3 When monolithic units with tapered upper section are lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.
 - .4 Install additional maintenance hole ladder rungs in adjusted portion of units as required.
 - .5 Re-use existing gratings, frames and I beams.

3.5 SEALING OVER EXISTING UNITS

- .1 Cut galvanized iron sheet to extend 50 mm beyond opening of existing maintenance hole or catch basin grating.
 - .1 Center iron sheet over existing grating and spot or stitch weld to grating.
- .2 Fill with cast-in-place concrete.

3.6 FIELD QUALITY CONTROL

- .1 Leakage Test, in accordance with the requirements of NQ 1809-300 (2018).

3.7 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 00 – Cleaning
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 31 00 00.01 – Earthworks – Short Form
- .5 Section 31 05 16 – Aggregates for Earthwork
- .6 Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .7 Section 33 05 16 - Maintenance Holes and Catch Basin Structures
- .8 Section 33 31 11 – Public Sanitary Sewerage Gravity Piping
- .9 Section 33 41 00 – Storm Utility Drainage Piping

1.2 REFERENCE STANDARDS

- .1 National Fire Code of Canada (2015).
- .2 National Plumbing Code - Canada (2015).
- .3 Municipal standards in effect.
- .4 Bureau de normalisation du Québec (B.N.Q.):
 - .1 BNQ 1809-300 (latest edition): Construction – General Technical Clauses – Water and Sewer Pipes.
 - .2 NQ 3624-250 (latest edition): Unplasticized Poly(Vinyl Chloride) (PVC-U) Pipe and Fittings – Rigid Pipe for Pressurized Water Supply and Distribution.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Make sure pipe certification is on the pipe.
- .3 Samples:
 - .1 Inform Departmental Representative of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.
 - .2 Submit for testing 4 weeks minimum prior to beginning work, samples of proposed materials.
 - .3 Submit manufacturer's test data and certification that pipe materials meet requirements of BNQ 1809-300 (2018) specifications 4 weeks minimum prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect water distribution piping from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.5 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Departmental Representative.
- .3 Notify Departmental Representative minimum of 24 hours in advance of interruption in service.
- .4 Do not interrupt water service for more than 3 hours unless otherwise authorized.
- .5 Notify fire department of planned or accidental interruption of water supply to hydrants.

PART 2 - PRODUCTS**2.1 PIPE, JOINTS AND FITTINGS**

- .1 In addition to BNQ 1809-300 (2018), the watermain pipes will be made of polyvinyl chloride (PVC) class DR-18. The diameter is as indicated on the drawings. PVC pressure pipes must be certified to NQ 3624-250.

2.2 VALVES AND VALVE BOXES

- .1 Valves to open counter clockwise.
- .2 Gate valves: In addition to the article "Through-flow valves" of BNQ 1809-300 (latest version and its amendments), gate valves (or direct-flow valves) must be protected with an anode. All bolts must be 316 grade stainless steel.
- .3 Cast iron valve boxes: In addition to the "Valve Box" article in BNQ1809-300 (2018), the valve boxes must be made of ductile cast iron of deep sliding type with guide washer and the top of the valve box must be adjustable.
 - .1 Top of box to be marked WATER, EAU.

2.3 HYDRANTS

- .1 In addition to the article "fire hydrants" in BNQ 1809-300 (2018), all bolts must be 316 stainless steel. If the fire hydrants are indicated as non-draining, they must be to be from the inside.
- .2 Hydrant paint: red exterior enamel to MPI #96.

2.4 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to: Section 31 05 16 - Aggregate Materials and requirements on drawings.

2.5 BACKFILL MATERIAL

- .1 Backfill material to: Section 31 23 33 .01 - Excavating, Trenching and Backfilling and requirements on drawings.

2.6 PIPE DISINFECTION

- .1 Disinfect the water distribution system in accordance with the requirements of BNQ 1809-300 (2018).

PART 3 - EXECUTION**3.1 EXAMINATION**

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

3.2 PREPARATION

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

3.3 TEMPORARY WATER SUPPLY NETWORK

- .1 At the locations indicated on the drawings, a temporary water supply and fire protection system must be installed in accordance with BNQ 1809-300 (2018). Temporary fire hydrants must be provided and existing and non-functional fire hydrants must be covered with burlap.

3.4 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Trench alignment and depth require Departmental Representative's approval prior to placing bedding material and pipe.

3.5 GRANULAR BEDDING

- .1 Backfill trenches in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling.
- .2 Place granular bedding material in uniform layers.
- .3 Do not place material in frozen condition.

- .4 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .5 Shape transverse depressions in bedding as required to suit joints.
- .6 Compact each layer full width of bed to 95 % minimum of corrected maximum dry density.
- .7 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling with compacted bedding material.

3.6 EXISTING WATERMAIN PIPE TO ABANDON

- .1 The existing watermain must remain in operation throughout the works to serve residents. At the end of the work, if there are existing pipes to abandon, the Contractor must concretize and wall all the ends and openings of the work to abandon. The wall must be made with a waterproof cap compatible for PVC pipes or cast iron.
- .2 Before being reclosed and walled, these structures must be purged of all the water they contain and completely filled with lean concrete (minimum 10 MPa) by injection under pressure, and at each end. The existing structure must be completely and perfectly filled. The Contractor shall, if necessary and at his expense, use a pumping system.

3.7 PIPE INSTALLATION

- .1 Terminate building water service at 1 m outside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Lay pipes to BNQ 1809-300 (2018) and manufacturer's standard instructions and specifications.
 - .1 Do not use blocks except as specified.
- .3 Join pipes in accordance with BNQ 1809-300 (2018) and manufacturer's recommendations.
- .4 Bevel or taper ends of PVC pipe to match fittings.
- .5 Handle pipe by methods recommended by pipe manufacturer and approved by Departmental Representative. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .6 Lay pipes on prepared bed, true to line and grade.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

- .2 Take up and replace defective pipe.
- .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .7 Face socket ends of pipe in direction of laying. For mains on grade of 2 % or greater, face socket ends up-grade.
- .8 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .9 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .10 Position and join pipes with equipment and methods approved by Departmental Representative.
- .11 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Align pipes before jointing.
- .13 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .14 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
- .15 Complete each joint before laying next length of pipe.
- .16 Minimize deflection after joint has been made.
- .17 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .18 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes.
- .19 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .20 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.

- .21 Do not lay pipe on frozen bedding.
- .22 Do hydrostatic and leakage test in accordance with BNQ 1809-300 (2018) specifications and have results approved by Departmental Representative before surrounding and covering joints and fittings with granular material.
- .23 Backfill remainder of trench.

3.8 VALVE INSTALLATION

- .1 Install valves in accordance with BNQ 1809-300 (2018) specifications at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of Bedding same as adjacent pipe. Valves shall not to be supported by pipe.

3.9 HYDRANTS

- .1 Install hydrants at locations as indicated in accordance with BNQ 1809-300 (2018).
- .2 Install gate valve and cast iron valve box on hydrant service leads as indicated.
- .3 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm above final grade.
- .4 Place concrete thrust blocks as indicated and in accordance with BNQ 1809-300 (2018) and ensuring that drain holes are unobstructed.
- .5 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes.
- .6 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.10 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with the drawings.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by the Departmental Representative.
- .6 All work must be done in accordance with BNQ 1809-300 (2018).

3.11 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with BNQ 1809-300 (2018).
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Departmental Representative at least 24 hours in advance of proposed tests.
 - .1 Perform tests in presence of Departmental Representative.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated.
- .6 Leave hydrants, valves, joints and fittings exposed.
- .7 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .8 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .9 Open valves.
- .10 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .11 Thoroughly examine exposed parts and correct for leakage as necessary.
- .12 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .13 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .14 Repeat hydrostatic test until defects have been corrected.

3.12 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated in the Section 31 23 33.01 - Excavation, Trenching and Backfilling.
 - .1 Do not dump material within 1000 mm of pipe.
- .2 Do not place material in frozen condition.
- .3 Compact each layer from pipe invert to mid height of pipe to at least 95 % of corrected maximum dry density.
- .4 Compact each layer from mid height of pipe to underside of backfill to at least 90 % of corrected maximum dry density.

3.13 BACKFILL

- .1 Perform piping backfilling in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact backfill to at least 95 % corrected maximum dry density.
 - .1 In other areas, compact to at least 90% corrected maximum dry density.

3.14 HYDRANT FLOW TESTS

- .1 Conduct flow tests on every hydrant to determine fire flows prior to painting hydrant caps and ports.

3.15 PAINTING OF HYDRANTS

- .1 After installation, paint hydrants red.
- .2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

3.16 FLUSHING AND DISINFECTING

- .1 Rinsing and disinfection must be performed in accordance with BNQ 1809-300 (2018).
 - .1 Notify Departmental Representative at least four (4) days before disinfection begins.

3.17 SURFACE RESTORATION

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

3.18 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 00 – Cleaning
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 31 00 00.01 – Earthworks – Short Form
- .5 Section 31 05 16 – Aggregates for Earthwork
- .6 Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .7 Section 33 05 16 - Maintenance Holes and Catch Basin Structures
- .8 Section 33 14 16 – Site Water Utility Distribution Piping
- .9 Section 33 41 00 – Storm Utility Drainage Piping

1.2 REFERENCE STANDARDS

- .1 Bureau de normalisation du Québec (B.N.Q.):
 - .1 BNQ 1809-300 (latest edition): Construction – General Technical Clauses – Water and Sewer Pipes.
 - .2 NQ 3624-135 (latest edition): Unplasticized Poly(Vinyl Chloride) (PVC-U) Pipe and Fittings – Pipes of 200 mm in Diameter or Larger for Sewage and Soil Drainage.
- .2 National Plumbing Code - Canada (2015).

1.3 SCHEDULING:

- .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
- .3 Notify Departmental Representative 24 hours minimum in advance of any interruption in service.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

- .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
 - .2 Submit for testing at least 2 weeks prior to beginning Work, samples of materials proposed.
- .4 Certificates:
 - .1 Certification to be marked on pipe.
- .5 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification 2 weeks minimum before beginning Work.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse of padding, crates, pallets, packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 PLASTIC PIPE

- .1 Polyvinyl chloride (PVC) pipes complying with the standard NQ 3624-135 (2000).

2.2 SERVICE CONNECTIONS

- .1 Polyvinyl chloride (PVC) pipes complying with the standard NQ 3624-135 (2000).

- .2 Clamps saddle: Stainless steel band, cast iron saddle, oil resistant seals, and oil resistant O-rings located at the end of the branch.

2.3 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 05 16 - Aggregate for Earthwork and requirements indicated on drawings.

2.4 BACKFILL MATERIAL

- .1 Backfill material to Section 31 23 33.01 - Excavation, trenching and backfilling.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation and remove defective materials from site to approval of Departmental Representative.
- .2 Clean and dry pipes and fittings before installation.
- .3 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.3 TRENCHING

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

3.4 GRANULAR BEDDING

- .1 Backfill trenches in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling.
- .2 Place bedding in unfrozen condition.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95 % corrected maximum dry density.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

3.5 SEWER PIPE TO ABANDON

- .1 In addition to the BNQ 1809-300 (latest version and its amendments), the works must be purged of all the water they contain before being closed and walled at each end. The Contractor shall, if necessary and at his expense, use a pumping system.

3.6 INSTALLATION

- .1 Lay and join pipes to: BNQ 1809-300 (2018).
- .2 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Joint deflection permitted within limits recommended by pipe manufacturer.
- .6 Water to flow through pipe during construction, only as permitted by Departmental Representative.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

- .8 Install plastic pipe and fittings in accordance with BNQ 1809-300
- .9 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's written recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
 - .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .11 Plug lifting holes with pre-fabricated plugs approved by Departmental Representative, set in shrinkage compensating grout.
- .12 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .14 Use prefabricated saddles or field connections approved by Departmental Representative, for connecting pipes to existing sewer pipes.
 - .1 Joints to be structurally sound and watertight.

3.7 PIPE SURROUND

- .1 Place surround material in unfrozen condition.

- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Backfill trenches in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling.
 - .1 Do not dump material within 1 m of pipe.
- .4 Compact each layer from pipe invert to mid height of pipe to at least 95 % corrected maximum dry density.
- .5 Compact each layer from mid height of pipe to underside of backfill to at least 90 % corrected maximum dry density.
- .6 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.8 BACKFILL

- .1 Backfill trenches in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling.
- .2 Place backfill material in unfrozen condition.
- .3 Under paving and walks, compact backfill to at least 95 % corrected maximum dry density.
 - .1 In other areas, compact to at least 90 % corrected maximum dry density.

3.9 SERVICE CONNECTIONS

- .1 Install pipe to BNQ 1809-300 (2018) specifications.
- .2 Plug service laterals with watertight caps or plugs as approved by Departmental Representative.
- .3 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade.
 - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

3.10 FIELD TESTING

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

- .2 Remove foreign material from sewers and related appurtenances in accordance with BNQ 1809-300 (2018).
- .3 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .4 Do infiltration and exfiltration testing in accordance with BNQ 1809-300 (2018).
 - .1 Perform tests in presence of Departmental Representative.
 - .2 Notify Departmental Representative 24 hours minimum in advance of proposed tests.
- .5 Carry out tests on each section of sewer between successive manholes including service connections.
- .6 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- .7 Exfiltration test: in accordance with BNQ 1809-300 (2018).
- .8 Infiltration test: in accordance with BNQ 1809-300 (2018).
- .9 Repair and retest sewer line as required, until test results are within limits specified.
- .10 Repair visible leaks regardless of test results.
- .11 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by video camera, digital camera or by other related means.

3.11 CLEANING

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

END OF SECTION

PART 1 - GENERAL**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 00 – Cleaning
- .3 Section 01 74 19 – Waste Management and Disposal
- .4 Section 31 00 00.01 – Earthworks – Short Form
- .5 Section 31 05 16 – Aggregates for Earthwork
- .6 Section 31 23 33.01 – Excavating, Trenching and Backfilling
- .7 Section 33 05 16 - Maintenance Holes and Catch Basin Structures
- .8 Section 33 14 16 – Site Water Utility Distribution Piping
- .9 Section 33 31 11 –Public Sanitary Gravity Piping

1.2 REFERENCE STANDARDS

- .1 Bureau de normalisation du Québec (BNQ)
 - .1 BNQ 1809-300 (latest edition): Construction – General Technical Clauses – Water and Sewer Pipes.
 - .2 NQ 2622-126 (latest edition): Reinforced Concrete and Unreinforced Concrete Pipes and Monolithic Lateral Connections for Evacuation of Domestic Wastewater and Storm Water.
 - .3 NQ 3624-135 (latest edition): Unplasticized Poly(Vinyl Chloride) (PVC-U) Pipe and Fittings – Pipes of 200 mm in Diameter or Larger for Sewage and Soil Drainage.
 - .4 BNQ-3624-110 (latest edition), Single-Wall Polyethylene (PE) Pipe and Fittings for Surface Water Evacuation, Soil Drainage and Culverts.
 - .5 BNQ-3624-115 (latest edition), Polyethylene (PE) Pipe and Fittings for Soil and Foundation Drainage.
- .2 National Plumbing Code - Canada (2015).

1.3 SCHEDULING

- .1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.

- .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
 - .2 Submit to Departmental Representative for testing, at least 2 weeks prior to beginning Work, following samples of materials proposed.
- .4 Certification to be marked on pipe.
- .5 Test and Evaluation Reports: submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.
- .6 Manufacturer's Instructions: submit to Departmental Representative copy of manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse of pallets, packaging materials, crates, padding, in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS**2.1 CONCRETE PIPE**

- .1 Reinforced concrete circular pipes and fittings: in accordance with NQ 2622-126 (2009), Class IV.

2.2 PLASTIC PIPE

- .1 Type PSM Poly Vinyl Chloride (PVC): to NQ 3624-135 (2000).
 - .1 Standard Dimensional Ratio (SDR): as indicated on drawings.

2.3 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material in accordance with Section 31 05 16 - Aggregate for Earthwork and requirements on drawings.

2.4 BACKFILL MATERIAL

- .1 Backfill material in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling.

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 33.01 - Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer.
- .3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

- .1 Backfill trenches in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling
- .2 Place bedding in unfrozen condition.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipes.

- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95 % corrected maximum dry density.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

3.4 SEWER PIPE TO ABANDON

- .1 In addition to the BNQ 1809-300 (latest version and its amendments), the works must be purged of all the water they contain before being closed and walled at each end. The Contractor shall, if necessary and at his expense, use a pumping system.

3.5 INSTALLATION

- .1 Lay and join pipes to : BNQ 1809-300 (2018).
- .2 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .3 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Joint deflection permitted within limits recommended by pipe manufacturer.
- .7 Water to flow through pipes during construction only as permitted by Departmental Representative.
- .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Install plastic pipe and fittings in accordance with BNQ 1809-300 (2018).
- .10 Joints:
 - .1 Concrete pipe:
 - .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 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent creep during down time.
- .12 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.
- .13 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .14 Make watertight connections to manholes and catch basins.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .15 Use prefabricated saddles or approved field connections in accordance with BNQ 1809-300 (2018) for connecting pipes to existing sewer pipes.
 - .1 Joint to be structurally sound and watertight.
- .16 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.6 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes in accordance with BNQ 1809-300 (2018).
 - .1 Leave joints and fittings exposed until field testing is completed.

- .3 Backfill trenches in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling
 - .1 Do not dump material within 1 m of pipe.
- .4 Compact each layer from pipe invert to mid height of pipe to at least 95 % corrected maximum dry density.
- .5 Compact each layer from mid height of pipe to underside of backfill to at least 90 % corrected maximum dry density.
- .6 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 BACKFILL

- .1 Backfill trenches in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling
- .2 Place backfill material in unfrozen condition.
- .3 Under paving and walks, compact backfill to at least 95 % corrected maximum dry density. In other areas, compact backfill to at least 90 % corrected maximum dry density.

3.8 SERVICE CONNECTIONS

- .1 Install pipe to BNQ 1809-300 (2018) specifications.
- .2 Plug service laterals with watertight caps or plugs as approved by Departmental Representative.
- .3 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade.
 - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

3.9 FIELD TESTS AND INSPECTIONS

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 Remove foreign material from sewers and related appurtenances in accordance with BNQ 1809-300 (2018).
- .3 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.

3.10 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 28 - Grounding - Secondary.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A82/A82M-05a, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A185/A185M-05a, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .3 ASTM C139-05, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - .4 ASTM C 478/C478M-06, Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - .5 ASTM D1056-00, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- .2 CSA Group (CSA).
 - .1 CAN/CSA-A3000-03(R2005), Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .2 CSA A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .3 CAN/CSA-G30.18-M92(R2002), Billet-Steel Bars for Concrete Reinforcement.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (SDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and data sheets, and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit two copies WHMIS SDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .3 Shop Drawings:
 - .1 Submit shop drawings for precast manholes.

June 30, 2020

- .4 Quality Assurance Submittals: Submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports: Submit certified test reports for specified materials 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.
- .5 Manufacturer's Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings: Convene pre-installation meeting two weeks prior to beginning work pertaining to this Section, with Departmental Representative in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordinate 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 61 00 - Common Product Requirements.
 - .2 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 PVC DUCTS

- .1 PVC ducts, complying with CSA C22 No. 211-1, DB2 type, encased in the reinforced concrete, dimensions as per indications.

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, and adaptors, as required to make complete installation.
- .2 Expansion joints.

June 30, 2020

- .3 Rigid PVC, 5°, 22.5°, 45°, and 90° angle couplings according to requirements, bend radius: 915 mm, unless otherwise indicated.

2.3 ADHESIVE SOLVENT

- .1 Adhesive solvent approved for PVC conduit assemblies.

2.4 MANHOLES

- .1 Pulling and cable passing concrete sections and extension sections, prefabricate, and in steel formwork.
- .2 Pulling and cable passing prefabricated concrete sections: In accordance to ASTM C478/C478M.
- .3 Walls and Bottom: Monolithic concrete construction.
- .4 Aggregates: In accordance to CSA A23.1/A32.2.
- .5 Cement: In accordance with CAN/CSA-A3001, GU type.
- .6 Reinforcing steel lattice built in welded steel wires: In accordance with ASTM A82/A82M.
- .7 Two pulling rings, completely encased in the concrete.
 - .1 The steel pulling rings and other encased elements shall be put in place before the pouring.
 - .2 Pull rings shall be put in place in front of each conduit entrance in the opposite wall.
- .8 Neoprene or butyl-based water sealant placed between the pulling well and the cast-iron buffer frame.
- .9 Circular pulling wells, interior diameter 1,040 mm and 500 mm height.
- .10 Access Buffer Frames:
 - .1 Cast iron.
 - .2 Bolted buffers to prevent non-authorized entry.
 - .3 Dimensions: Available opening of 762 mm diameter.

2.5 GROUNDING

- .1 Ground Rods: In accordance with Section 26 05 28 - Grounding - Secondary.

2.6 CABLE PULLING EQUIPMENT

- .1 Pulling Iron: Galvanized steel rods, size, and shape, as indicated.
- .2 Pull Rope: 6-mm stranded nylon, tensile strength 5 kN.

2.7 WARNING TAPE

- .1 Standard 4-mil polyethylene 76 mm wide tape, yellow with black letters, imprinted with "ATTENTION - CÂBLE ÉLECTRIQUE ENFOUI".

June 30, 2020

2.8 MARKERS

- .1 Concrete Type Cable Markers: 600 x 600 x 100 mm, with words: "Cable", "Joint", "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.
- .2 Cedar Post Type Markers: 89 x 89 mm square, 1.5 m long, pressure treated with a clear 5% copper pentachlorophenol naphthenate solution, donning an indication plate, fixed near the top, facing the conduit.
 - .1 Nameplate: Aluminum anodized 89 x 125 mm, 1.5 mm thick mounted on cedar post with mylar label 0.125 mm thick with words "Cable", "Joint", "Conduit" with arrows to indicate change in direction.

Part 3 Execution**3.1 MANUFACTURER'S INSTRUCTIONS**

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

3.2 DUCTS - GENERAL

- .1 Install underground duct banks, including formwork.
- .2 Build duct bank on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of maximum Proctor dry density.
 - .1 Avoid concrete touching the soil containing iron pyrite.
- .3 Open trench completely between manholes before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .4 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
- .5 Install base spacers at maximum intervals of 1.5 m levelled to grades indicated for bottom layer of ducts.
- .6 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 40 mm horizontally and vertically.
 - .1 Stagger joints in adjacent layers at least 150 mm and make joints watertight.
 - .2 Encase duct bank with 75 mm thick concrete cover.
 - .3 Use galvanized steel conduit for sections extending above finished grade level.
- .7 Make transpositions, offsets, and changes in direction sections.
- .8 Use bell ends at duct terminations in manholes or buildings.
- .9 Use conduit to duct adapters when connecting non-metallic conduits to metallic conduits.
- .10 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.

June 30, 2020

- .11 Cut, ream, and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .12 Allow concrete to attain 50% of its specified strength before backfilling.
- .13 Use anchors, ties, and trench jacks as required to secure ducts and prevent moving during placing of concrete.
 - .1 Tie ducts to spacers with twine or other non-metallic material.
 - .2 Remove weights or wood braces before concrete has set and fill voids.
- .14 Clean ducts before laying:
 - .1 Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .15 Duct cleaning:
 - .1 Pull 300 mm long x diameter 6 mm less than internal diameter of duct steel mandrel through each duct, immediately after placing of concrete.
 - .2 Then pull stiff bristle brush through duct; avoid disturbing or damaging ducts where concrete has not set completely.
 - .3 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .16 Install four 3-m lengths of 10M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings.
 - .1 Wire rods to 10M dowels at manhole or building and support from duct spacers.
 - .2 Protect existing cables and equipment when breaking into existing manholes.
 - .3 Place concrete down sides of duct bank filling space under and around ducts.
 - .4 Rod concrete with flat bar between vertical rows filling voids.
- .17 Install pull rope continuous throughout each duct run with 3-m spare rope at each end.
- .18 Install the duct bank group for the electrical entry in accordance with the Guide governing low voltage, at 347/600 V, for installation on a base, published by Hydro-Quebec.

3.3 PULLING WELLS

- .1 Install the prefabricated pulling wells, as per indications.
- .2 Install the frames and buffer frames for each pulling well.
- .3 Give the bottom a 1:48 slope to the sump; install the evacuation accessories as per indications.

3.4 MARKERS

- .1 Mark location of duct runs under hard surfaced areas not terminating in manhole with railway spike driven flush in edge of pavement, directly over run.
 - .1 Place concrete duct marker at ends of such duct runs.
 - .2 Construct markers and install flush with grade.
- .2 Mark ducts every 150 m along straight runs and changes in direction.

June 30, 2020

- .3 Where markers are removed to permit installation of additional duct, reinstall existing markers.
- .4 Lay concrete markers flat and centered over duct with top 25 mm above earth surface.
- .5 Submit drawings showing locations of markers.
- .6 Compliance: Complying with requirements, recommendation, and manufacturer's written specifications, including all available technical bulleting and instructions pertaining to handling, storage and product installation, as the shop drawing/technical data sheet indications.

3.5 FIELD QUALITY CONTROL

- .1 Site Tests/Inspections:
 - .1 Inspection of duct will be carried out by Departmental Representative prior to placing.
 - .2 Placement of concrete and duct cleanout to be done when Departmental Representative present.

3.6 CLEANING

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

END OF SECTION

June 30, 2020

Part 1 General**1.1 RELATED REQUIREMENTS**

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

1.2 REFERENCE STANDARDS

- .1 CAN CSA/CSA International.
 - .1 CAN/CSA C22.2 No. 211.2-06 (R2011) - Rigid PVC (Unplasticized) Conduit.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Quality Assurance Submittals: Submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: Signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: For installation and special handling criteria, installation sequence, cleaning procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: Remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 PVC DUCTS AND FITTINGS**

- .1 Rigid PVC Duct: Schedule 40 according to CSA C22.2 No. 211.2, expanded flange ends, prefabricate connections, for direct burial, diameter according to indications.
 - .1 Nominal length: 3 or 6 m \pm 12 mm.

June 30, 2020

.2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make a complete installation.

.3 Rigid PVC 90°, 45° bends, and 5° angle couplings as required.

2.2 SOLVENT WELD COMPOUND

.1 Solvent cement for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

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

2.4 WARNING TAPE

.1 Standard 4-mil polyethylene 76 mm wide tape, yellow with black letters, imprinted with "ATTENTION - CÂBLE ÉLECTRIQUE ENFOUI".

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install duct in accordance with manufacturer's instructions and at elevations, as indicated.

.2 Clean inside of ducts before laying.

.3 Install plastic duct spacers and ensure full, even support every 1.5 m and smooth transition throughout duct length.

.4 Slope ducts with slope of 1 to 400 minimum.

.5 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.

.6 Pull through each duct steel mandrel with a diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth, and other foreign material.

.1 Pull stiff bristle brush through each duct immediately before pulling-in cables.

.7 Install a pull rope continuous throughout each duct run with 3-m spare rope at each end.

.8 Place continuous strip of warning tape 300 mm above duct before backfilling trenches.

.9 Install markers as required.

.10 Notify the Departmental Representative for field review upon completion of direct buried ducts and obtain acceptance prior to backfill.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools, and equipment.
- .2 Waste Management: Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

APPENDIX 1

CHENIL - CONSTRUCTION D'UN HANGAR ***475, Chemin Grande-Ligne*** ***Rigaud, Québec*** ***ÉTUDE GÉOTECHNIQUE***

Rapport no L-15-1847
22 février 2016



Brookfield
Global Integrated Solutions



JOURNEAUX ASSOC
Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6

T (514) 630-4997 F (514) 630-8937

TABLE DES MATIÈRES

1	INTRODUCTION.....	1
2	DESCRIPTION DU SITE.....	2
2.1	Drainage – Ruisseau Noir, digue et structure de contrôle pour eaux de protection contres les incendies.....	3
3	TRAVAUX DE CHANTIER	4
3.1	Forages	4
3.2	Échantillonnage.....	6
3.3	Niveaux de la nappe d'eau	8
3.4	Essais en laboratoire	8
4	CONDITIONS DE SOLS.....	9
4.1	Stratigraphie.....	9
4.1.1	Sol végétal	9
4.1.2	Argile silteuse/Silt argileux de couleur brune, desséché, très raide	10
4.1.3	Silt argileux gris	11
4.1.4	Sable silteux	13
5	CONDITIONS D'EAU SOUTERRAINE.....	14
6	ENVIRONNEMENT	15
7	DISCUSSION ET RECOMMANDATIONS.....	16
7.1	Détails du bâtiment	16
7.2	Préparation du site et drainage.....	16
7.3	Rehaussement du terrain.....	18
7.4	Fondations.....	18
7.4.1	Murs des fondations périphériques - Capacité portante des sols	18
7.5	Excavation pour les empattements	20
7.5.1	Portes de garage	20
7.6	Dalle sur sol.....	20
7.7	Évaluation structure du chemin d'accès	21
7.8	Considération sismiques	22
8	RECOMMANDATIONS GÉNÉRALES.....	23

Annexes

ANNEXE A	Photo du site des installations de L'Agence des Services Frontaliers du Canada (ASFC) – Rigaud
ANNEXE B	Plan de localisation des forages
ANNEXE C	Rapports de forage
ANNEXE D	Résultats des limites Atterberg
ANNEXE E	Résultats des essais de chargement
ANNEXE F	Certificat des analyses chimiques- Environnement

1 INTRODUCTION

Les services de Journeaux Assoc., une division de LAB JOURNEAUX INC., ont été retenus par BROOKFIELD SOLUTIONS GLOBALES INTÉGRÉES CANADA LP., pour le Numéro du Projet GOC338666, afin d'effectuer une étude géotechnique, tel que spécifié au devis, pour la construction d'un nouveau hangar situé au sud-ouest des installations de L'Agence des Services Frontaliers du Canada (ASFC) situées au 475, chemin de la Grande-Ligne, Rigaud, Québec.

Le client prévoit de bâtir un hangar d'un étage mesurant 45 mètres x 30 mètres (150 pieds x 100 pieds') avec dalle sur sol supportant les légères charges de petits véhicules.

Cette région est reconnue pour ses dépôts d'argile de la mer Champlain qui ont été déposés jusqu'à l'élévation 47 m à cet endroit et s'étend jusqu'au pied du mont Rigaud situé au sud de la ville de Rigaud. C'est sur cette terrasse que le hangar sera construit.

Trois (3) forages profonds pour le bâtiment et un (1) forage superficiel pour la future route d'accès ont été effectués pour l'étude géotechnique. Quatre (4) autres sondages superficiels peu profonds ont été ajoutés au programme de sondage à la fin du chantier. Ces sondages ont été proposés pour vérifier s'il y avait du remblai à l'endroit des excavations pour la construction des fondations du bâtiment. Les détails des informations obtenus au chantier ainsi que les résultats des analyses en laboratoire sont groupés dans l'Annexe C. Les conclusions et recommandations tirées de cette étude sont résumées à la fin du rapport.

La caractérisation environnementale du présent mandat se limitait aux sols naturels rencontrés immédiatement sous la couche organique dont l'un des échantillons a été sélectionné à une profondeur de 1 mètre vu l'absence de remplissage à cet endroit. Aucune observation visuelle ou odeur de contamination n'a été aperçue dans les sols plus profonds prises des forages pour cela ces échantillons n'ont pas été soumis à des essais de caractérisation chimiques.

2 DESCRIPTION DU SITE

Les installations de L'Agence des Services Frontaliers du Canada (ASFC) sont localisées au pied du mont Rigaud au sud de la ville de Rigaud. Le complexe est construit sur une terrasse d'argile surélevée à l'élévation 47 m. La rivière Rigaud est localisée à environ 1 km à l'ouest de la ville et coule de l'ouest vers l'est, sous l'autoroute 40, pour rejoindre la rivière Outaouais quelques kilomètres plus au nord.

Le ruisseau Noir reçoit les eaux de surface s'écoulant du mont Rigaud au sud et coule vers l'est pour s'accumuler dans une petite tourbière à la sortie de laquelle un barrage a été construit pour emmagasiner les eaux pour le système de protection contre les incendies pour les installations de L'Agence des Services Frontaliers du Canada (ASFC).

La Figure 2-1 plus bas montre l'emplacement du nouveau hangar mesurant 45 mètres de longueur par 30 mètres de largeur situé sur un terrain plat et gazonnée.



Figure 2-1 : Regardant vers le nord-ouest du terrain à l'étude avec le réservoir d'eau pour incendies du côté sud. Remarquez la faible profondeur de la rigole de drainage des eaux de surface provenant de la cour du chenil au nord.

2.1 Drainage – Ruisseau Noir, digue et structure de contrôle pour eaux de protection contre les incendies

À l'endroit du site de construction, le terrain est légèrement incliné vers l'est ou vers le petit ruisseau Noir encastré dans une vallée avec parois d'argile d'une profondeur de 3 mètres, une tourbière et un lac retenu par un petit barrage servant à retenir les eaux de surface dans un réservoir (60 mètres x 50 mètres) pour le système de protection contre les incendies pour le complexe gouvernemental. Ce petit ruisseau est alimenté les écoulements des eaux de surface provenant de la montagne.

Le bassin de rétention des eaux de surface est construit sur des terrains de la ville. Une structure de contrôle maintient les eaux du bassin à l'élévation 43.2 m, soit environ 4 mètres plus bas que le site de construction du nouveau hangar.

Sur le site de construction, il y a une petite rigole avec très faible pente vers l'est qui longe le site du côté nord entre le site de construction et un terrain clôturé à l'ouest servant pour l'entraînement des chiens policiers. La rigole draine vers l'est et se décharge dans le fossé du chemin existant qui, à son tour, se décharge dans le réservoir d'eau du ruisseau Noir qui retient l'eau pour le système de protection contre les incendies du complexe.

La petite rigole sur le site du nouveau hangar est très peu profonde et n'est pas très efficace pour assécher le terrain proposé pour la construction du bâtiment. Ceci explique pourquoi qu'au moment des forages, le site était très humide, avec quelques flaques d'eau en surface. L'équipement de forage s'enfonçait facilement dans la couche argileuse de surface sur le site de construction (voir Figure 2-1 plus haut).

3 TRAVAUX DE CHANTIER

3.1 Forages

Les travaux de chantier ont été réalisés le 21 novembre et 11 décembre 2015. Le 21 novembre 2015, trois (3) forages conventionnels avec échantillonnage (TF-15-01, TF-15-02, TF-15-03) ont été portés à une profondeur de 8 mètres pour le bâtiment et un court forage (TF-15-04) a été fait pour caractériser les sols à l'endroit du futur chemin d'accès au site.

Le 11 décembre 2015, quatre (4) autres sondages superficiels ont été réalisés manuellement près du périmètre du bâtiment afin de vérifier s'il pourrait y avoir du remblai sur le site proposé pour la construction du nouveau hangar. Dans ces quatre (4) forages superficiels, la couche d'argile

naturelle très raide et desséchée a été rencontrée immédiatement sous la couche organique de surface; une preuve que du remplissage n'existe pas à ces endroits.

Les forages ont alors été arrêtés dans ce dépôt naturel d'argile desséchée très dure.

Le tableau 3-1 plus bas présente les détails des forages TF-15-01 à TF-15-04. Tous les forages conventionnels profonds effectués le 21 novembre 2015 ont été réalisés à l'aide d'une foreuse mécanique (voir Figure 3-1 plus bas). L'emplacement approximatif de ces forages est montré sur la Figure 2-1 plus haut et présenté sur le dessin L1847-01 à l'Annexe B.

Bien que le contrat prévoyait trois (3) sondages se rendant à 6 mètres de profondeur, les trous de forage ont été portés plus profondément pour se rendre sur un sol plus compact à des profondeurs d'environ 9 mètres. À ce niveau, il est considéré que le forage se rapprochait du refus. Cette indication était utile pour évaluer si une solution de pieux pourrait être considérée comme alternative possible pour supporter le bâtiment.

Table 3-1: Sommaire des forages réalisés

SONDAGE	ÉLÉVATION (m)	PROFONDEUR ATTEINTE (m)	EMPLACEMENT
TF-15-01	47	8,5	Coin NO Hangar
TF-15-02	47	8,5	Coin SE Hangar
TF-15-03	47	8,5	Milieu Hangar
TF-15-04	46,6	1,0	Milieu du chemin d'accès



Figure 3-1: Foreuse mécanique légère

3.2 Échantillonnage

Une cuillère fendue standard (51 mm de diamètre) a servi au prélèvement d'échantillons des sols en surface. L'échantillonneur a également servi pour estimer l'indice « N » de l'essai de pénétration standard. Des essais au pénétromètre faits au bout de l'échantillonneur ont permis d'évaluer l'ordre de grandeur de la résistance des sols argileux sur le terrain. Ces indices permettent de faire une estimation générale de la consistance et de la compacité des matériaux traversés.

Des tubes à paroi mince (76 mm de diamètre) ont été utilisés pour prélever des échantillons des sols argileux non-remaniés intacts dans la zone de plus faible résistance à partir de 2,5 mètres de profondeur. Des essais au scissomètre en laboratoire ont été faits sur ces échantillons de bonne qualité pour mieux évaluer la résistance au cisaillement et par déduction la capacité portante des sols argileux.

Tous les échantillons prélevés ont été transportés au laboratoire Journeaux Assoc pour les essais en laboratoire à Dorval, où ils ont été identifiés visuellement et les meilleurs échantillons ont été sélectionnés pour les essais standards de classification selon l'échelle d'Atterberg, y compris les essais plus critiques de chargement.

À l'Annexe C, les rapports de forage présentent tous les renseignements recueillis sur le chantier et certains résultats des essais en laboratoire.

Au départ, deux (2) forages profonds ont été localisés aux deux (2) coins opposés du bâtiment proposé et un troisième au centre du terrain de construction. Vu l'espacement de presque 20 mètres entre les forages et, par prudence, quatre (4) autres sondages peu profonds ont été faits pour vérifier s'il pourrait y avoir du remplissage sur le site qui pourrait se présenter dans les excavations nécessaires pour la construction de semelles pour les murs et les colonnes du bâtiment. Ces matériaux, si contaminés, pourraient ajouter considérablement au coût du projet et même obliger le déplacement du bâtiment sur un autre terrain.

Ces sondages, avec échantillonnage en continu, ont été rapidement portés jusqu'au niveau du sol naturel qui a été trouvé presque immédiatement sous la couche organique. Ces sondages ont confirmé la présence d'argile très dure comme il a été trouvé aux endroits des trois (3) forages profonds; une indication qu'il n'y a pas de remplissage à ces endroits.

3.3 Niveaux de la nappe d'eau

Le niveau d'eau a été mesuré dans un tube rigide de type « Casagrande » d'un diamètre de 19 mm et crépiné dans les derniers 3,0 mètres. Ces tubes ont été installés au fond de deux (2) trous forés aux coins opposés du bâtiment, à une profondeur de 9 mètres. Le niveau d'eau se trouve à une profondeur d'environ 2 mètres.

3.4 Essais en laboratoire

Certains échantillons représentatifs des sols rencontrés dans les forages ont été soumis aux essais suivants :

Table 3-2: Essais géotechniques en laboratoire

DESCRIPTION DE L'ESSAI	NORME	NOMBRE
Teneur en eau	ASTM D2216	23
Poids Unitaire	ASTM D7263	16
Limites Atterberg	ASTM D4318	8
Essai de chargement		2

Les résultats de ces essais sont reportés sur les rapports de forage à l'Annexe C. Les résultats des essais des limites Atterberg sont regroupés à l'Annexe D, et les résultats des deux essais de chargement sont présentés à l'Annexe E.

4 CONDITIONS DE SOLS

La description des sols présentée dans les paragraphes qui suivent ainsi que sur les rapports de forage s'applique seulement à l'endroit précis où les forages ont été réalisés. Par conséquent, les conclusions et recommandations sont tirées d'une extrapolation raisonnable de ces informations obtenues sur des dépôts.

4.1 Stratigraphie

Les trois (3) forages et les quatre (4) sondages peu profonds ont pénétré le couvert végétal (50 mm) suivi d'un dépôt très dur d'argile silteuse, desséchée et de couleur brune.

En profondeur, ce dépôt recouvre un dépôt silt argileux – argile silteux saturé, de couleur grise et de plus faible résistance. Sous le dépôt de silt argileux, une couche de sable silteux ou de silt et sable gris, saturé, avec une résistance légèrement plus élevée au fonçage de l'échantillonneur que dans le dépôt d'argile saturée, a été rencontrée au fond des forages TF-15-01, TF-15-02 et TF-15-03.

Une description plus détaillée de la stratigraphie des sols à l'endroit du bâtiment est donnée plus bas.

4.1.1 Sol végétal

Une couche superficielle de sol végétal de couleur gris foncé d'une épaisseur de 50 mm d'épaisseur recouvre tout le terrain.

Cette couche était saturée d'eau au moment des forages; une indication d'un mauvais drainage du terrain à cause de la couche d'argile très dure et imperméable et des pentes trop douces, le tout amplifié par l'eau déversant du lot voisin du côté nord-est de la propriété.

4.1.2 Argile silteuse/Silt argileux de couleur brune, desséché, très raide

Sous le sol végétal, on retrouve un dépôt cohésif d'argile silteuse, desséchée, très dure, de couleur brune. Cette couche desséchée s'étend jusqu'au niveau de la nappe phréatique située à environ 2,4 mètres de profondeur.

La teneur en eau de l'argile augmente avec la profondeur, soit d'environ 33% pour l'argile desséchée en surface jusqu'à 41% pour la couche près la nappe d'eau.

Les limites d'Atterberg montrent que cette couche a une limite de liquidité qui croît de 46 à 63% avec la profondeur. Les limites de plasticité correspondantes sont de 25 à 39%. Ces valeurs, avec teneur eau inférieure à la limite de liquidité, sont typiques d'une argile silteuse desséchée. Cette argile est donc peu sensible à la liquéfaction et aux glissements de terrain rétrogressifs. De plus, la teneur en eau se situe le plus souvent près de sa limite de plasticité; une valeur qui confirme une très faible sensibilité au remaniement de ce dépôt de consistance très raide (voir charte des essais d'Atterberg sur la Figure 4-1 plus bas).

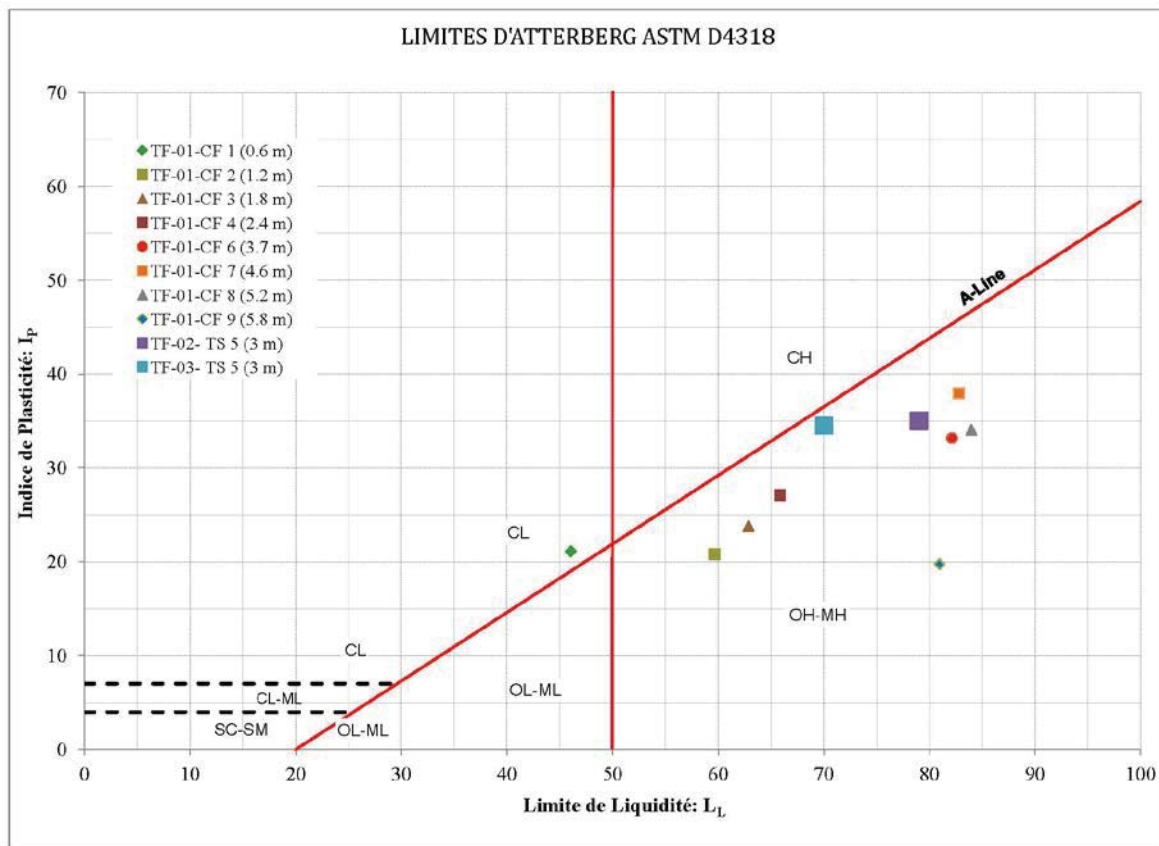


Figure 4-1 : Limites d'Atterberg

La résistance au cisaillement non drainé « C_u » de cette couche a été mesurée à l'aide d'un scissomètre de laboratoire miniature et d'un pénétromètre de poche. La couche très raide et desséchée en surface avait des résistances de 250 kPa et qui décroissaient à environ 150 kPa au niveau de la nappe d'eau situé à environ 2,5 mètres de profondeur. Ces valeurs sont typiques d'une couche d'argile de faible teneur en eau, soit près de la limite de plasticité.

4.1.3 Silt argileux gris

La couche d'argile silteuse, brunâtre, desséchée en surface devient plutôt une couche saturée de silt argileux de couleur grise à partir de la profondeur d'environ 2,4 mètres. Cette couche s'étend jusqu'à environ 7 mètres de profondeur pour donner une épaisseur d'environ 5 mètres.

La teneur en eau de cette couche est plus élevée que la croûte desséchée et augmente de 38 à 76% sur des échantillons prélevés en profondeur. Les limites de liquidité ont aussi augmenté et varient entre 81 et 84%. Les limites de plasticité correspondantes varient de 45 à 61%. Ceci indique que cette couche est d'une plasticité élevée avec teneur en eau près de la limite de plasticité, soit un dépôt de faible sensibilité au remaniement (voir charte des essais d'Atterberg sur la Figure 4-1 plus haut et sur les rapports de forage).

En profondeur, les échantillons ont été remaniés par l'opération de forage et la résistance au cisaillement non drainé « C_u », mesurée à l'aide d'un pénétromètre de poche au chantier, n'ont pas été retenue. Seuls les indices de pénétration « N » variant entre 20 et 10 ont été utilisées pour confirmer une résistance décroissante du dépôt comparativement aux valeurs « N » de 30 à 40 mesurées dans la couche superficielle dure et desséchée.

Deux (2) essais de chargement ont été réalisés sur des échantillons de silt argileux gris non remaniés prélevés à 3 mètres de profondeur dans les forages TF-15-02 (coin sud-est du bâtiment) et TF-15-03 (milieu du bâtiment). À partir de ces essais, on remarque une croissance importante des taux de compression des échantillons, une fois de la charge ait dépassé 200 kPa (voir Figure 4-2 plus bas).

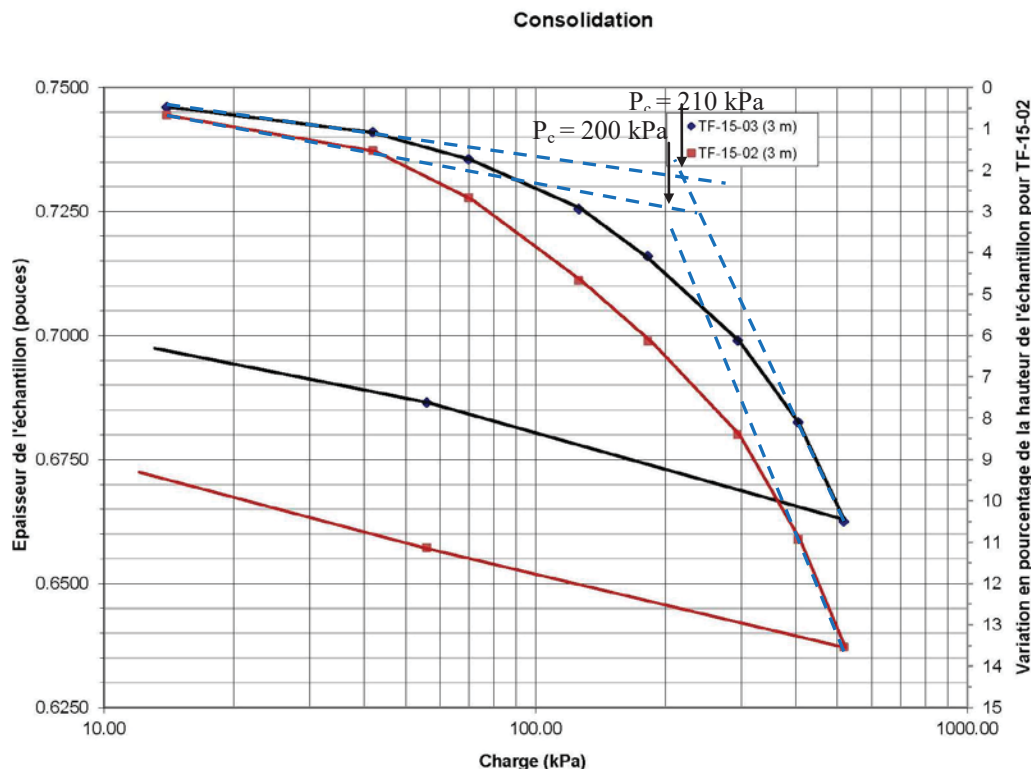


Figure 4-2 : Essais de chargement

Cette charge est considérée comme la charge de préconsolidation pour la couche d'argile grise à une profondeur de 2,5 mètres. Les charges ajoutées au poids du sol existant à ce niveau par les nouvelles fondations ne devront pas dépassées 80% de cette valeur si les tassements des semelles doivent être limités à environ 25 mm (voir Figure 7-1 plus bas).

4.1.4 Sable silteux

À partir de 6 mètres de profondeur, l'échantillonneur a été foncé avec un poids réglementé jusqu'à 8,5 mètres de profondeur où un dépôt un peu plus consistant a été détecté. Du sable silteux de couleur grise a été récupéré au bout de l'échantillonneur qui a été foncé dans une couche plus consistante jusqu'à une profondeur d'environ 7,5 mètres dans le forage TF-15-01.

Étant donné que les indices de pénétration augmentent légèrement, soit généralement de 8 à 10 jusqu'à 14, ce dépôt sablonneux s'étend probablement jusqu'au dépôt de moraine sous-jacent.

Le tableau 4-1 plus bas résume la stratigraphie tel que rencontrée lors des forages :

Table 4-1: Résumé des épaisseurs des couches de sol

FORAGE	EMPLACEMENT	SOL VÉGÉTAL (mm)	ARGILE SILTEUSE DESSÉCHÉE (m)	SILT ARGILEUX (m)	SABLE SILTEUX (ESTIMÉ) (m)
TF-15-01	Coin NO Hangar	50	0,05 à 2,4 m (2,4 m)	2,4 à 7,6 m (5,2 m)	7,6 à 8.5 m (0,9 m)
TF-15-02	Coin SE Hangar	50	0,05 à 1,8 m (1,8 m)	1,8 à 7,3 m (5,5 m)	7,3 à 8.5 m* (1,2 m)
TF-15-03	Milieu Hangar	50	0,05 à 2,1 m (2,1 m)	2,1 à 7,3 m (5,2 m)	7,3 à 8.5 m* (1,2 m)
TF-15-04	Milieu Chemin d'accès	50	0,05 à 1,2 m (1,2 m)	Non atteint	Non atteint

* Probablement

5 CONDITIONS D'EAU SOUTERRAINE

Lors des travaux de forage, deux (2) tubes en plastique crépinés ont été installés jusqu'au fond des forages TF-15-01 et TF-15-02. Les résultats de ces mesures sont donnés sur le tableau 5-1 plus bas.

Tableau 5-1 : Niveau d'eau

FORAGE	EMPLACEMENT	ÉLÉVATION DU TROU DE FORAGE (m)	NIVEAU D'EAU		
			Date	Profondeur (m)	Élévation (m)
TF-15-01	Coin NO Hangar	47	21 nov. 2015	2,4	44,6
			11 déc. 2015	1,8	45,6
TF-15-02	Coin SE Hangar	47	21 nov. 2015	2,4	44,6
			11 déc. 2015	0,2*	46,8
TF-15-03	Milieu Hangar	47	21 nov. 2015	2,4	44,6
			11 déc. 2015	0,2	46,8
TF-15-04	Milieu Chemin d'accès	47	21 nov. 2015	1,2	46,8
			11 déc. 2015	1,0*	46

* Trous remplis d'eau pendant une forte pluie

Les forages ont été faits avec une tarière mécanisée sans utiliser d'eau. Le jour des forages, le niveau d'eau se situait généralement à 2,4 m sous le niveau du terrain ou à l'élévation géodésique 44,6 m.

Le niveau varie selon les saisons, soit plus élevé en automne et au printemps et plus bas en été et en hiver.

Le forage TF-15-04 a été fait à l'endroit du chemin proposé pour donner accès au nouveau hangar. Ce trou a été porté à 1,2 mètre de profondeur toujours dans la couche d'argile raide. Aucune eau n'a été rencontrée dans ce forage.

6 ENVIRONNEMENT

Un échantillon a été prélevé en surface du terrain dans les trous de forage TF-15-01, TF-15-02 et TF-15-03 aux fins d'essais de caractérisation environnementale. Lors des travaux de chantier, aucune odeur n'a été détectée ou contamination observée visuellement. Les résultats des essais de caractérisation environnementale sont présentés à l'Annexe F. Selon ces résultats, le sol aux emplacements des trois (3) forages profonds est de classe « A », ce qui signifie que les sols ne sont pas contaminés.

Étant donné que les forages conventionnels demandés au contrat étaient situés aux coins opposés du bâtiment, il restait à échantillonner les sols aux endroits des excavations pour les empattements des longs murs de fondation pour valider la présence de remblai sur le site.

Alors, dans le but de confirmer s'il y avait présence de remplissage à l'intérieur de la zone de construction du bâtiment, quatre (4) sondages superficiels peu profonds avec échantillonnage en continu ont été portés au niveau du terrain naturel, soit la couche d'argile silteuse, brunâtre, desséchée et très raide.

Ces quatre (4) sondages, faits sur les deux longs murs du bâtiment mesurant 45 mètres de longueur, n'ont pas trouvé de remplissage mais seulement la couche très raide d'argile silteuse sous le gazon et la couche organique de même stratigraphie que celle identifiée dans les trois (3) forages conventionnels.

7 DISCUSSION ET RECOMMANDATIONS

7.1 Détails du bâtiment

Selon les informations fournies, le hangar pour l'entraînement des chiens policiers sera chauffé, aura 45 mètres de longueur par 30 mètres de largeur et aura une dalle sur sol.

Les charges sur la dalle seront faibles, étant limité à celles transmises par des automobiles ou des fourgonnettes, soit des charges ne dépassant pas quelques 30 kPa. Aucun autre détail n'est connu de la construction.

7.2 Préparation du site et drainage

L'emplacement choisi pour la construction du bâtiment est un terrain plat, gazonné, voisin à un bâtiment semblable situé à moins de 50 mètres au nord. Pour le bâtiment existant, la dalle est légèrement soulevée par rapport au terrain extérieur.

À L'emplacement du nouveau hangar, le terrain argileux était saturé d'eau, au moment de l'étude géotechnique (novembre 2015). Cette eau provenait des terrains à l'ouest et en amont du site de construction.

Seule une petite rigole peu profonde sépare le lot de construction des lots bâtis et permet à l'eau de surface de s'accumuler sur le site du nouveau hangar. Il est clair que la nouvelle dalle sur sol et le terrain fini au pourtour du bâtiment doivent être construits à un niveau au moins 500 mm plus haut que le terrain existant pour empêcher ces inondations.

De plus, la rigole du côté ouest du site doit être approfondie d'environ 300 mm pour intercepter les eaux de surface qui arrivent de ces terrains des côtés nord et ouest. Ces eaux doivent être rapidement évacuées vers le fossé qui longe le chemin d'accès principal qui, à son tour, s'écoule vers l'est et le petit réservoir du ruisseau Noir. Une pente d'au moins 0,5% est nécessaire pour favoriser un écoulement rapide des eaux et pour minimiser la formation de glace pendant la période de gel en automne.

Une protection contre l'érosion des sols argileux et silteux est nécessaire pour minimiser l'érosion des pentes et du fond du nouveau fossé au dégel. Cette érosion pourrait créer l'instabilité des talus et ceux-ci doivent donc être excavés avec des pentes d'un minimum de 2,5H:1V. Un gravier naturel arrondi de 50 mm de diamètre doit être utilisé pour empêcher l'érosion des parois.

7.3 Rehaussement du terrain

Il est recommandé de rehausser le terrain prévu pour la construction du bâtiment dans le but de favoriser un bon drainage vers les limites de la propriété.

Vu la présence de sols argileux sur le site et leur sensibilité au remaniement en périodes de pluie, il est recommandé d'ajouter un remblai d'au moins 500 mm de sable grossier propre (moins de 3% passant le tamis 0,08 mm) ou un matériau granulaire non gélif. Le rehaussement granulaire doit être fait après avoir enlevé la mince couche de sol organique en surface et après avoir recouvert la surface décapée avec un géotextile de qualité.

En période de pluie abondante quand le dépôt d'argile silteuse est facile à remanié, la compaction doit être faite avec des équipements légers sans utiliser de vibration. Ce travail de compaction doit être fait lorsqu'un technicien d'expérience est sur les lieux pour fixer le nombre de passes du lourd compacteur, s'il est utilisé, pour éviter le remaniement de l'argile sensible.

7.4 Fondations

7.4.1 Murs des fondations périphériques - Capacité portante des sols

Vu que le bâtiment sera chauffé, on doit profiter de la capacité portante élevée de la croûte d'argile desséchée et dure en établissant le niveau des fondations le plus haut possible, mais toujours protégées contre le gel.

Sur la figure 7-1 plus bas, l'influence des charges imposées par les murs de fondation, le poids du rehaussement et les charges de la dalle sont sur la couche d'argile grise et plus molle à partir de 2,5 mètres de profondeur du terrain existant.

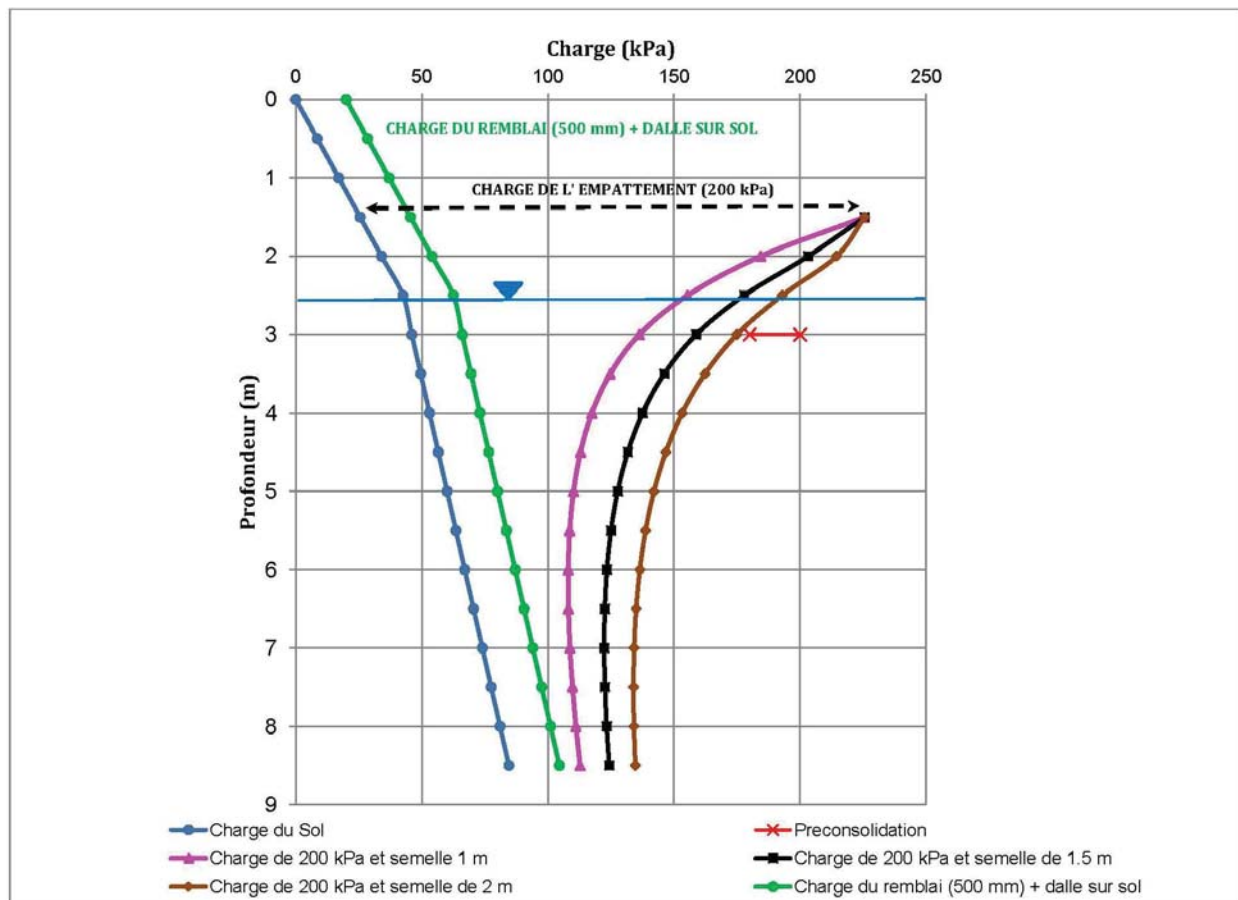


Figure 7-1 : Effet d'une charge d'empatement

Les murs périphériques du bâtiment pourront reposer sur la dalle sur sol ou sur les semelles filantes reposant sur la couche d'argile silteuse très raide et de bonne capacité portante (200 kPa) à 500 mm sous le niveau du terrain existant. Pour des semelles filantes d'une largeur d'environ 1 mètre, une capacité portante de 200 kPa peut être utilisée pour les calculs tout en limitant les tassements à moins de 20 mm.

7.5 Excavation pour les empattements

À cause de la présence d'argile imperméable jusqu'en surface du terrain, il est clair que le remplissage des excavations placées après l'installation des semelles filantes deviendront saturés d'eau en automne à moins que le fond des tranchées soit bien drainé. Pour cette raison, il est recommandé d'asseoir les fondations le plus haut possible pour profiter de la capacité portante de la croûte d'argile. À un niveau plus élevé, un isolant sur les murs extérieurs des fondations sera nécessaire, tout en ajoutant un isolant horizontal de 1,0 mètre de largeur au niveau des fondations, pour protéger les fondations contre le gel. Si les murs sont supportés sur la dalle sur sol sur-épaissie au pourtour du bâtiment, un isolant horizontal de 2 mètres de largeur doit être installé au niveau inférieur du béton.

7.5.1 Portes de garage

Il est à noter que l'accumulation de neiges sur les côtés du hangar agira comme protection supplémentaire contre la pénétration du gel en hiver, sauf aux approches des grandes portes d'entrée des véhicules qui seront déneigées en hiver. À cet endroit, les fondations à l'entrée des véhicules seront exposées aux plus basses températures de l'hiver et la pénétration du gel sera plus profonde que sur les murs de côté. Pour empêcher la pénétration du gel sous les fondations à cet endroit, la dalle d'approche à l'entrée doit être protégée avec un isolant et chauffée.

7.6 Dalle sur sol

- Les indices de gel indiquent que la pénétration du gel peut atteindre 1,5 mètre aux endroits où le terrain est exposé aux basses températures de l'hiver où il n'y a pas d'accumulation de neige.

- Tous les murs extérieurs doivent être protégés contre le gel et supportés sur une dalle sur-épaissie au pourtour. Un isolant ou un remblai de protection contre la pénétration du gel doit être ajouté pour empêcher que le gel avance sous les extrémités de la dalle.
- Le plancher en béton du hangar chauffé peut reposer sur le remblai granulaire compact, comme décrit plus haut. Il est recommandé que la dalle soit coulée sur une membrane imperméable (50 mm) pour empêcher l'humidité de remonter vers la surface de la dalle.
- La membrane doit être déposée sur une mince couche de sable d'une épaisseur d'environ 75 mm et légèrement compactée pour empêcher sa perforation par les pierres concassées.
- Avant le début de la construction, toute eau de surface doit être acheminée vers l'est et le petit ruisseau Noir via le fossé existant de la rue principale.
- Dans le but de minimiser les excavations dans la couche d'argile desséchée et dure, il est recommandé de rehausser le site de construction d'environ 500 mm avec un remblai de sable or de sable et gravier propre.

7.7 Évaluation structure du chemin d'accès

Le chemin d'accès du hangar, d'une longueur de moins de 20 mètres, partira du chemin principal existant puis enjambera le fossé de drainage existant avant d'arriver au terrain de construction. Les sols naturels au niveau de l'infrastructure sont composés essentiellement d'argile silteuse, dure et desséchée recouverte d'une mince couche organique. L'argile est peu perméable et très gélive en présence d'eau abondante.

Le chemin de construction temporaire donnant accès au chantier doit suivre le même tracé que le chemin permanent. L'utilisation de ce chemin par les lourds camions aura l'effet de bien

compacter le terrain naturel par les nombreux passages des camions chargés. Un ponceau robuste doit être installé au fond du fossé existant pour permettre le passage des lourds véhicules. Ce ponceau doit être laissé en place pour la future route d'accès permanente.

La construction de ce chemin doit impliquer une membrane géotextile de bonne qualité suivi d'un remblai granulaire de sable et gravier ou de sable propre d'au moins 600 mm d'épaisseur pour supporter les lourds camions. Une fois la construction terminée, le chemin peut être reprofilé et une couche de pierre concassée MG-20 de 100 mm d'épaisseur peut être ajoutée puis pavé par la suite, si prévu aux plans.

7.8 Considération sismiques

Les sols rencontrés se décrivent comme étant de l'argile silteuse de compacité ferme à très raide, suivi d'un dépôt cohérent silt argileux de compacité ferme. À la lumière de ces résultats et en fonction des paramètres donnés au tableau 4.1.8.4a du *Code national du bâtiment*, le terrain à l'étude se situe dans la catégorie d'emplacement « D ».

Tableau 4.1.8.4.A.
Catégories en fonction de la réponse sismique des emplacements
Faisant partie intégrante des paragraphes 4.1.8.4. 2) et 3)

Catégorie d'emplacement	Profil du sol	Propriétés moyennes des 30 premiers mètres d'après l'annexe A.		
		Vitesse moyenne des ondes de cisaillement, \bar{V}_s (m/s)	Résistance moyenne à la pénétration standard, \bar{N}_{60}	Résistance du sol non drainé au cisaillement, s_u
A	Roche dure	$\bar{V}_s > 1500$	s/o	s/o
B	Roche	$760 < \bar{V}_s \leq 1500$	s/o	s/o
C	Sol très dense et roche tendre	$360 < \bar{V}_s < 760$	$\bar{N}_{60} > 50$	$s_u > 100$ kPa
D	Sol consistant	$180 < \bar{V}_s < 360$	$15 \leq \bar{N}_{60} \leq 50$	$50 \text{ kPa} < s_u \leq 100 \text{ kPa}$
E	Sol meuble	$\bar{V}_s < 180$	$\bar{N}_{60} < 15$	$s_u < 50$ kPa
		Tout profil de plus de 3 m d'épaisseur et dont le sol a les caractéristiques suivantes : • indice de plasticité : $PI > 20$; • teneur en eau : $w \geq 40$ %; et • résistance du sol non drainé au cisaillement : $s_u < 25$ kPa		
F	Autres sols ⁽¹⁾	Une évaluation spécifique à l'emplacement est exigée.		

(1) Parmi les autres types de sol, on compte notamment :

- les sols liquéfiables, les argiles très sensibles et extrasensibles, les sols peu consolidés susceptibles d'affaissement et d'autres sols susceptibles d'affaissement ou de défaillance en raison de charges dues aux séismes;
- la tourbe et les argiles à forte teneur en matières organiques dont l'épaisseur dépasse 3 m;
- les argiles ayant une grande plasticité ($PI > 75$) dont l'épaisseur dépasse 8 m; et
- les argiles raides, de molles à moyennes, dont l'épaisseur dépasse 30 m.

8 RECOMMANDATIONS GÉNÉRALES

- Toute excavation temporaire doit être réalisée selon les spécifications standard (CSST, Québec), soit avec des parois en pente minimum de 1H:1V (ou plus douces) pour des excavations de moins de 2 mètres de profondeur si l'excavation est sèche. Les excavations sous la nappe d'eau doivent avoir des pentes beaucoup plus douces ou avoir un système de soutènement temporaire approprié si nécessaire.
- L'excavation doit restée sèche en tout temps. Étant donné la faible profondeur de la nappe d'eau, l'utilisation d'un système de pompage aux extrémités des excavations est donc à prévoir. L'eau doit toujours demeurer plus basse que le dessous des semelles.
- La capacité portante de la couche d'argile très raide à 600 mm du niveau du terrain (argile sensible) a été évaluée à 200 kPa tout en limitant les tassements différentiels à moins de 20 mm.
- Il faut prendre soin de ne pas remanier le sol naturel au fond des excavations à moins de supporter les murs sur la dalle sur sol. De plus, le fond de l'excavation pour la semelle doit être inspecté par un ingénieur en géotechnique lors de l'excavation et aussi avant de couler le béton.
- Mettre un dispositif de drainage adéquat au niveau des semelles, tel qu'un drain français de 150mm de diamètre entouré d'un géotextile approprié et d'un sable et gravier propre. Pour s'assurer que les remblais granulaires des excavations pour les fondations ne deviennent pas saturés d'eau, les drains français doivent être reliés avec pente appropriée

au système d'égout pluvial existant enfoui sous le pavage du chemin d'accès devant le site.

- Si de la pierre concassée est utilisée comme remblai sous la dalle sur sol, elle doit être de type MG20, libre de pyrite et avoir une classification DB tel que spécifié par le MTQ.
- Avant de couler la dalle de béton, un pare-vapeur (feuille de polyéthylène de 6 mil industrielle appropriée) doit être placé sur un coussin de sable propre pour limiter la transmission de l'humidité ou la pénétration de gaz de sol comme le radon.
- Les empattements d'environ 1 mètre de largeur installés sur la croûte d'argile raide à 1 mètre de profondeur doivent être protégés contre le gel avec un isolant placé sur les murs extérieurs du bâtiment et aussi à 1,0 mètre horizontal au niveau des empattements.
- Le terrain fini au périmètre des murs de fondation doit avoir une pente minimale de 2% vers l'extérieur de la propriété.
- La protection de tous services enfouis ainsi que toutes lignes aériennes (électricité, téléphone) doit être considérée.
- Les matériaux argileux d'excavation pourraient être utilisés en période de sécheresse pour le rehaussement du terrain ou le remblayage pour les stationnements. La couche organique doit être conservée aux fins de réutilisation.
- Pour une construction hivernale, il est obligatoire de protéger les fondations et les sols argileux contre le gel en tout temps.

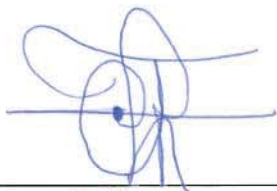
- Le chemin de construction temporaire doit être construit à l'emplacement du chemin d'accès futur. Un ponceau robuste sera nécessaire pour prolonger le fossé existant du chemin d'accès principal s'écoulant vers le réservoir d'eau de protection contre les incendies du ruisseau Noir.

BROOKFIELD SOLUTIONS GLOBALES INTÉGRÉES CANADA LP.

Étude géotechnique

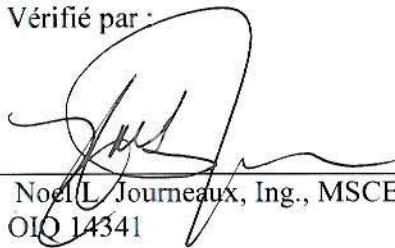
Chenil - Construction d'un nouveau hangar
475 chemin de la Grande-Ligne
Rigaud, Québec

Préparé par :



Sherif Kamel, ing., Ph.D.
OIQ 5004384

Vérifié par :



Noël Journeaux, Ing., MSCE, F ASCE
OIQ 14341

 **JOURNEAUX ASSOC**
Division LAB JOURNEAUX INC.
801 Bancroft Pointe-Claire, QC H9R 4L6
T (514) 630-4997 F (514) 630-8937

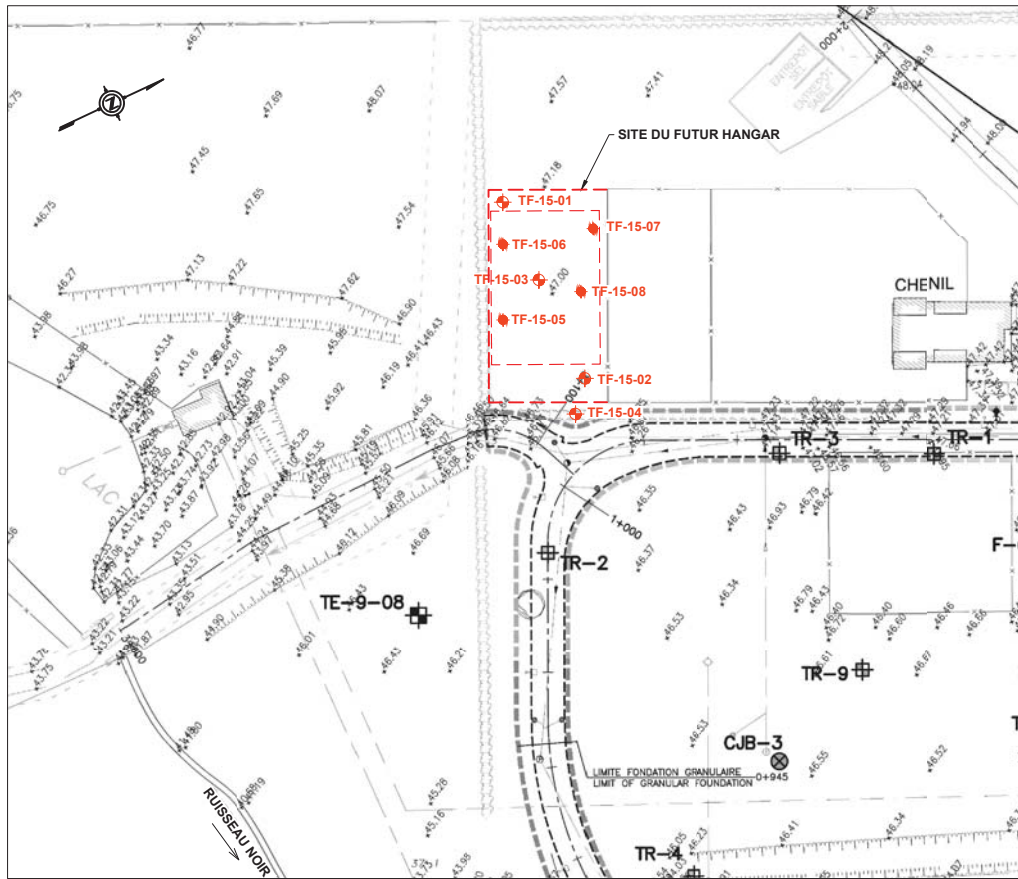
ANNEXE A

**Photo du site des installations de L'Agence des Services
Frontaliers du Canada (ASFC) - Rigaud**

ANNEXE B

Plan de localisation des forages

11 JANVIER 2016



NOTE:
BASÉ SUR PLAN: TRAVAUX CIVIL, ÉTAT DES LIEUX, FEUILLE C17/38, PROJET No. R002974.206
DE TRAVAUX PUBLICS ET SERVICES GOUVERNEMENTAUX CANADA, EN DATE DU 2010-12-20
SAUF INDICATION CONTRAIRE, TOUTES LES DIMENSIONS SONT EN MÈTRES.

CLIENT:	Brookfield Global Integrated Solutions
DATE:	11-01-2016
PROJET No.:	L-15-1847

PROJET:
PROJET DE CHENIL
PLAN DE LOCALISATION DES FORAGES
475 CHEMIN GRANDE-LIGNE
RIGAUD, QUÉBEC

ÉCHELLE:	1:800
DESSINÉ PAR:	S.E.
PROJETÉ PAR:	S.K.
APPROUVÉ PAR:	N.J.

LÉGENDE	
	FORAGE CONVENTIONNEL
	SONDAGE SUPERFICIEL
0 20m 40m	
Echelle 1:800	

JOURNEAUX ASSOC Division L&S JOURNEAUX INC. 801 Boncroft Pointe • Châteauguay, QC J7B 4L6 Tél: 514.830.4997 info@journeauxassoc.com	
DESSIN No.:	L1847-02
FIGURE No.:	
REV.:	A

ANNEXE C

Rapports de forage

RAPPORT DE FORAGE

CLIENT:



PROJET: Étude géotechnique Chenil-Hangar

SITE: 475 Ch. Grande-Ligne, Rigaud

SONDAGE: **TF-15-01**

NO PROJET: L-15-1847

NIVEAU D'EAU: 44.54 m

DATE DU FORAGE: 2015-11-21

DATE EAU: 2015-11-21

TYPES D'ÉCHANTILLONS		TYPES D'ÉCHANTILLONEURS		TESTS LABORATOIRE				Scissomètre (Su) ◇ intacte			
	Remanié	CF Cuillère fendue		AG Analyse granulométrique				(Sur) ◆ remanié			
	Non remanié	TS Tube à parois mince (Shelby)		C Consolidation (kPa)				Pénétromètre (Cu) △ intacte			
	Perdu	EP Échantillonneur à piston		γ _t Poids volumique (kN/m³)				(Cur) ▲ remanié			
	Carotte	CD Carrotier à diamant		LL Limite de liquidité (%)				Pénétration dynamique × - - - - ×			
				LP Limite de plasticité (%)							
PROFONDEUR-m	STRATIGRAPHIE			EAU	ÉCHANTILLONS				ESSAIS		
	ÉLÉVATION-m PROFONDEUR-m	DESCRIPTION SOL	PROFIL SOL	PIEZOMÈTRE	ÉCHANTILLON TYPE et NO	TYPES	RÉCUPÉRATION %	N	TENEUR EN EAU %	LABORATOIRE et TESTS IN SITU	(Remanié): ◆ / ◇ (Intacte) RÉSIST CISAILLEMENT N/D 50 100 150 200 N 20 40 60 80 TENEUR EN EAU ET LIMITES (%) 20 40 60 80 L.P. L.L.
	47.00	Niveau									
	0.00	SOL VÉGÉTAL									
1	46.95	Noir, humide avec végétation.		N.E. 2.5 m - 2015-11-21	CF-01		100	7	34.7	γ _t = 19.29 kN/m³ Cu=100kPa LL=46% LP=25%	
	0.05	ARGILE SILTEUSE - SILT ARGILEUX			CF-02		100	20	33.7	γ _t = 19.13 kN/m³ Cu=175kPa LL=60% LP=39%	
		Brune avec trace et joint de sable, humide avec une consistance ferme et à 1m devient raide à très raide.			CF-03		100	17	33	γ _t = 19.19 kN/m³ Cu=130kPa LL=63% LP=39%	
					CF-04		100	23	41.1	γ _t = 18.25 kN/m³ Cu=110kPa LL=66% LP=39%	
2	44.60	SILT ARGILEUX			TS-05		0			γ _t = 17.61 kN/m³ Cu=60kPa LL=82 LP=49%	
	2.40	Grise, saturée d'une consistance ferme,		CF-06		100	7	50.8	γ _t = 17.99 kN/m³ LL=83 LP=45%		
3	43.60	COUCHE D'ARGILE, rougâtre ferme			CF-07		100	2	47.2	γ _t = 15.91 kN/m³ LL=84% LP=50%	
	3.40			CF-08		100	4	71.9	LL=81% LP=61%		
4	43.00	ARGILE SILTEUSE, grisâtre ferme, à 4.5m la consistance devient à très molle.			CF-09		100	0	48.5		
	4.00										
5											
6											
7											
8	39.38	SABLE SILTEUX									
	7.62	Gris, saturé d'une compacité compacte.		CF-10		100					
9	38.47	Fin du forage									
	8.53										


JOURNEAUX ASSOC
 Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6

Référence:

Coordonnées:

Technicien: C.R. & S.K.

Vérifié par: N.L.J.

PAGE

1/1

RAPPORT DE FORAGE

CLIENT:



PROJET: Étude géotechnique Chenil-Hangar

SITE: 475 Ch. Grande-Ligne, Rigaud

SONDAGE: **TF-15-02**

NO PROJET: L-15-1847

NIVEAU D'EAU: 44.55 m

DATE DU FORAGE: 2015-11-21

DATE EAU: 2015-11-21

TYPES D'ÉCHANTILLONS		TYPES D'ÉCHANTILLONEURS		TESTS LABORATOIRE				Scissomètre (Su) ◇ intacte				
	Remanié	CF	Cuillère fendue	AG	Analyse granulométrique			Pénétromètre (Cu) △ intacte				
	Non remanié	TS	Tube à parois mince (Shelby)	C	Consolidation (kPa)							
	Perdu	EP	Échantillonneur à piston	γ _t	Poids volumique (kN/m³)			(Cur) ▲ remanié				
	Carotte	CD	Carrotier à diamant	LL	Limite de liquidité (%)			Pénétration dynamique × - - - - ×				
				LP	Limite de plasticité (%)							
PROFONDEUR-m	STRATIGRAPHIE			EAU	ÉCHANTILLONS				ESSAIS			
	ÉLÉVATION-m PROFONDEUR-m	DESCRIPTION SOL	PROFIL SOL	PIEZOMÈTRE	ÉCHANTILLON TYPE et NO	TYPES	RÉCUPÉRATION %	N	TENEUR EN EAU %	LABORATOIRE et TESTS IN SITU	(Remanié): ◆ / ◇ (Intacte) RÉSIST CISAILEMENT N/D 50 100 150 200 N 20 40 60 80 L.P. — L.L. TENEUR EN EAU ET LIMITES (%) 20 40 60 80	
1	47.00	Niveau		N.E. 2.5 m - 2015-11-21								
	0.00	SOL VÉGÉTAL										
	46.95	Noir, humide avec végétation.			CF-01		50	8	36.3	γ _t = 19.32 kN/m³ Cu=220kPa		
2	0.05	ARGILE SILTEUSE - SILT ARGILEUX			CF-02		100	30	33.1	γ _t = 18.86 kN/m³ Cu=180kPa		
		Brune, humide avec trace de sable d'une consistance ferme à très raide.										
3	45.20	SILT ARGILEUX			TS-03		100		36.9	γ _t = 18.97 kN/m³ Cu=220kPa		
	1.80	Grise, rougâtre avec signe d'oxidation, humide d'une consistance très raide devenant ferme à 3.6m.			CF-04		100	13		Cu=180kPa		
4	43.60	COUCHE D'ARGILE, rougâtre ferme	TS-05		50		59	γ _t = 16.9 kN/m³ LL=79% LP=44%				
	3.40		CF-06		100	6	60	γ _t = 16.75 kN/m³				
5	43.00	ARGILE SILTEUSE, grisâtre ferme	CF-07		100	4	67	γ _t = 16.76 kN/m³				
	4.00											
6			CF-08		100	5	66.8					
7			CF-09		100	5	75.7					
8	39.69	Probable ment dépôt de sable silteux, lâche, saturé..							Pén_dyn, N'=7			
	7.32								Pén_dyn, N'=9			
									Pén_dyn, N'=7			
9									Pén_dyn, N'=8			
									Pén_dyn, N'=9			
									Pén_dyn, N'=8			
	38.47	Fin du forage										
	8.53											


JOURNEAUX ASSOC
 Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6

Référence:

Coordonnées:

Technicien: C.R. & S.K.

Vérifié par: N.L.J.

PAGE

1/1

RAPPORT DE FORAGE

CLIENT:



PROJET: Étude géotechnique Chenil-Hangar

SITE: 475 Ch. Grande-Ligne, Rigaud

NO PROJET: L-15-1847

DATE DU FORAGE: 2015-11-21

SONDAGE: **TF-15-03**

NIVEAU D'EAU: 44.50 m

DATE EAU: 2015-11-21

[illegible]

JOURNEAUX ASSOC
Division LAB JOURNEAUX INC

Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6

Référence:

Coordonnées:

Technicien: C.R. & S.K.

Vérifié par: N.L.J.

PAGE

1/1

ANNEXE D

Résultats Des Limites Atterberg

LIMITES D'ATTERBERG ASTM D 4318

Projet No.: L-15-1847
 Sondage No.: TF-15-01
 Échantillon No.: CF-01
 Date: 30/11/2015
 LJA No.: ---

Client: Brookfield Solutions Globales Intégrées Canada LP

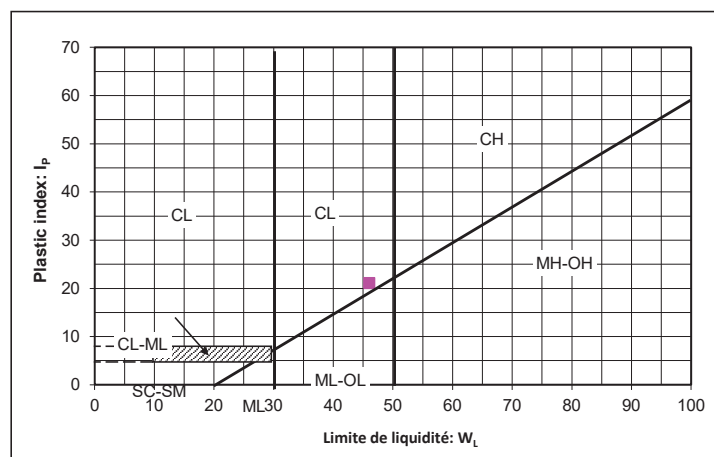
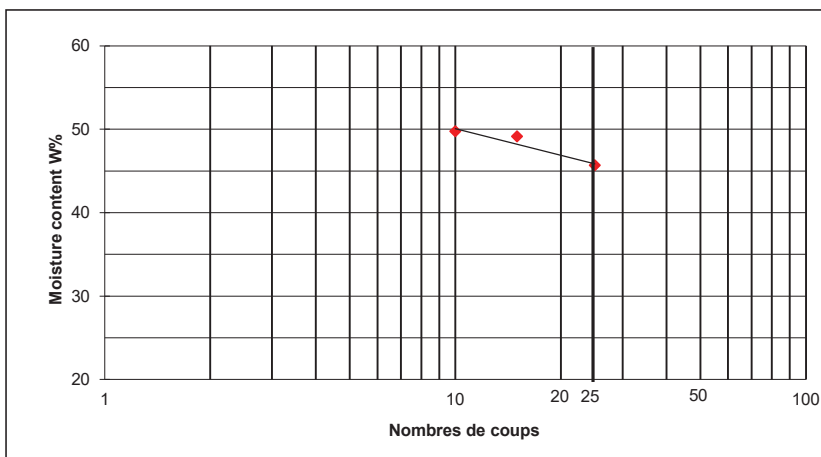
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 34.66 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 46.03 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 24.93 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 21.11 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ 0.46101 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	2.08	2.22	-
Masse totale sèche:	1.94	2.04	-
Masse du contenant:	1.32	1.38	-
Masse du sol sec:	0.62	0.66	-
Teneur en eau:	22.58	27.27	-
Résultat moyen:	24.93%		

Teneur en Eau Naturelle		
4	5	6
92.4	-	-
69.7	-	-
4.2	-	-
65.5	-	-
34.66	-	-
Résultat Moyen:	34.66%	

Limite de liquidité							
Nombre de coups:	25	15	10	-	-	-	----
Masse totale humide:	6.59	7.55	7.56	-	-	-	g
Masse totale sèche:	4.95	5.54	5.51	-	-	-	g
Masse du contenant:	1.36	1.45	1.39	-	-	-	g
Masse du sol sec:	3.59	4.09	4.12	-	-	-	g
Teneur en eau:	45.68	49.14	49.76	-	-	-	%



Prélevé par: C.R.

Analysé par: A.M.

Vérifié par: N.J.

Date: 21/11/2015

Date: 26/11/2015

Date:

LIMITES D'ATTERBERG ASTM D 4318

Projet No.: L-15-1847
 Sondage No.: TF-15-01
 Échantillon No.: CF-02
 Date: 30/11/2015
 LJA No.: ---

Client: Brookfield Solutions Globales Intégrées Canada LP

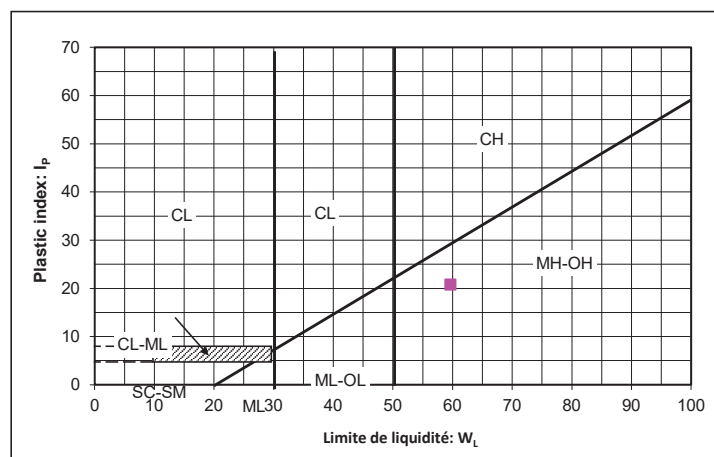
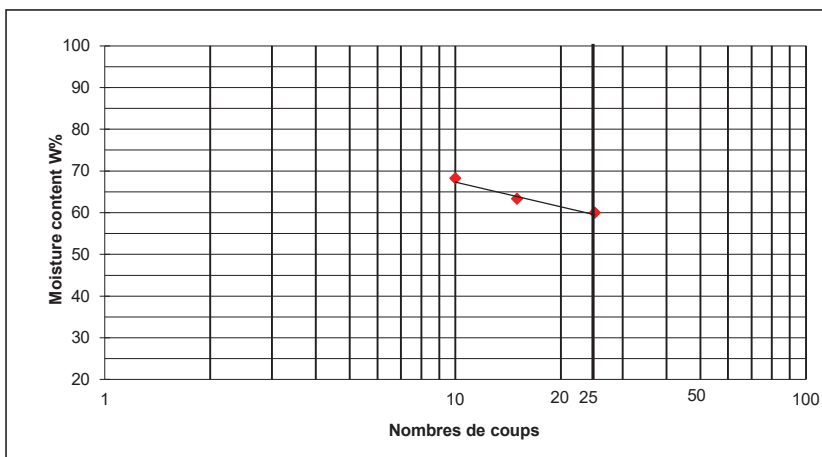
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 33.66 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 59.63 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 38.84 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 20.79 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ -0.2491 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	2.20	2.22	-
Masse totale sèche:	1.96	1.99	-
Masse du contenant:	1.35	1.39	-
Masse du sol sec:	0.61	0.60	-
Teneur en eau:	39.34	38.33	-
Résultat moyen:	38.84%		

Teneur en Eau Naturelle		
4	5	6
153.7	-	-
115.9	-	-
3.6	-	-
112.3	-	-
33.66	-	-
Résultat Moyen:	33.66%	

Limite de liquidité							
Nombre de coups:	25	15	10	-	-	-	----
Masse totale humide:	7.14	9.50	9.81	-	-	-	g
Masse totale sèche:	4.95	6.32	6.37	-	-	-	g
Masse du contenant:	1.30	1.30	1.33	-	-	-	g
Masse du sol sec:	3.65	5.02	5.04	-	-	-	g
Teneur en eau:	60.00	63.35	68.25	-	-	-	%



Prélevé par:C.R.

Analysé par:A.M.

Verifié par:N.J.

Date:21/11/2015

Date:26/11/2015

Date:

LIMITES D'ATTERBERG ASTM D 4318

Projet No.: L-15-1847
 Sondage No.: TF-15-01
 Échantillon No.: CF-03
 Date: 30/11/2015
 LJA No.: ---

Client: Brookfield Solutions Globales Intégrées Canada LP

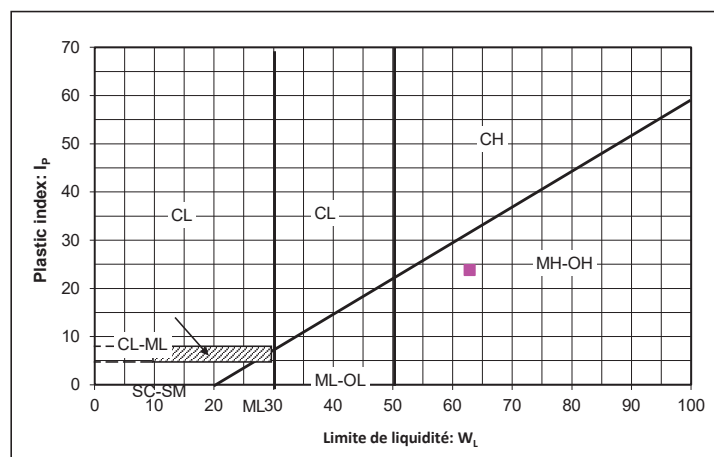
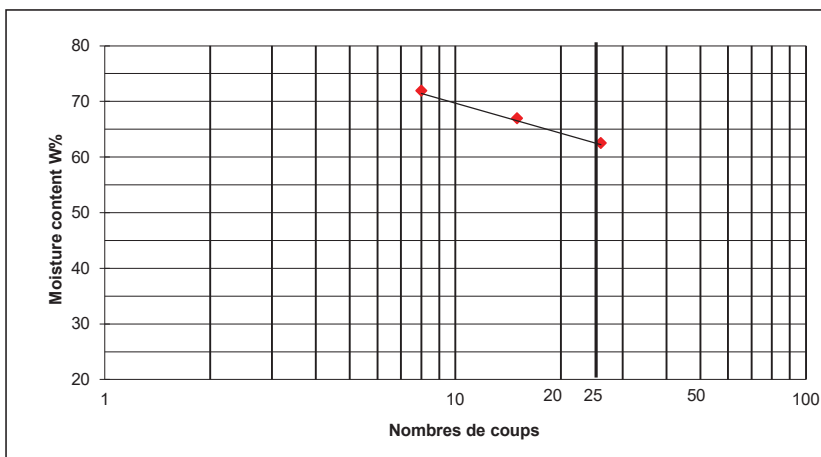
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 32.96 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 62.86 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 39.06 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 23.81 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ -0.2562 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	2.41	2.64	-
Masse totale sèche:	2.12	2.28	-
Masse du contenant:	1.35	1.39	-
Masse du sol sec:	0.77	0.89	-
Teneur en eau:	37.66	40.45	-
Résultat moyen:	39.06%		

Teneur en Eau Naturelle		
4	5	6
168.8	-	-
128	-	-
4.2	-	-
123.8	-	-
32.96	-	-
Résultat Moyen:	32.96%	

Limite de liquidité						
Nombre de coups:	26	15	8	-	-	----
Masse totale humide:	8.59	12.16	10.09	-	-	g
Masse totale sèche:	5.82	7.84	6.45	-	-	g
Masse du contenant:	1.39	1.39	1.39	-	-	g
Masse du sol sec:	4.43	6.45	5.06	-	-	g
Teneur en eau:	62.53	66.98	71.94	-	-	%



Prélevé par: C.R.	Analysé par: A.M.	Verifié par: N.J.
Date: 21/11/2015	Date: 26/11/2015	Date:

LIMITES D'ATTERBERG ASTM D 4318

Projet No.: L-15-1847
 Sondage No.: TF-15-01
 Échantillon No.: CF-04
 Date: 30/11/2015
 LJA No.: ---

Client: Brookfield Solutions Globales Intégrées Canada LP

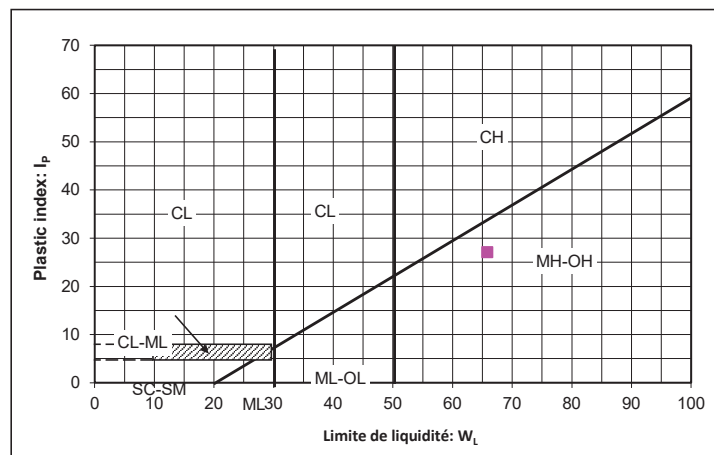
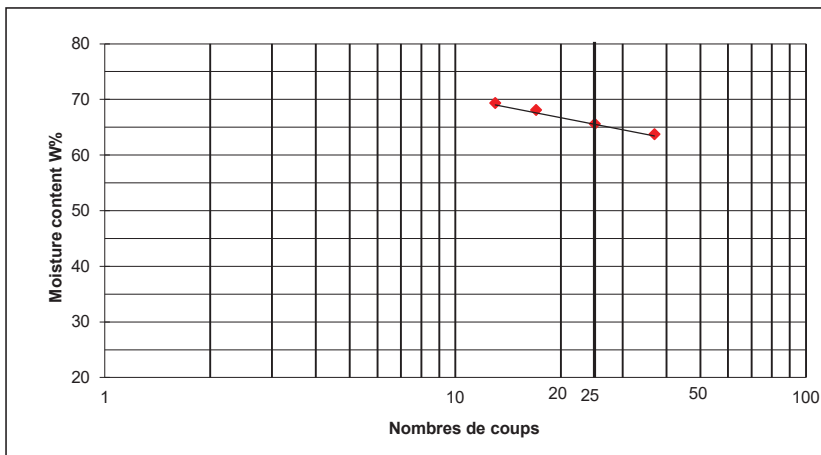
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 41.15 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 65.82 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 38.72 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 27.10 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ 0.08974 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	2.26	2.69	-
Masse totale sèche:	2.01	2.33	-
Masse du contenant:	1.39	1.36	-
Masse du sol sec:	0.62	0.97	-
Teneur en eau:	40.32	37.11	-
Résultat moyen:	38.72%		

Teneur en Eau Naturelle		
4	5	6
158.9	-	-
113.8	-	-
4.2	-	-
109.6	-	-
41.15	-	-
Résultat Moyen:	41.15%	

Limite de liquidité							
Nombre de coups:	37	25	17	13	-	-	----
Masse totale humide:	7.90	7.59	7.22	6.68	-	-	g
Masse totale sèche:	5.35	5.11	4.85	4.53	-	-	g
Masse du contenant:	1.35	1.33	1.37	1.43	-	-	g
Masse du sol sec:	4.00	3.78	3.48	3.10	-	-	g
Teneur en eau:	63.75	65.61	68.10	69.35	-	-	%



Prélevé par:C.R.

Analysé par:A.M.

Verifié par:N.J.

Date:21/11/2015

Date:26/11/2015

Date:

LIMITES D'ATTERBERG ASTM D 4318

Projet No.: L-15-1847
 Sondage No.: TF-15-01
 Échantillon No.: CF-06
 Date: 30/11/2015
 LJA No.: ---

Client: Brookfield Solutions Globales Intégrées Canada LP

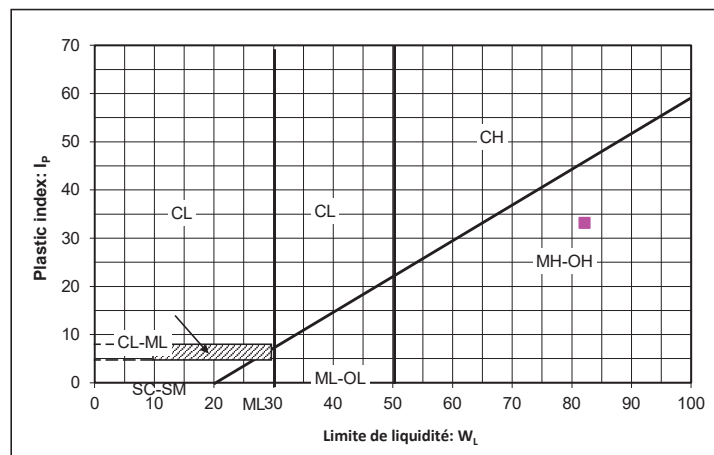
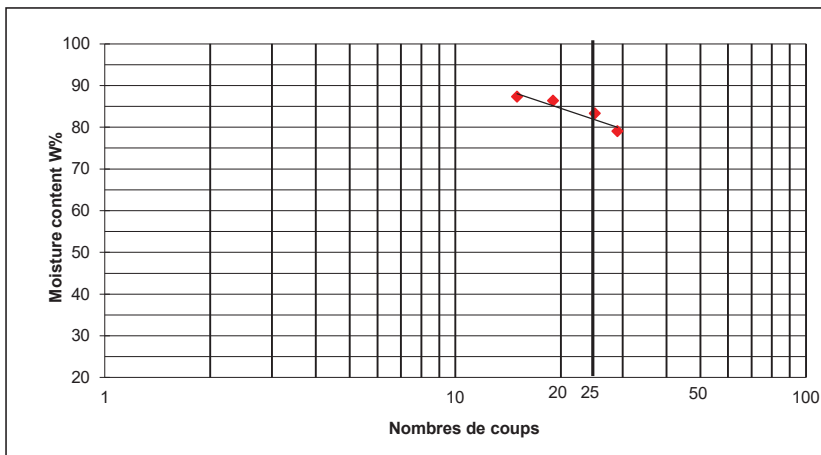
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 50.81 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 82.12 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 48.95 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 33.18 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ 0.0561 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	2.34	2.54	-
Masse totale sèche:	2.01	2.15	-
Masse du contenant:	1.33	1.36	-
Masse du sol sec:	0.68	0.79	-
Teneur en eau:	48.53	49.37	-
Résultat moyen:	48.95%		

Teneur en Eau Naturelle		
4	5	6
125.3	-	-
84.5	-	-
4.2	-	-
80.3	-	-
50.81	-	-
Résultat Moyen:	50.81%	

Limite de liquidité							
Nombre de coups:	29	25	19	15	-	-	----
Masse totale humide:	8.60	9.79	10.28	8.44	-	-	g
Masse totale sèche:	5.39	5.94	6.16	5.13	-	-	g
Masse du contenant:	1.33	1.32	1.39	1.34	-	-	g
Masse du sol sec:	4.06	4.62	4.77	3.79	-	-	g
Teneur en eau:	79.06	83.33	86.37	87.34	-	-	%



Prélevé par:C.R.

Analysé par:A.M.

Verifié par:N.J.

Date:21/11/2015

Date:26/11/2015

Date:

LIMITES D'ATTERBERG ASTM D 4318

Projet No.: L-15-1847
 Sondage No.: TF-15-01
 Échantillon No.: CF-07
 Date: 30/11/2015
 LJA No.: ---

Client: Brookfield Solutions Globales Intégrées Canada LP

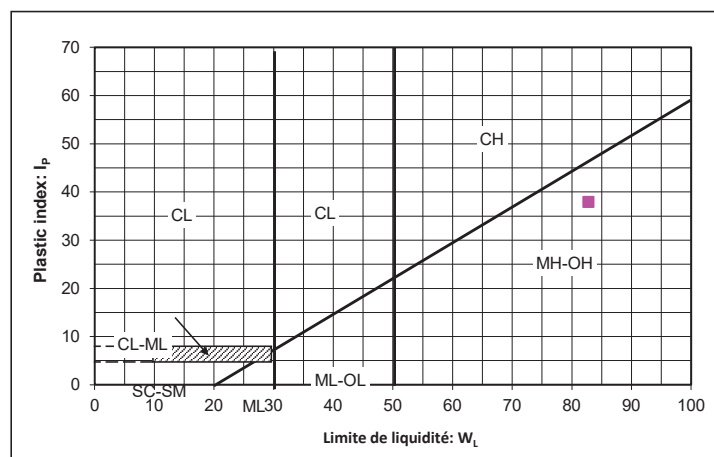
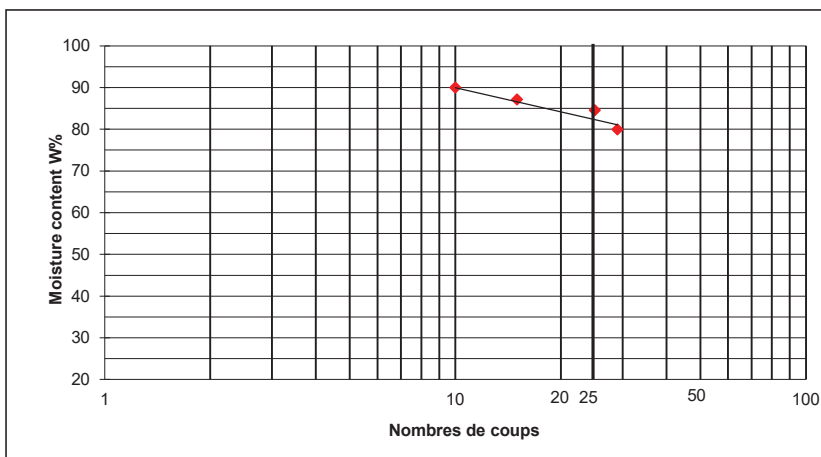
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 47.19 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 82.77 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 44.83 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 37.94 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ 0.06206 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	1.88	2.10	-
Masse totale sèche:	1.71	1.85	-
Masse du contenant:	1.31	1.32	-
Masse du sol sec:	0.40	0.53	-
Teneur en eau:	42.50	47.17	-
Résultat moyen:	44.83%		

Teneur en Eau Naturelle		
4	5	6
103.8	-	-
71.9	-	-
4.3	-	-
67.6	-	-
47.19	-	-
Résultat Moyen:	47.19%	

Limite de liquidité							
Nombre de coups:	29	25	15	10	-	-	----
Masse totale humide:	9.36	6.37	9.79	7.63	-	-	g
Masse totale sèche:	5.81	4.07	5.86	4.66	-	-	g
Masse du contenant:	1.37	1.35	1.35	1.36	-	-	g
Masse du sol sec:	4.44	2.72	4.51	3.30	-	-	g
Teneur en eau:	79.95	84.56	87.14	90.00	-	-	%



Prélevé par:C.R.

Analysé par:A.M.

Verifié par:N.J.

Date:21/11/2015

Date:26/11/2015

Date:

Client: Brookfield Solutions Globales Intégrées Canada LP

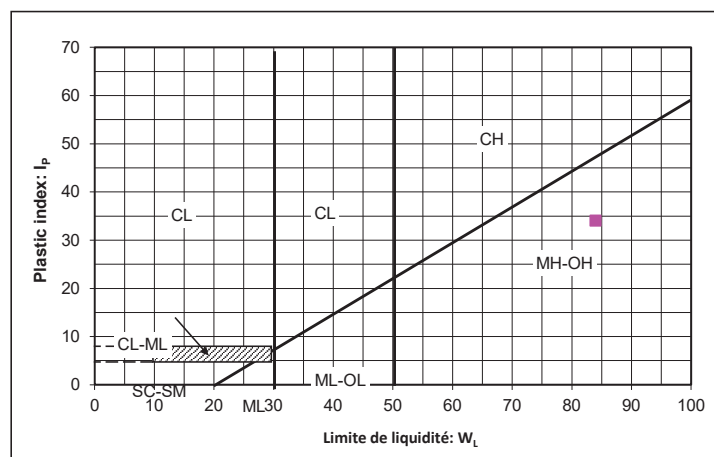
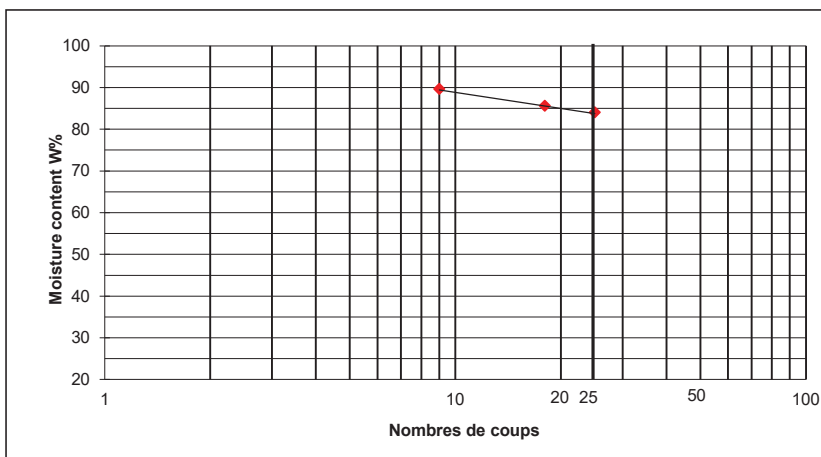
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 71.89 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 83.96 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 49.90 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 34.06 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ 0.64572 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	1.89	2.13	-
Masse totale sèche:	1.69	1.88	-
Masse du contenant:	1.31	1.35	-
Masse du sol sec:	0.38	0.53	-
Teneur en eau:	52.63	47.17	-
Résultat moyen:	49.90%		

Teneur en Eau Naturelle		
4	5	6
146.9	-	-
87.3	-	-
4.4	-	-
82.9	-	-
71.89	-	-
Résultat Moyen:	71.89%	

Limite de liquidité							
Nombre de coups:	25	18	9	-	-	-	----
Masse totale humide:	8.76	7.81	10.65	-	-	-	g
Masse totale sèche:	5.49	4.83	6.57	-	-	-	g
Masse du contenant:	1.60	1.35	2.02	-	-	-	g
Masse du sol sec:	3.89	3.48	4.55	-	-	-	g
Teneur en eau:	84.06	85.63	89.67	-	-	-	%



Prélevé par:C.R.

Analysé par:A.M.

Verifié par:N.J.

Date:21/11/2015

Date:26/11/2015

Date:

LIMITES D'ATTERBERG ASTM D 4318

Projet No.: L-15-1847
 Sondage No.: TF-15-01
 Échantillon No.: CF-09
 Date: 30/11/2015
 LJA No.: ---

Client: Brookfield Solutions Globales Intégrées Canada LP

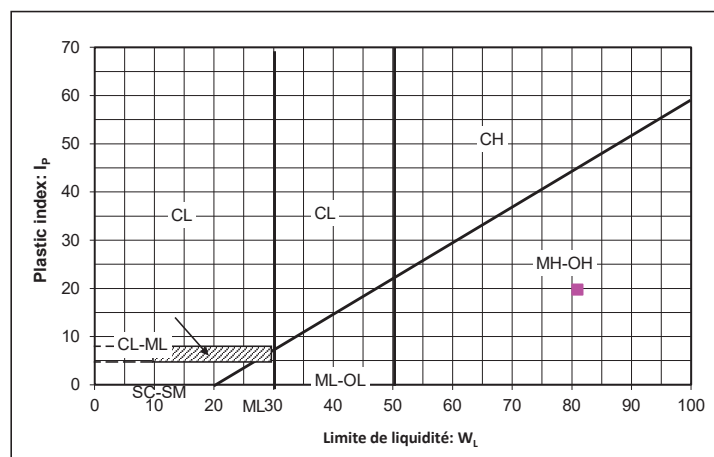
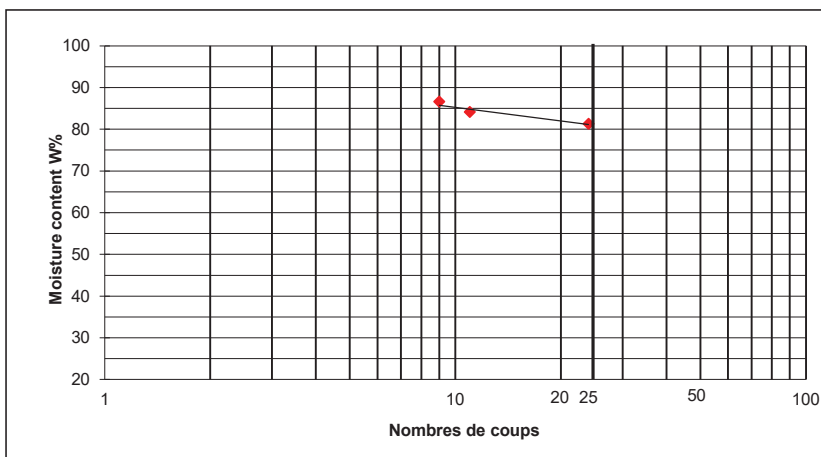
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 48.49 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 80.93 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 61.18 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 19.75 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ -0.6426 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	2.10	2.06	-
Masse totale sèche:	1.79	1.80	-
Masse du contenant:	1.31	1.35	-
Masse du sol sec:	0.48	0.45	-
Teneur en eau:	64.58	57.78	-
Résultat moyen:	61.18%		

Teneur en Eau Naturelle		
4	5	6
141.7	-	-
96.8	-	-
4.2	-	-
92.6	-	-
48.49	-	-
Résultat Moyen:	48.49%	

Limite de liquidité							
Nombre de coups:	24	11	9	-	-	-	----
Masse totale humide:	10.01	8.17	7.19	-	-	-	g
Masse totale sèche:	6.14	5.04	4.47	-	-	-	g
Masse du contenant:	1.38	1.32	1.33	-	-	-	g
Masse du sol sec:	4.76	3.72	3.14	-	-	-	g
Teneur en eau:	81.30	84.14	86.62	-	-	-	%



Prélevé par: C.R.

Analysé par: A.M.

Vérifié par: N.J.

Date: 21/11/2015

Date: 26/11/2015

Date:

LIMITES D'ATTERBERG ASTM D 4318

Projet No.: L-15-1847
 Sondage No.: TF-15-02
 Échantillon No.: ST-05
 Date: 05/01/2016
 LJA No.: ---

Client: Brookfield Solutions Globales Intégrées Canada LP

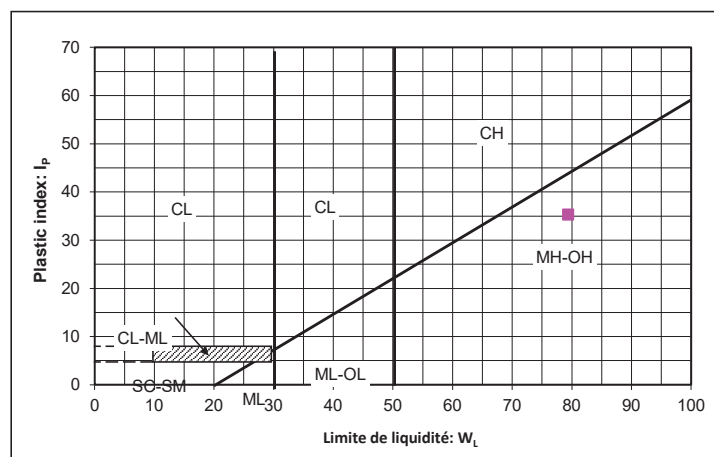
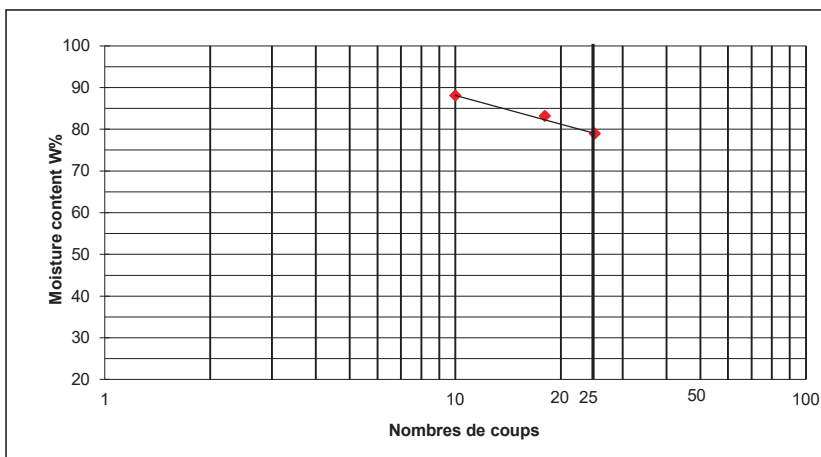
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 58.94 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 79.37 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 44.06 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 35.31 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ 0.42126 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	2.14	2.66	-
Masse totale sèche:	1.89	2.34	-
Masse du contenant:	1.34	1.59	-
Masse du sol sec:	0.55	0.75	-
Teneur en eau:	45.45	42.67	-
Résultat moyen:	44.06%		

Teneur en Eau Naturelle		
4	5	6
112.7	-	-
72.8	-	-
5.1	-	-
67.7	-	-
58.94	-	-
Résultat Moyen:	58.94%	

Limite de liquidité							
Nombre de coups:	25	18	10	-	-	-	----
Masse totale humide:	7.64	7.98	9.72	-	-	-	g
Masse totale sèche:	4.86	4.96	5.80	-	-	-	g
Masse du contenant:	1.34	1.33	1.35	-	-	-	g
Masse du sol sec:	3.52	3.63	4.45	-	-	-	g
Teneur en eau:	78.98	83.20	88.09	-	-	-	%



Prélevé par: C.R.	Analysé par: A.M.	Vérifié par: N.J.
Date: 21/11/2015	Date: 15/12/2015	Date:

LIMITES D'ATTERBERG ASTM D 4318

Projet No.: L-15-1847
 Sondage No.: TF-15-03
 Échantillon No.: ST-05
 Date: 05/01/2016
 LJA No.: ---

Client: Brookfield Solutions Globales Intégrées Canada LP

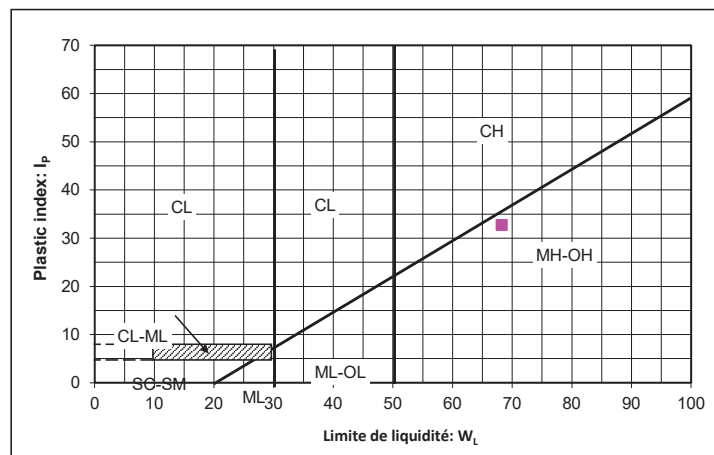
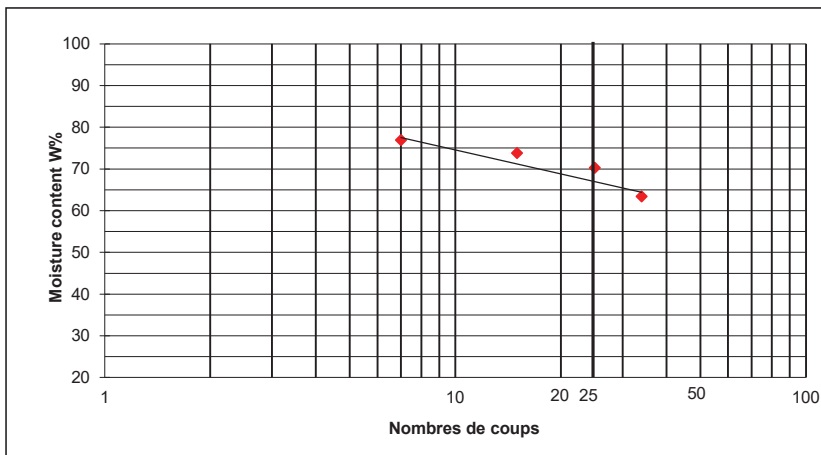
Projet: Étude géotechnique pour hanger sur le site de l'ASFC à Rigaud, Québec

Method	Results
Sans séchage: <input type="checkbox"/>	Teneur en eau naturelle: 51.25 W%
Séchage à l'air: <input checked="" type="checkbox"/>	Limite de liquidité: 68.23 W _L
Séchage au four: <input type="checkbox"/>	Limite de plasticité: 35.50 W _P
	Indice de plasticité: $I_P = W_L - W_P =$ 32.73 I _P
	Indice de liquidité: $I_L = (W - W_P) / I_P =$ 0.48107 I _L

Limite de plasticité			
Contenant No.:	1	2	3
Masse totale humide:	2.09	2.03	-
Masse totale sèche:	1.89	1.85	-
Masse du contenant:	1.35	1.32	-
Masse du sol sec:	0.54	0.53	-
Teneur en eau:	37.04	33.96	-
Résultat moyen:	35.50%		

Teneur en Eau Naturelle		
4	5	6
46.8	-	-
32.4	-	-
4.3	-	-
28.1	-	-
51.25	-	-
Résultat Moyen:	51.25%	

Limite de liquidité							
Nombre de coups:	34	25	15	7	-	-	----
Masse totale humide:	6.75	6.85	5.83	9.37	-	-	g
Masse totale sèche:	4.67	4.58	3.97	5.87	-	-	g
Masse du contenant:	1.39	1.35	1.45	1.32	-	-	g
Masse du sol sec:	3.28	3.23	2.52	4.55	-	-	g
Teneur en eau:	63.41	70.28	73.81	76.92	-	-	%



Prélevé par:C.R.

Analysé par:A.M.

Verifié par:N.J.

Date:21/11/2015

Date:15/12/2015

Date:

ANNEXE E

Résultats Des Essais de Chargement



JOURNEAUX ASSOC
Division LAB JOURNEAUX INC.

Tel.: (514) 630-4997

Fax.: (514) 630-8937

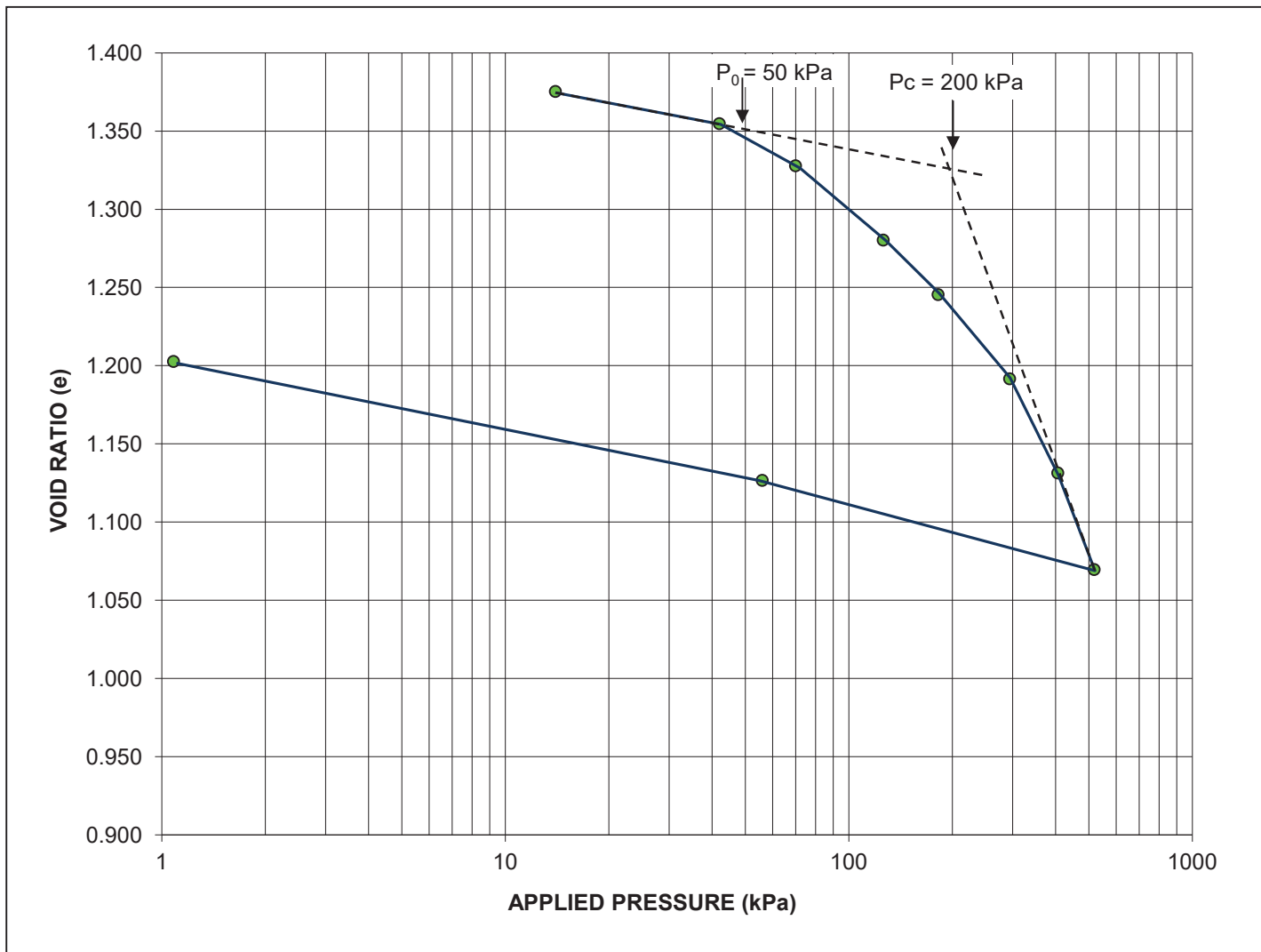
**ONE DIMENSIONAL
CONSOLIDATION
TEST**

Client: **Brookfield Solutions Globales Intégrées Ca**
Projet No.: **L-15-1847**
Projet : **Étude géotechnique pour hanger sur le site**
Date: **04/12/15**

Forage: **TF-02**
Profondeur : **3 m**

Échantillons: **TS-5**
Description: **Argile Silteux Grise**

Date de forage: **21/11/15**



LL : **79**
PI : **44**

Cu : **kPa**

TEST SUMMARY

	SAMPLE CHARACTERISTICS		COMPRESSIBILITY PROPERTIES	
	INITIAL STATE	FINAL STATE		
w	48.54 %	44.75 %	σ_p' : Consolidation pressure	200 kPa
γ	16.56 kN/m³	16.58 kN/m³	σ_{vo}' : Vertical effective stress	50 kPa
γ_d	11.15 kN/m³	11.46 kN/m³	$\sigma_p' - \sigma_{vo}'$: Overconsolidation difference	150 kPa
Sr	95.29 %	92.09 %	Cv: Coefficient of consolidation	m²/s
e	1.375	1.131	Cmv: Coefficient of compressibility	N/A kPa⁻¹
			COMPRESSION INDEX	
Dr	estimated	measured		
DIMENSIONS				
Dia. (cm) 6.350 Height (cm) 1.905			C _i : compression Index	

Sampled by: C.R & S. K.

Date: 15-11-21

Analysed by: N. Journeaux

Date: 15-12-04

**ONE DIMENSIONAL
CONSOLIDATION
TEST**

 Client: **Brookfield Solutions Globales Intégrées Ca**

 Project No.: **L-15-1847**

 Project : **Étude géotechnique pour hanger sur le site**

 Date: **04/12/15**

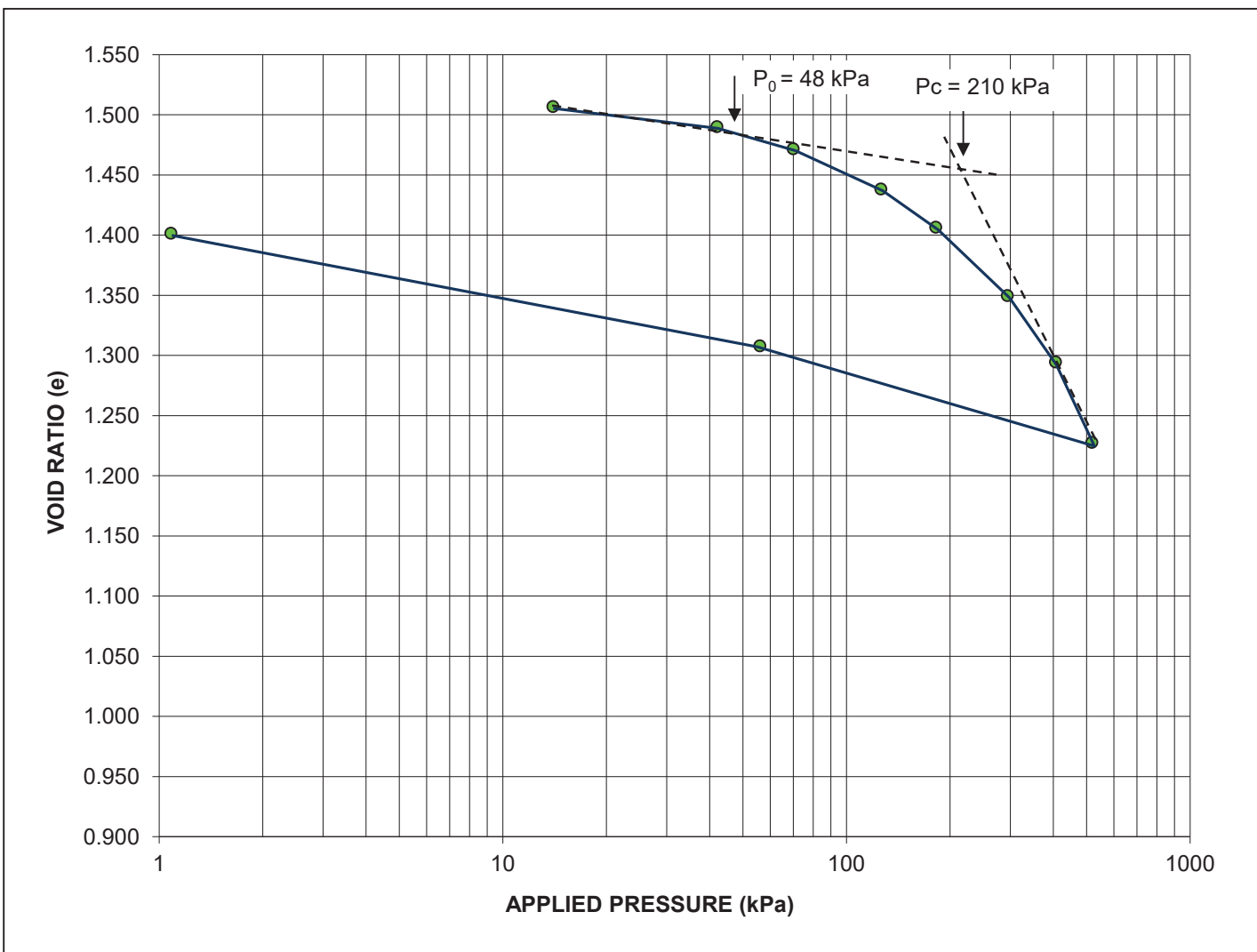
 Forage: **TF-03**

 Échantillons: **TS-5**

 Date de forage: **21/11/15**

Profondeur :

3 m

 Description: **Argile Silteux Grise**

 LL : **70**

 Cu : **kPa**

 PI : **36**
TEST SUMMARY

	SAMPLE CHARACTERISTICS		COMPRESSIBILITY PROPERTIES	
	INITIAL STATE	FINAL STATE		
w	52.15 %	50.00 %	σ_p' : Consolidation pressure	210 kPa
γ	16.08 kN/m³	16.38 kN/m³	σ_{vo}' : Vertical effective stress	48 kPa
γ_d	10.57 kN/m³	10.92 kN/m³	$\sigma_p' - \sigma_{vo}'$: Overconsolidation difference	162 kPa
Sr	93.44 %	94.73 %	Cv: Coefficient of consolidation	m ² /s
e	1.507	1.228	Cmv: Coefficient of compressibility	N/A kPa⁻¹
			COMPRESSION INDEX	
Dr	estimated	measured		
DIMENSIONS				
Dia. (cm) 6.350 Height (cm) 1.905			C _i : compression Index	

Sampled by: C.R & S. K.

Date: 15-11-21

Analysed by : N. Journeaux

Date: 15-12-04

ANNEXE F

Certificat Des Analyses Chimiques- Environnement

Certificat d'analyse

N° BON DE TRAVAIL: 15M047708

N° DE PROJET:

9770 ROUTE TRANSCANADIENNE
ST. LAURENT, QUEBEC
CANADA H4S 1V9
TEL (514)337-1000
FAX (514)333-3046
<http://www.agatlabs.com>

NOM DU CLIENT: JOURNEAUX ASSOC (DIV. DE LAB JOURNE

PRÉLEVÉ PAR:

À L'ATTENTION DE: Noel Joumeaux

LIEU DE PRÉLÈVEMENT:

Hydrocarbures aromatiques polycycliques (HAP) (sol)

DATE DE RÉCEPTION: 2015-11-27

DATE DU RAPPORT: 2015-12-03

IDENTIFICATION DE L'ÉCHANTILLON: F1-15-1847 1.5 F2-15-1847 3' F4-15-1847 2'											
		MATRICE: Sol					Sol		Sol		
		DATE D'ÉCHANTILLONNAGE: 2015-11-27					2015-11-27		2015-11-27		
Paramètre	Unités	C / N: A	C / N: B	C / N: C	C / N: D	LDR	7241155	7241159	7241160		
Acénaphène	mg/kg	0.1	10	100	100	0.1	<0.1	<0.1	<0.1		
Acénaphthylène	mg/kg	0.1	10	100	100	0.1	<0.1	<0.1	<0.1		
Anthracène	mg/kg	0.1	10	100	100	0.1	<0.1	<0.1	<0.1		
Benzo(a)anthracène	mg/kg	0.1	1	10	34	0.1	<0.1	<0.1	<0.1		
Benzo(a)pyrène	mg/kg	0.1	1	10	34	0.1	<0.1	<0.1	<0.1		
Benzo (b) fluoranthène	mg/kg	0.1	1	10	-	0.1	<0.1	<0.1	<0.1		
Benzo (j) fluoranthène	mg/kg	0.1	1	10	-	0.1	<0.1	<0.1	<0.1		
Benzo (k) fluoranthène	mg/kg	0.1	1	10	-	0.1	<0.1	<0.1	<0.1		
Benzo(c)phénanthrène	mg/kg	0.1	1	10	56	0.1	<0.1	<0.1	<0.1		
Benzo(g,h,i)pérylène	mg/kg	0.1	1	10	18	0.1	<0.1	<0.1	<0.1		
Chrysène	mg/kg	0.1	1	10	34	0.1	<0.1	<0.1	<0.1		
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	82	0.1	<0.1	<0.1	<0.1		
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	34	0.1	<0.1	<0.1	<0.1		
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	34	0.1	<0.1	<0.1	<0.1		
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	34	0.1	<0.1	<0.1	<0.1		
Diméthyl-7,12benzo(a)anthracène	mg/kg	0.1	1	10	34	0.1	<0.1	<0.1	<0.1		
Fluoranthène	mg/kg	0.1	10	100	100	0.1	<0.1	<0.1	<0.1		
Fluorène	mg/kg	0.1	10	100	100	0.1	<0.1	<0.1	<0.1		
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	34	0.1	<0.1	<0.1	<0.1		
Méthyl-3cholantrène	mg/kg	0.1	1	10	150	0.1	<0.1	<0.1	<0.1		
Naphtalène	mg/kg	0.1	5	50	56	0.1	<0.1	<0.1	<0.1		
Phénanthrène	mg/kg	0.1	5	50	56	0.1	<0.1	<0.1	<0.1		
Pyrène	mg/kg	0.1	10	100	100	0.1	<0.1	<0.1	<0.1		
Méthyl-1naphtalène	mg/kg	0.1	1	10	56	0.1	<0.1	<0.1	<0.1		
Méthyl-2naphtalène	mg/kg	0.1	1	10	56	0.1	<0.1	<0.1	<0.1		
Diméthyl-1,3naphtalène	mg/kg	0.1	1	10	56	0.1	<0.1	<0.1	<0.1		
Triméthyl-2,3,5naphtalène	mg/kg	0.1	1	10	56	0.1	<0.1	<0.1	<0.1		

Certifié par:



La procédure des Laboratoires AGAT concernant les signatures et les signataires se conforme strictement aux exigences d'accréditation ISO 17025:2005 comme le requiert, lorsque applicable, CALA, CCN et MDEFP. Toutes les signatures sur les certificats d'AGAT sont protégées par des mots de passe et les signataires rencontrent les exigences des domaines d'accréditation ainsi que les exigences régionales approuvées par CALA, CCN et MDEFP.

AGAT CERTIFICAT D'ANALYSE

Page 2 de 7

Cette version remplace et annule toute version, le cas échéant. Ce document ne doit pas être reproduit, sinon en entier, sans l'autorisation écrite du laboratoire. Les résultats ne se rapportent qu'aux échantillons soumis pour analyse.



Certificat d'analyse

N° BON DE TRAVAIL: 15M047708

N° DE PROJET:

9770 ROUTE TRANSCANADIENNE
ST. LAURENT, QUEBEC
CANADA H4S 1V9
TEL (514)337-1000
FAX (514)333-3046
<http://www.agatlabs.com>

NOM DU CLIENT: JOURNEAUX ASSOC (DIV. DE LAB JOURNE

PRÉLEVÉ PAR:

À L'ATTENTION DE: Noel Joumeaux

LIEU DE PRÉLÈVEMENT:

Hydrocarbures aromatiques polycycliques (HAP) (sol)

DATE DE RÉCEPTION: 2015-11-27

DATE DU RAPPORT: 2015-12-03

IDENTIFICATION DE L'ÉCHANTILLON: F1-15-1847 1.5 F2-15-1847 3' F4-15-1847 2'

MATRICE: Sol Sol Sol

DATE D'ÉCHANTILLONNAGE: 2015-11-27 2015-11-27 2015-11-27

Étalon de recouvrement	Unités	Limites	7241155	7241159	7241160
Acénaphthène-D10	%	40-140	99	111	106
Fluoranthène-D10	%	40-140	108	104	105
Pérylène-D12	%	40-140	87	82	76

Commentaires: LDR - Limite de détection rapportée; C / N - Critères Normes: A se réfère QC PTC (Critère A), B se réfère QC PTC (Critère B), C se réfère QC PTC (Critère C), D se réfère QC RESC (Annexe 1)

Certifié par:



Félix Bessier

La procédure des Laboratoires AGAT concernant les signatures et les signataires se conforme strictement aux exigences d'accréditation ISO 17025:2005 comme le requiert, lorsque applicable, CALA, CCN et MDDEFP. Toutes les signatures sur les certificats d'AGAT sont protégées par des mots de passe et les signataires rencontrent les exigences des domaines d'accréditation ainsi que les exigences régionales approuvées par CALA, CCN et MDDEFP.

AGAT CERTIFICAT D'ANALYSE

Page 3 de 7

Cette version remplace et annule toute version, le cas échéant. Ce document ne doit pas être reproduit, sinon en entier, sans l'autorisation écrite du laboratoire. Les résultats ne se rapportent qu'aux échantillons soumis pour analyse.



Certificat d'analyse

N° BON DE TRAVAIL: 15M047708

N° DE PROJET:

9770 ROUTE TRANSCANADIENNE
ST. LAURENT, QUEBEC
CANADA H4S 1V9
TEL (514)337-1000
FAX (514)333-3046
<http://www.agatlabs.com>

NOM DU CLIENT: JOURNEAUX ASSOC (DIV. DE LAB JOURNE

PRÉLEVÉ PAR:

À L'ATTENTION DE: Noel Joumeaux

LIEU DE PRÉLÈVEMENT:

Hydrocarbures pétroliers C10-C50 (sol)

DATE DE RÉCEPTION: 2015-11-27

DATE DU RAPPORT: 2015-12-04

IDENTIFICATION DE L'ÉCHANTILLON: F1-15-1847 1.5 F2-15-1847 3' F4-15-1847 2'

MATRICE: Sol Sol Sol

DATE D'ÉCHANTILLONNAGE: 2015-11-27 2015-11-27 2015-11-27

Paramètre	Unités	C / N: A	C / N: B	C / N: C	C / N: D	LDR	7241155	7241159	7241160
Hydrocarbures pétroliers C10 à C50	mg/kg	300	700	3500	10000	100	<100	<100	<100

Étalon de recouvrement	Unités	Limites							
Nonane	%	40-140					101	106	102

Commentaires: LDR - Limite de détection rapportée; C / N - Critères Normes: A se réfère QC PTC (Critère A), B se réfère QC PTC (Critère B), C se réfère QC PTC (Critère C), D se réfère QC RESC (Annexe 1)

Certifié par:



Felix Bessier

La procédure des Laboratoires AGAT concernant les signatures et les signataires se conforme strictement aux exigences d'accréditation ISO 17025:2005 comme le requiert, lorsque applicable, CALA, CCN et MDDEFP. Toutes les signatures sur les certificats d'AGAT sont protégées par des mots de passe et les signataires rencontrent les exigences des domaines d'accréditation ainsi que les exigences régionales approuvées par CALA, CCN et MDDEFP.

AGAT CERTIFICAT D'ANALYSE

Page 4 de 7

Cette version remplace et annule toute version, le cas échéant. Ce document ne doit pas être reproduit, sinon en entier, sans l'autorisation écrite du laboratoire. Les résultats ne se rapportent qu'aux échantillons soumis pour analyse.



JOURNEAUX ASSOC

Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6

T (514) 630-4997 F (514) 630-8937

APPENDIX 2

VÉRIFICATION DE LA CAPACITÉ PORTANTE DES SOLS POUR L'AGRANDISSEMENT DU CHENIL ET LA CONSTRUCTION D'UN HANGAR DE FORMATION COLLÈGE DES DOUANES CANADA RIGAUD, QUÉBEC

Mémoire Technique
L-20-2253
27 avril 2020



TABLE DE MATIÈRES

1	INTRODUCTION.....	1
2	RAPPORTS ET INFORMATION FOURNIS.....	1
3	NATURE ET PROPRIÉTÉS DES SOLS EN PLACE.....	2
4	CONDITIONS DE L'EAU SOUTERRAINE	3
5	CAPACITÉ PORTANTE	4
5.1	Hypothèses de calcul.....	4
5.1.1	Hypothèses géotechniques.....	4
5.2	Capacité portante de la fondation des semelles en états limites	5
5.2.1	État limite ultime de portance (ÉLUL) (Manuel Canadien d'Ingénierie des Fondations).5	
5.2.2	État limite de tenue en service (ÉLUT)	6
6	DISCUSSION	12
6.1	Effet d'interférence de semelles étroitement espacées	12
6.2	Dimensionnement et profondeur des semelles isolées.....	13
7	RÉFÉRENCES - BIBLIOGRAPHIE	13

Tableaux

Tableau 3-1: Résumé des résultats des essais de consolidations	3
Tableau 5-1: Résumé des paramètres et propriétés utilisés dans les calculs de la capacité portante à l'ÉLUL	4
Tableau 5-2: Capacité portante à l'état limite ultime (ÉLUL) pour semelles carrées encastrées à une profondeur $D_f = 1,5$ m.....	5
Tableau 5-3: Capacité portante à l'état limite ultime (ÉLUL) pour semelles carrées encastrées à une profondeur $D_f = 2,65$ m.....	5
Tableau 5-4: La capacité portante à l'état limite de tenue en service (ÉLUT) pour semelles carrées encastrées à une profondeur $D_f = 1,5$ m	6
Tableau 5-5: La capacité portante à l'état limite de tenue en service (ÉLUT) pour semelle carrée encastrée à une profondeur $D_f = 2,65$ m	6

Figures

Figure 5-1: Variation des contraintes par rapport à la profondeur causée par une charge de 350 kPa appliquée sur une semelle carrée de 1,0 m x 1,0 m encastrée à une profondeur 1,5 m	7
Figure 5-2: Variation des contraintes par rapport à la profondeur causée par une charge de 140 kPa appliquée sur une semelle carrée de 2,0 m x 2,0 m encastrée à une profondeur 1,5 m	8
Figure 5-3: Variation des contraintes par rapport à la profondeur causée par une charge de 120 kPa appliquée sur une semelle carrée de 2,5 m x 2,5 m encastrée à une profondeur 1,5 m	9
Figure 5-4: Variation des contraintes par rapport à la profondeur causée par une charge de 85 kPa appliquée sur une semelle carrée de 3,0 m x 3,0 m encastrée à une profondeur 1,5 m	10

Figure 5-5: Variation des contraintes par rapport à la profondeur causée par une charge de 70 kPa appliquée sur une semelle carrée de 3,0 m x 3,0 m encastrée à une profondeur 2,65 m	11
Figure 6-1: Effet d'interférence de semelles étroitement espacées	12

Annexes

ANNEXE A Extrait des rapports de forages pertinents

ANNEXE B Graphiques des essais de consolidations

1 INTRODUCTION

Les services de Journeaux Assoc. (Lab. Journeaux Inc.) ont été retenus par Stantec afin de vérifier les paramètres géotechniques fournis dans les études antérieures préparées par Terratech en 2009, Journeaux Assoc. en 2016 et Englobe en 2019 afin de confirmer la résistance géotechnique ‘la capacité portante’ des fondations peu profonde du projet d’agrandissement du chenil qui inclut la construction d’un hangar de formation du collège des douanes Canada à Rigaud, Québec.

Le but de cette étude est de confirmer la résistance géotechnique ‘la capacité portante’ pour le dimensionnement et la profondeur des fondations isolées fournies pour la conception structurale du bâtiment (niveau du terrain naturel et niveau du dessous des semelles).

2 RAPPORTS ET INFORMATION FOURNIS

Dans la préparation de ce mémorandum technique, les rapports suivants, fournis par Stantec, ont été consultés :

- 1- **Terratech 2009** : Rapport T-1779 (605898), *Étude géotechnique et d’échantillonnage environnemental des sols, développement du centre d’apprentissage de Rigaud (ASFC) Rigaud, Québec.*
- 2- **Journeaux Assoc. 2016** : Rapport L-15-1847, *Étude géotechnique, chenil-construction d’un hangar 475 chemin Grande-Ligne, Rigaud, Québec.*
- 3- **Englobe 2019** : Rapport 025-P-0019200-0-01-001-GE-R-000100, *Étude géotechnique et caractérisation environnementale sommaire des sols, implantation d’un nouveau hangar et agrandissement du chenil de l’ASFC collège des douanes, 475 chemin de la Grande Ligne, Rigaud, Québec.*
- 4- Une copie des plans de structure préliminaire complétés à 50% tel que mentionné dans le courriel de M. Michaud de Stantec daté du 2 mars, 2020. L’information à retenir est que le niveau du terrain fini est à l’élévation 47,45 m et que le niveau de dessous des semelles à

l'élévation 45,95 m soit 1,5 m de profondeur pour la majorité des semelles. À l'exception, le niveau de dessous des semelles qui se trouvent à l'avant du bâtiment, pour la rampe qui mènera à la voie d'accès, est à l'élévation de 44,80 m soit à 2,65 m de profondeur.

- 5- Selon de l'information reçue, les charges maximales venant des colonnes du bâtiment sont :
en État Limite Ultime = 1100 kN et en État Limite de Service = 750 kN.

3 NATURE ET PROPRIÉTÉS DES SOLS EN PLACE

Selon les rapports des études géotechniques consultés (section 2 du présent memorandum), la stratigraphie du sol en place dans le secteur de l'étude est presque que homogène. Les différentes couches du sol rencontrées dans le secteur d'étude et leur épaisseur se résument comme suit:

- Terre végétale ou remblai. L'épaisseur de cette couche varie jusqu'à 0,6 m.
- Argile silteuse desséchée de couleur brune (croûte) d'épaisseur variant de 1,8 m à 5,0 m. L'élévation du dessus de cette couche varie de la surface 47,0 à 46,3 m. La consistance de cette couche est très raide en surface avec une résistance au cisaillement non drainé d'environ 220 kPa diminuant jusqu'à 110 kPa à environ 2,5 m de profondeur.
- Sous la croûte, l'argile silteuse devient de couleur grise sous la nappe d'eau. L'épaisseur de cette couche varie de 3,5 m à 5,5 m. L'élévation du dessus de cette couche varie de 44,90 à 41,40 m. La résistance au cisaillement non drainée de cette couche diminue de 110 kPa jusqu'à 44 kPa en profondeur.
- Till (mélange de silt, sable et gravier) est rencontré à une profondeur variant de 7 à 10 m soit à l'élévation du dessus de la couche de till varie de 39,9 m à 36,9 m. La compacité de cette couche est compacte à dense avec ($N = 25 - 34$ coups).

Des essais de consolidation ont été réalisés dans les études de Terratech (4 essais) et de Journeaux Assoc. (2 essais). Les résultats de ces essais sont résumés dans le Tableau 3-1 suivant :

Tableau 3-1: Résumé des résultats des essais de consolidations

RAPPORT	PROF. (m)	FORAGE	INDICE DE VIDES INITIAL	INDICE DE RECOMPRESSION C _{cr}	Mort-Terrain (P _o) kPa	PRÉCONS. (P _c) kPa
JOURNEAUX ASSOC. (2016)	3,00	TF-15-02	1,375	0,045	50	200
	3,00	TF-15-03	1,507	0,048	48	210
TERRATECH (2009)	4,20	F-6-08	1,831	0,036	65	200
	4,95	F-1-08	1,689	0,039	80	170
	6,45	F-1-08	2,114	0,040	100	180
	6,50	F-6-08	2,015	0,026	100	145

Selon les essais de consolidation l'argile brune desséchée est fortement sur-consolidée avec une charge de préconsolidation variant de 170 kPa à 200 kPa suivi de la couche d'argile grise sur-consolidée à 145 kPa à la profondeur de 6,5 m.

4 CONDITIONS DE L'EAU SOUTERRAINE

Les niveaux de l'eau souterraine mesurés et rapportés dans les trois (3) études géotechniques réalisées sont présentés dans le Tableau 4-1. Selon le rapport de Terratech (2009), le niveau d'eau dans le ruisseau près du coin sud-est du site était à l'élévation de 35,9 m le 17 novembre 2008.

Tableau 4-1: Résumé des niveaux de l'eau souterraine mesurés

RAPPORT	FORAGE	DATE	ÉL. SURFACE DU TERRAIN (m)	PROF. EAU SOUTERRAINE (m)	ÉL. EAU SOUTERRAINE (m)
ENGLOBE (2019)	TF-02-19	6 Août 2019	47,4	5,6	41,8
JOURNEAUX ASSOC (2016)	TF-15-01	21 Nov. 2015	47.0	2,4	44,6
		11 Déc. 2015		1,8	45,2
	TF-15-02	21 Nov. 2015	47.0	2,4	44,6
		11 Déc. 2015		0,2	46,8
	TF-15-03	21 Nov. 2015	47.0	2,4	44,6
		11 Déc. 2015		0,2	46,8
	TF-15-04	21 Nov. 2015	47.0	1,2	45,8
		11 Déc. 2015		1,0	46
TERRATECH (2009)	F-7-08	2 Déc. 2008	46,5	0,7	45,8
	F-6-08	2 Déc. 2008	47,0	7,3	39,7

Il est à noter que le niveau de l'eau souterraine peut varier avec les saisons et les années. Généralement, l'hypothèse que le niveau d'eau est à une profondeur de 3,0 m sous la surface du sol naturel est considérée dans les calculs.

5 CAPACITÉ PORTANTE

Le projet consiste à l'agrandissement du chenil et à la construction d'un nouveau hangar de formation du collège des douanes.

Les hypothèses et les recommandations présentées dans les paragraphes suivants sont basées sur les résultats des essais en laboratoire et les informations fournies dans les trois (3) études géotechniques réalisées dans le secteur où le projet sera construit, ainsi que les informations de conception structurale fournies par Stantec.

5.1 Hypothèses de calcul

5.1.1 Hypothèses géotechniques

Les paramètres et les propriétés mécaniques de la couche d'argile silteuse où les semelles de la structure seraient assises utilisés dans les calculs sont résumés dans le Tableau 5-1.

Tableau 5-1: Résumé des paramètres et propriétés utilisés dans les calculs de la capacité portante à l'ÉLUL

PARAMÈTRES	VALEURS
Angle effectif de frottement interne (ϕ')	0°
Cohésion (C)	114 - 68 kPa
Poids volumique (γ)	19 kN/m ³
Coefficient de portance pour la cohésion (N_c)	5,14
Coefficient de portance pour la pression des terres (N_q)	1,0
Coefficient de portance pour le poids du sol (N_γ)	0

5.2 Capacité portante de la fondation des semelles en états limites

5.2.1 État limite ultime de portance (ÉLUL) (Manuel Canadien d'Ingénierie des Fondations).

Le but du calcul de la capacité portante de la fondation est de vérifier que la fondation peut supporter la charge de la structure construite sur le sol support.

Pour ce cas, la capacité portante est calculée par la formule suivante :

$$R_n = 0.5 * (c * N_c * S_c + q_s * N_q * S_q + 0.5 * \gamma * B * N_\gamma * S_\gamma)$$

où

R_n = résistance géotechnique pondérée, kPa

Φ = Facteur de résistance géotechnique = 0.5

N_c, N_q, N_γ = facteurs de capacité portante

S_c, S_q, S_γ = facteurs pour tenir compte de la forme, de l'inclinaison, de la profondeur de la semelle et de la pente du sol

q_s = contrainte verticale appliquée au niveau de la fondation, kPa

B = largeur de la fondation, m

c = cohésion du sol, kPa

γ = poids volumique du sol, kN/m³

Les calculs ont été effectués en tenant compte des deux profondeurs où les semelles seront encastrées soient des profondeurs D_f de 1,5 m et 2,65 m.

Les Tableaux 5-2 et 5-3 résument la capacité portante à l'état limite ultime (ÉLUL) des semelles carrées de dimensions 1,0 m x 1,0 m; 2,0 m x 2,0 m; 2,5 m x 2,5 m et 3,0 m x 3,0 m encastrées à une profondeur de 1,5 m et encastrée à une profondeur de 2,65 m, respectivement.

Tableau 5-2: Capacité portante à l'état limite ultime (ÉLUL) pour semelles carrées encastrées à une profondeur $D_f = 1,5$ m

	SEMELLE CARRÉE			
Largeur	1,0 m x 1,0 m	2,0 m x 2,0 m	2,5 m x 2,5 m	3,0 m x 3,0 m
ÉLUL (kPa)	860	770	665	600
ÉLUL Pondérée (kPa)	430	385	330	300

Note : Facteur de 0,5 est utilisé pour l'ÉLUL pondérée

Tableau 5-3: Capacité portante à l'état limite ultime (ÉLUL) pour semelles carrées encastrées à une profondeur $D_f = 2,65$ m

	SEMELLE CARRÉE			
Largeur	1,0 m x 1,0 m	2,0 m x 2,0 m	2,5 m x 2,5 m	3,0 m x 3,0 m
ÉLUL (kPa)	1060	675	610	600
ÉLUL Pondérée (kPa)	530	335	305	300

Note : Facteur de 0,5 est utilisé pour l'ÉLUL pondérée

5.2.2 État limite de tenue en service (ÉLUT)

La capacité portante à l'état limite de tenue en service (ÉLUT) est établie de façon à maintenir les tassements totaux à moins de 25 mm et les tassements différentiels à moins de 20 mm. Ceci a été estimé à l'aide de la théorie de consolidation avec les paramètres présentés dans le Tableau 3-1 obtenus des essais de consolidation en laboratoire.

Les Figures 5-1 à 5-4 présente la charge du mort terrain, la charge du mort terrain avec une couche de remblai de 0,6 m et la variation des contraintes par rapport à la profondeur pour des charges appliquées sur des semelles carrées de dimensions 1,0 m x 1,0 m; 2,0 m x 2,0 m; 2,5 m x 2,5 m et 3,0 m x 3,0 m, respectivement. Les semelles sont encastrées à une profondeur de 1,5 m.

La Figure 5-5 présente la charge du mort terrain, la charge du mort terrain avec une couche de remblai de 0,6 m et la variation des contraintes par rapport à la profondeur pour charge de 70 kPa appliquée sur une semelle carrée de dimension 3,0 m x 3,0 m encastrée à une profondeur de 2,65 m.

Les Tableaux 5-4 et 5-5 résument la capacité portante à l'état limite de tenue en service (ÉLUT) des semelles carrées de dimensions 1,0 m x 1,0 m; 2,0 m x 2,0 m; 2,5 m x 2,5 m et 3,0 m x 3,0 m encastrées à une profondeur de 1,5 m et à une profondeur de 2,65 m, respectivement.

Tableau 5-4: La capacité portante à l'état limite de tenue en service (ÉLUT) pour semelles carrées encastrées à une profondeur $D_f = 1,5$ m

	SEMELLE CARRÉE			
Dimensions	1,0 m x 1,0 m	2,0 m x 2,0m	2,5 m x 2,5 m	3,0 m x 3,0 m
ÉLUT (kPa)	350	140	120	85

Tableau 5-5: La capacité portante à l'état limite de tenue en service (ÉLUT) pour semelle carrée encastrée à une profondeur $D_f = 2,65$ m

	SEMELLE CARRÉE			
Dimensions	1,0 m x 1,0 m	2,0 m x 2,0m	2,5 m x 2,5 m	3,0 m x 3,0 m
ÉLUT (kPa)	90	80	75	70

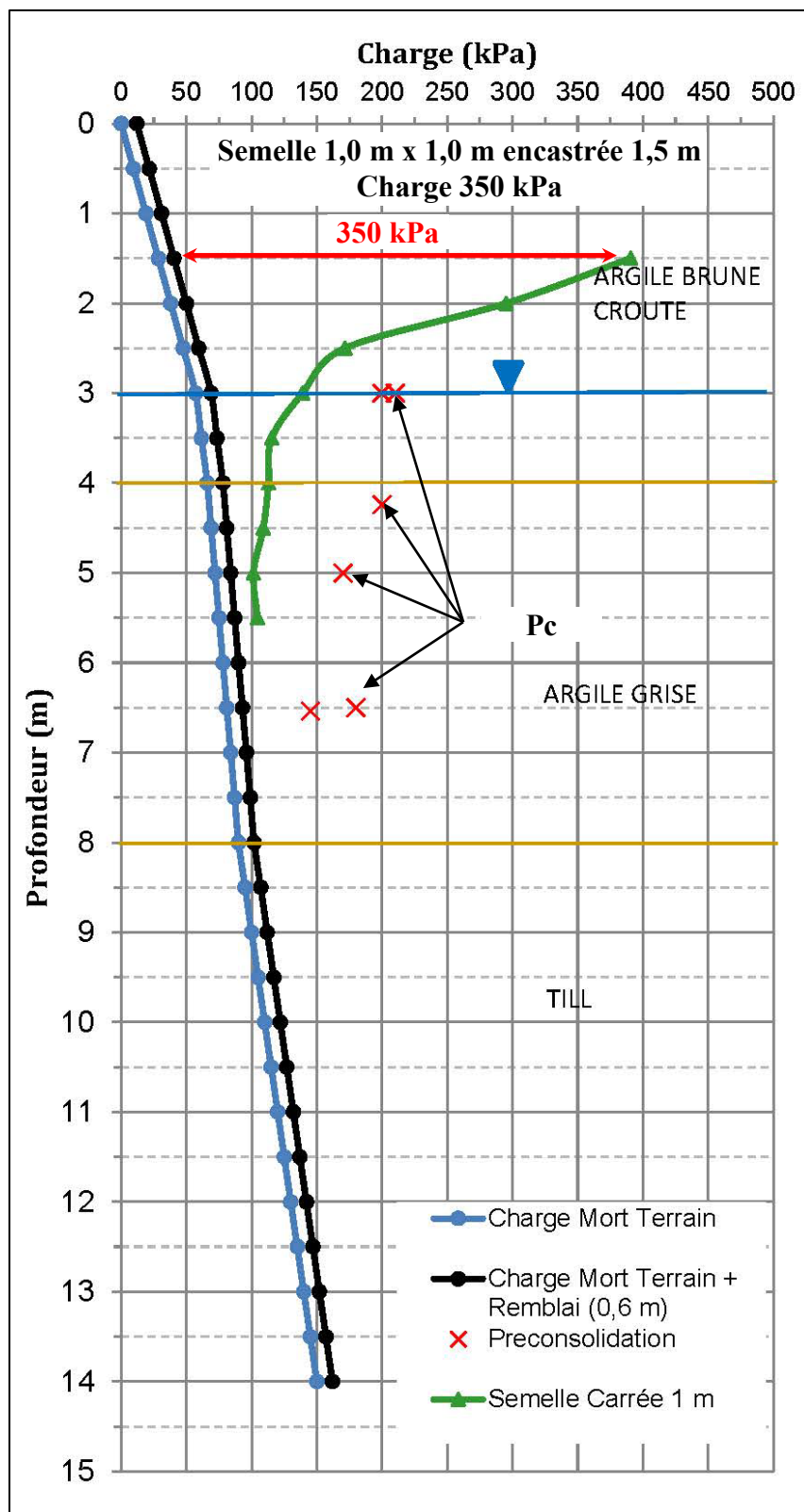


Figure 5-1: Variation des contraintes par rapport à la profondeur causée par une charge de 350 kPa appliquée sur une semelle carrée de 1,0 m x 1,0 m encastrée à une profondeur 1,5 m

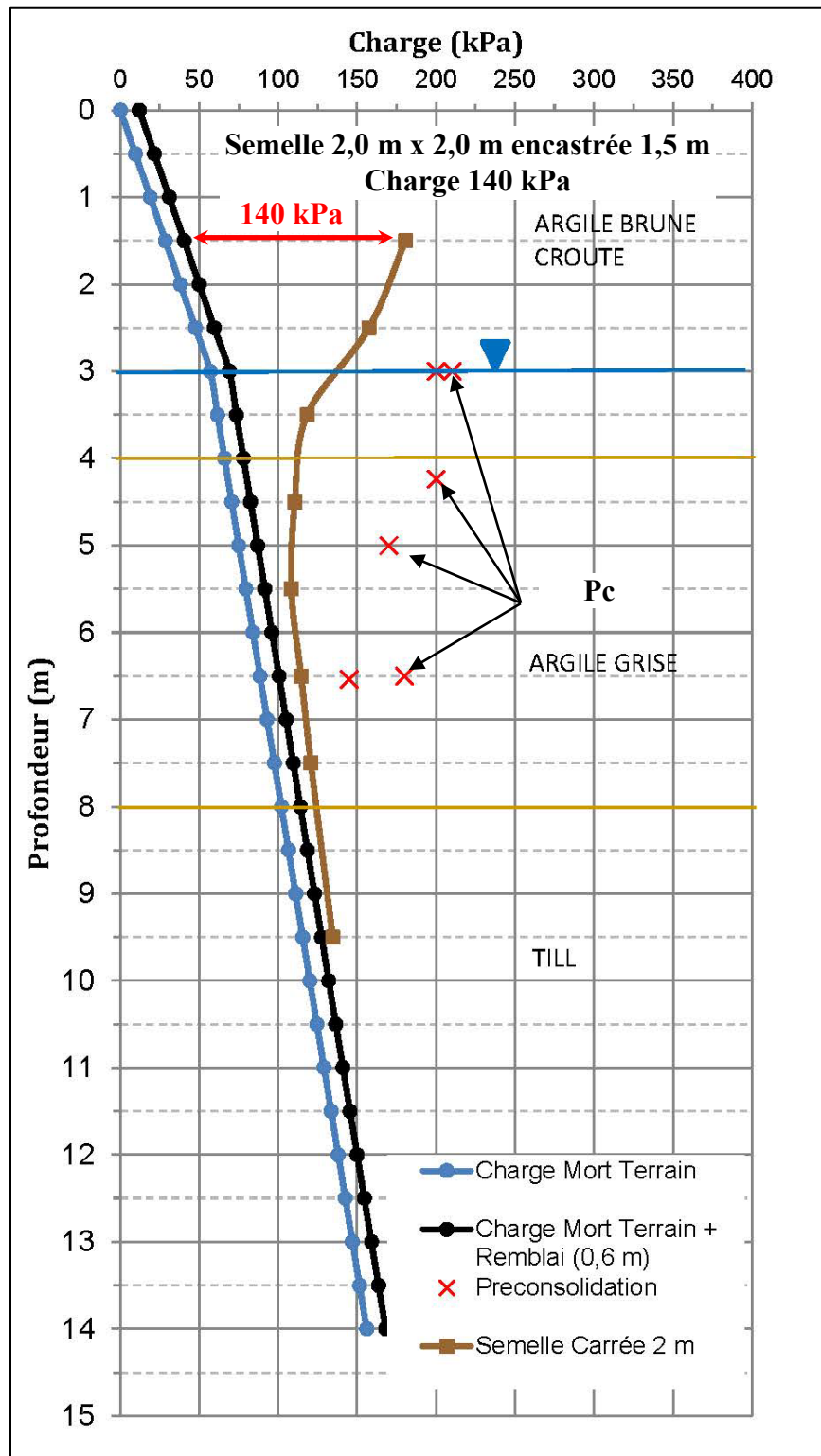


Figure 5-2: Variation des contraintes par rapport à la profondeur causée par une charge de 140 kPa appliquée sur une semelle carrée de 2,0 m x 2,0 m encastrée à une profondeur 1,5 m

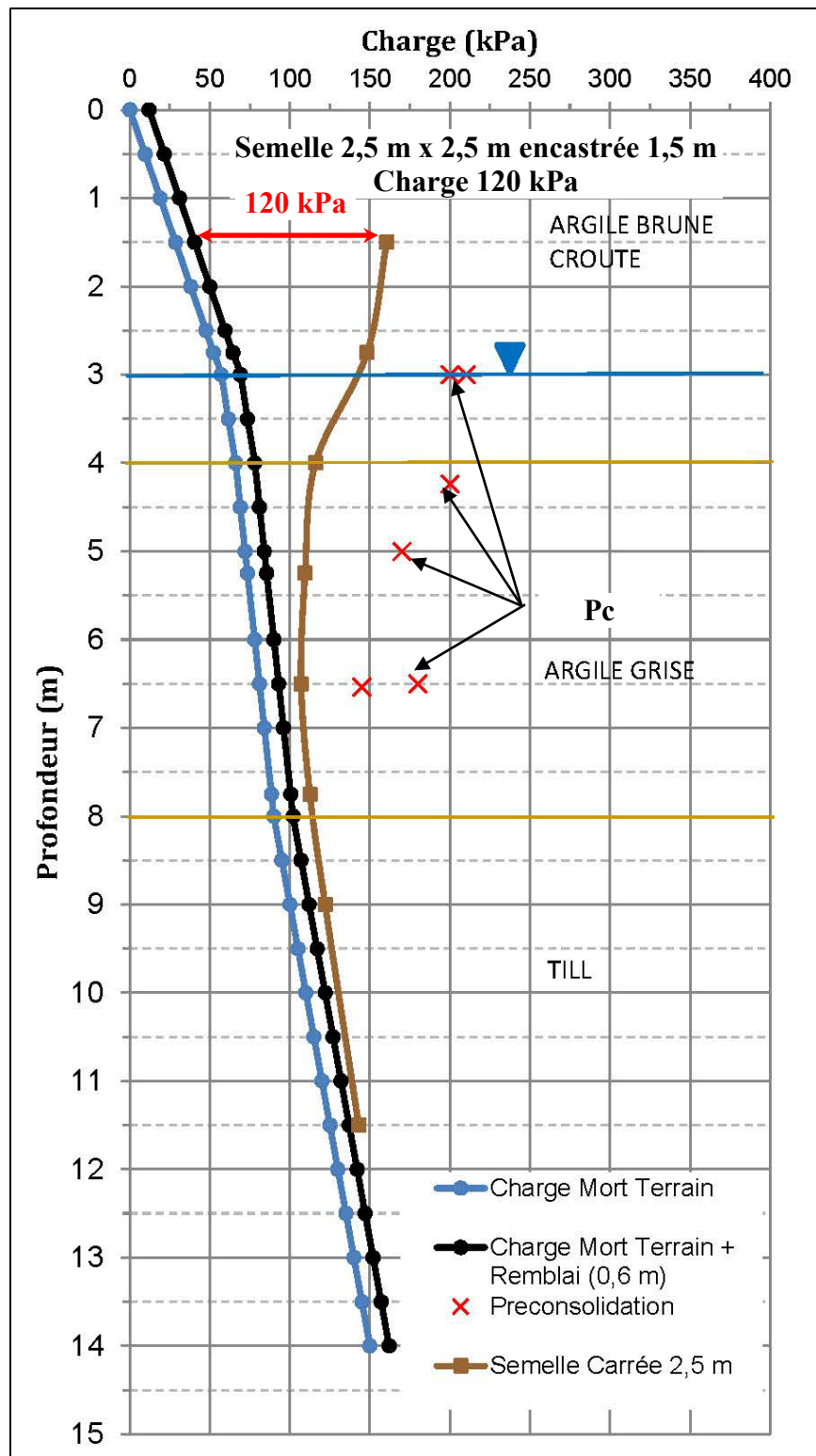


Figure 5-3: Variation des contraintes par rapport à la profondeur causée par une charge de 120 kPa appliquée sur une semelle carrée de 2,5 m x 2,5 m encastrée à une profondeur 1,5 m

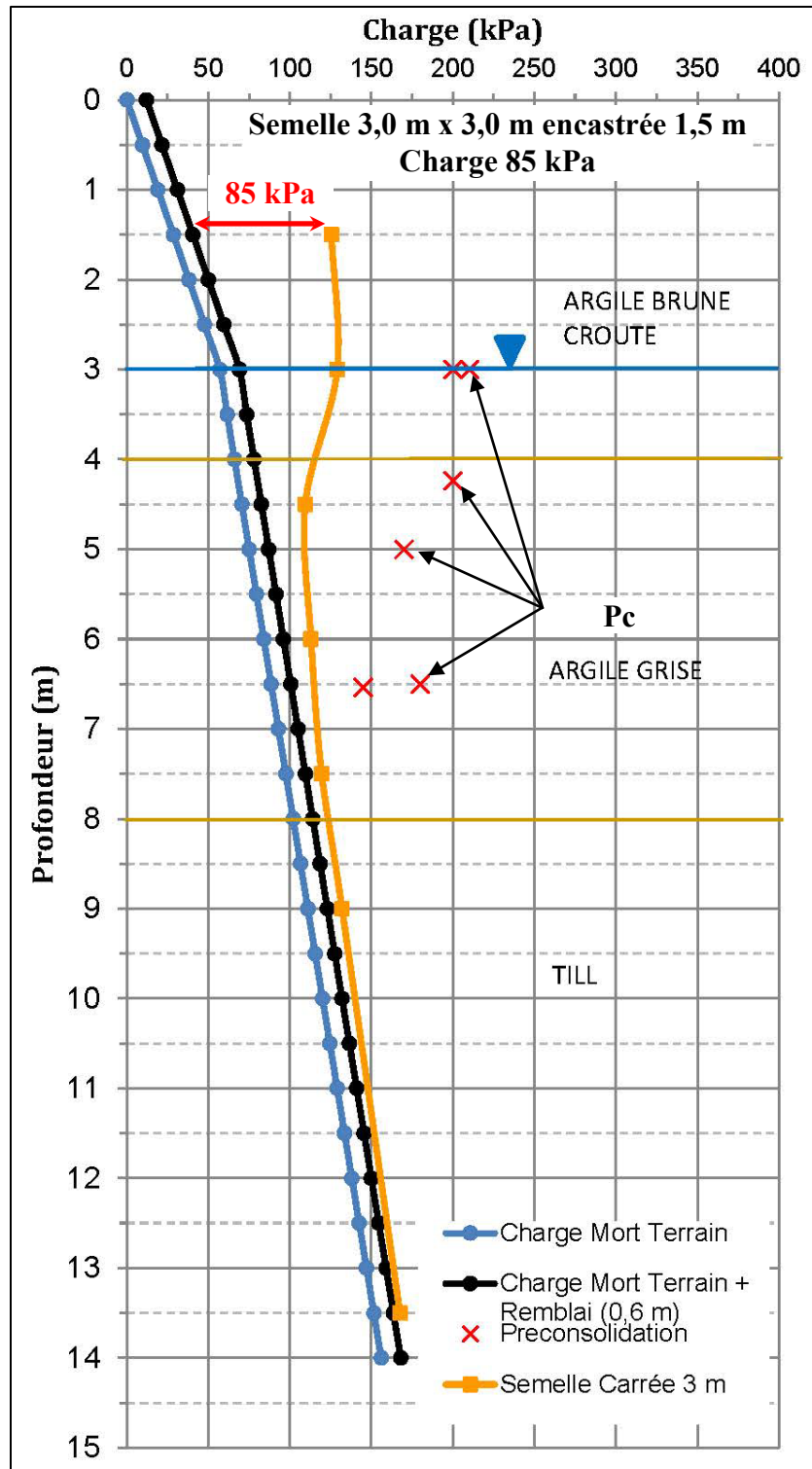


Figure 5-4: Variation des contraintes par rapport à la profondeur causée par une charge de 85 kPa appliquée sur une semelle carrée de 3,0 m x 3,0 m encastrée à une profondeur 1,5 m

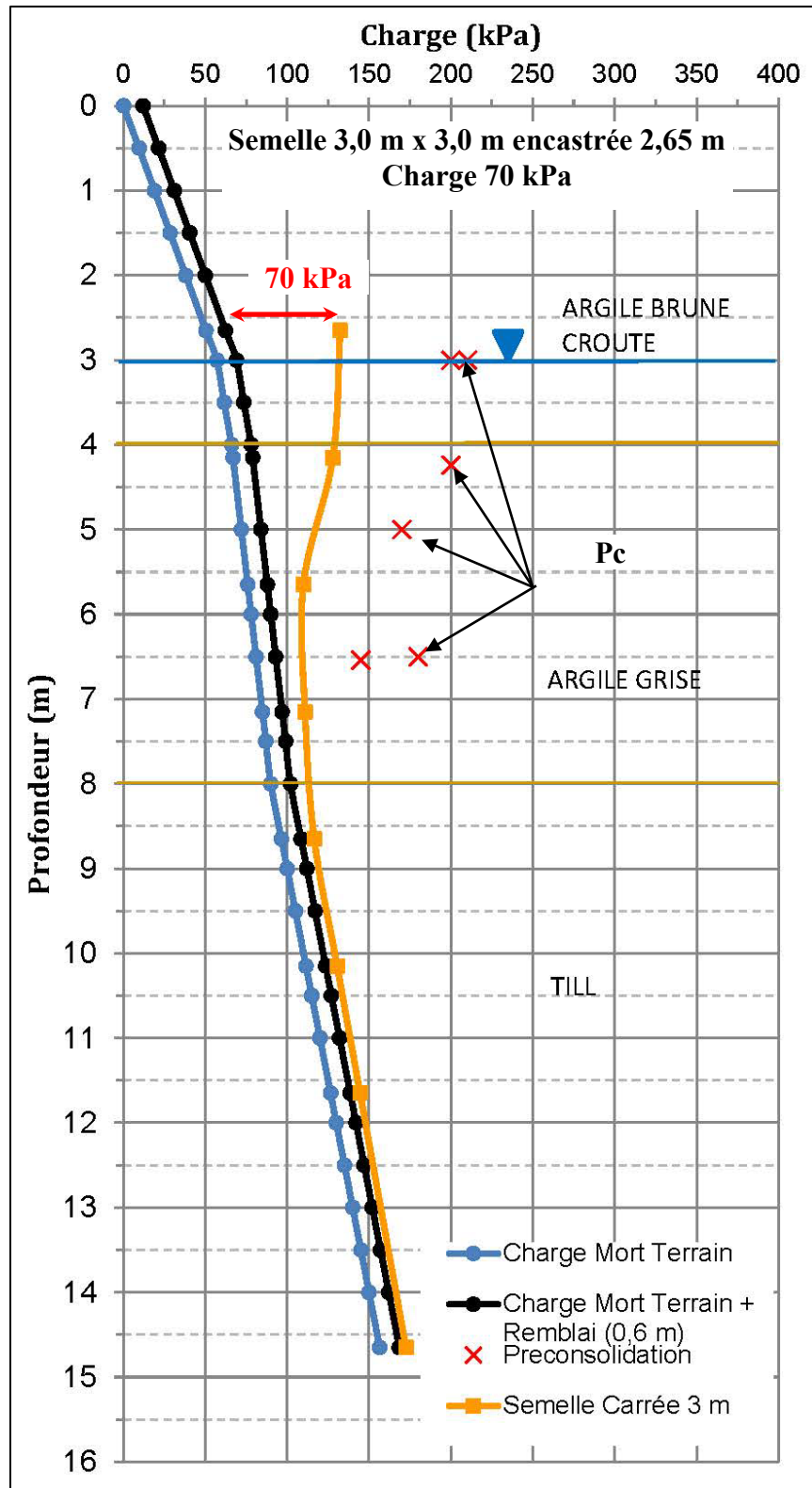


Figure 5-5: Variation des contraintes par rapport à la profondeur causée par une charge de 70 kPa appliquée sur une semelle carrée de 3,0 m x 3,0 m encastrée à une profondeur 2,65 m

6 DISCUSSION

Aux profondeurs d'encastrement prévues ($D_f = 1,5$ et $2,65$ m), les semelles isolées sont construites sur dépôt d'argile. En général, la résistance géotechnique 'la capacité portante' de l'argile est contrôlée par le tassement résultant de la profondeur d'encastrement des semelles carrées, le dimensionnement de la semelle et la charge appliquée par la structure. Donc, le dimensionnement des semelles doit respecter la capacité portante à l'état limite de tenue en service (ÉLUT) fournie pour la profondeur d'encastrement spécifié. Il est aussi important de prendre en considération les deux points des sections 6.1 et 6.2 suivantes.

6.1 Effet d'interférence de semelles étroitement espacées

Lorsque les semelles sont étroitement espacées, la zone d'influence des contraintes sous les semelles se chevauchent selon la règle de Boussinesq tel que indiqué dans la Figure 6-1 et le cumulative des deux charges s'approchent de la limite acceptable par rapport à la consolidation de l'argile

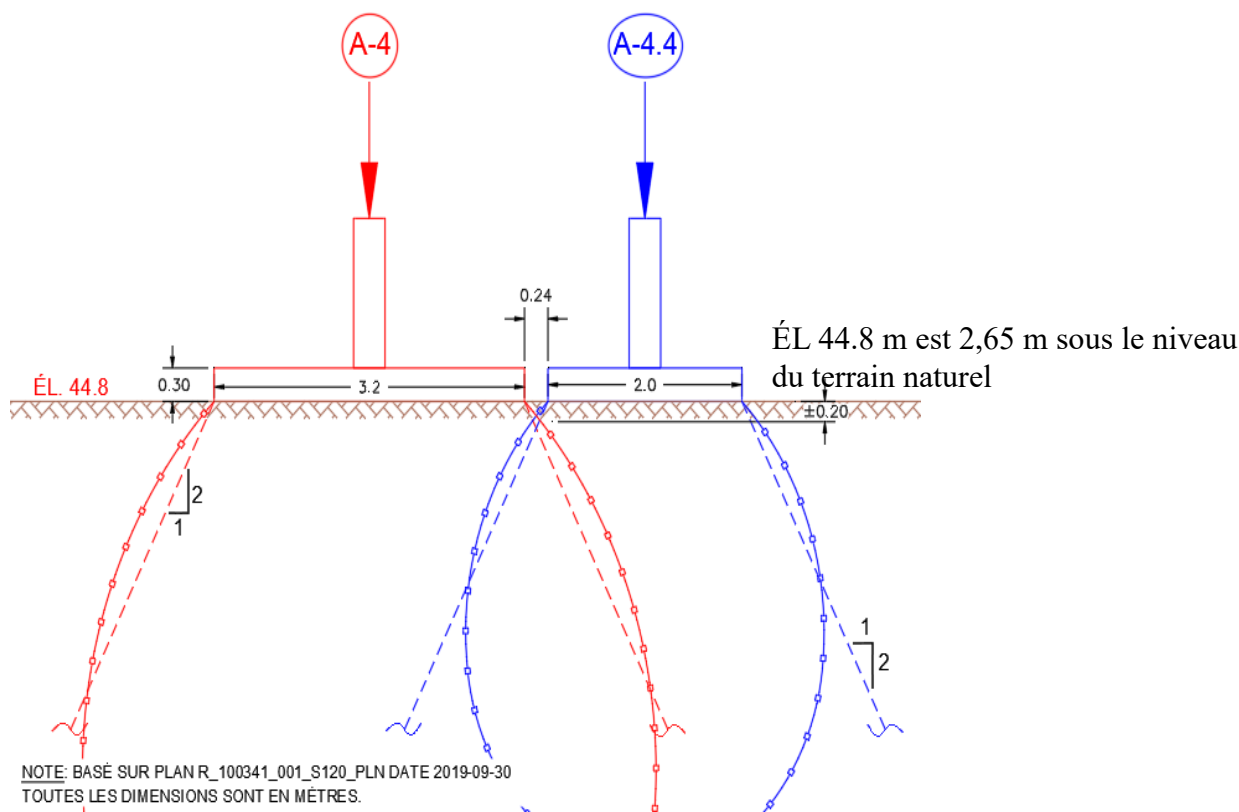


Figure 6-1: Effet d'interférence de semelles étroitement espacées

Afin d'éviter tout chevauchement des contraintes entre les semelles, l'espacement entre des semelles adjacentes ne doit pas être inférieur à la largeur des semelles. Si la largeur des semelles varie, l'espacement entre les semelles doit être égal à la largeur de la plus grande semelle.

Si l'espacement entre deux semelles est inférieur à la largeur de la plus grande semelle, l'interférence entre elles doit être prise en compte, ce qui réduira les charges maximales admissibles sur chacune des semelles, car les contraintes seront chevauchées en profondeur.

6.2 Dimensionnement et profondeur des semelles isolées

Les résistances géotechniques 'les capacités portantes' fournies sont pour les dimensions et les profondeurs d'encastresments spécifiés. Si un ou l'autre de ces paramètres est modifié, un nouveau calcul sera requis. En aucun cas, une règle de pouce doit être utilisée pour déterminer pour une dimension ou profondeur différente.

7 RÉFÉRENCES - BIBLIOGRAPHIE

1. Englobe. *Étude géotechnique et caractérisation environnementale sommaire des sols, implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC collège des douanes, 475 chemin de la grande ligne, Rigaud, Québec*. Rapport 025-P-0019200-0-01-001-GE-R-0001-00, octobre 2019.
2. Journeaux Assoc. *Étude géotechnique, chenil-construction d'un hangar 475 chemin Grande-Ligne, Rigaud, Québec*. Rapport L-15-1847, février 2016.
3. SOCIÉTÉ CANADIENNE DE GÉOTECHNIQUE, *Manuel Canadien d'ingénierie des Fondations*, 4e édition, 2013.
4. Terratech. *Étude géotechnique et d'échantillonnage environnemental des sols, développement du centre d'apprentissage de Rigaud (ASFC) Rigaud, Québec*. Rapport T-1779 (605898), février 2009.

**VÉRIFICATION DE LA CAPACITÉ PORTANTE DES SOLS POUR L'AGRANDISSEMENT DU CHENIL
ET LA CONSTRUCTION D'UN HANGAR DE FORMATION COLLÈGE DES DOUANES CANADA
RIGAUD, QUÉBEC**

Préparé par :



Sherif Kamel, ing., Ph.D.
O.I.Q. 5004384



JOURNEAUX ASSOC

Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6

T (514) 630-4997 F (514) 630-8937



JOURNEAUX ASSOC

Division LAB JOURNEAUX INC.

ANNEXE A

EXTRAIT DES RAPPORTS DE FORAGES PERTINENTS



Terratech

RAPPORT DE FORAGE

PROJET : Développement du Centre d'Apprentissage de Rigaud (ASFC) FORAGE : **F-6-08**
SITE : 435, Chemin de la Grande-Ligne, Rigaud, QC PAGE : 1 DE 1
DOSSIER NO : T-1779 (605898) TUBAGE : Tarière, NW
DATE DU FORAGE : 2008-11-17 AU 2008-11-18 CAROTTIER : -----
NIVEAU DE RÉFÉRENCE : Géodésique COORDONNÉES : 5037535,37 N 242864,19 E

ÉTAT DE L'ÉCHANTILLON		TYPE D'ÉCHANTILLONNEUR		ESSAIS DE LABORATOIRE ET IN SITU				Scissomètre (Su) ◇ intact (Sur) ◆ remanié Cône suédois (Cu) ▽ intact (Cur) ▼ remanié Pén Dyn. - cône × - - - - - ×					
	Remanié	CF	Carottier fendu	AG	Analyse granulométrique								
	Non remanié	TS	Tube à paroi mince (Shelby)	C	Consolidation								
	Perdu	EP	Échantillonneur à piston	Pv	Poids volumique (kN/m³)								
	Carotte	CD	Carottier à diamants	CH	Analyse chimique								
PROFONDEUR - m	STRATIGRAPHIE			NIVEAU D'EAU - m	ÉCHANTILLONS			TENEUR EN EAU et LIMITES (%) W _P W W _L ----- 20 40 60 80	ESSAIS DE LABORATOIRE ET IN SITU	PÉN. DYN. - CÔNE (coups/0.3m) 80 160			
	NIVEAU - m	PROF. - m	DESCRIPTION		SYMBOLE	TYPE ET NUMÉRO	ÉTAT			RÉCUPÉRATION %	N ou RQD	RÉSISTANCE AU CISAILLEMENT NON-DRAINÉ (kPa) 80 160	
	47,01		SURFACE DU TERRAIN										
	0,00		Sols organiques.										
	46,91		Remblai: sable, un peu de silt, beige, lâche.		CF-1		63	9		CH			
	0,10		Terrain naturel: argile silteuse brune, traces de sable.		CF-2		100	20		CH			
	46,40				CF-3		100	19					
	0,61				CF-4		100	11					
2					CF-5		100	7					
			Deviens grise à 3,8m.		TS-6		100	---					
					CF-7		100	2		Pv = 16 C			
					CF-8		100	1/61cm					
4					TS-9		100	---					
										Pv = 15 C			
6													
8	39,09		Till: sable, un peu de silt, traces à un peu de gravier. Présence de cailloux et blocs occasionnels.		CF-10		58	10					
	7,92												
			Récupération de plusieurs graviers grossiers et de 3 fragments de cailloux et/ou blocs (150mm à 330mm) lors de l'avancement du forage entre les prélèvements de sol.		CF-11		46	34					
10													
12													
14													
16	32,38												
	14,63		FIN DU FORAGE (Bris mécanique)										



Terratech

PROJET : Développement du Centre d'Apprentissage de Rigaud (ASFC) FORAGE : **F-7-08**
SITE : 435, Chemin de la Grande-Ligne, Rigaud, QC PAGE : 1 DE 1
DOSSIER NO : T-1779 (605898) TUBAGE : Tarière
DATE DU FORAGE : 2008-11-24 AU 2008-11-24 CAROTTIER : -----
NIVEAU DE RÉFÉRENCE : Géodésique COORDONNÉES : 5037464,87 N 242891,09 E

RAPPORT DE FORAGE

ÉTAT DE L'ÉCHANTILLON		TYPE D'ÉCHANTILLONNEUR		ESSAIS DE LABORATOIRE ET IN SITU				Scissomètre (Su) ◇ intact (Sur) ◆ remanié Cône suédois (Cu) ▽ intact (Cur) ▼ remanié Pén Dyn. - cône × - - - - - ×					
<div>Remanié</div> <div>Non remanié</div> <div>Perdu</div> <div>Carotte</div>		CF Carottier fendu TS Tube à paroi mince (Shelby) EP Échantillonneur à piston CD Carottier à diamants		AG Analyse granulométrique C Consolidation Pv Poids volumique (kN/m³) CH Analyse chimique									
PROFONDEUR - m	STRATIGRAPHIE			NIVEAU D'EAU - m	ÉCHANTILLONS			TENEUR EN EAU et LIMITES (%) W _P W W _L 20 40 60 80	ESSAIS DE LABORATOIRE ET IN SITU	PÉN. DYN. - CÔNE (coups/0.3m) 80 160			
	NIVEAU - m	PROF. - m	DESCRIPTION		SYMBOLE	TYPE ET NUMÉRO	ÉTAT			RÉCUPÉRATION %	N ou RQD	RÉSISTANCE AU CISAILLEMENT NON-DRAINÉ (kPa) 80 160	
	46,52		SURFACE DU TERRAIN										
	0,00 46,34 0,18		Sols organiques. Terrain naturel: argile silteuse, traces de sable, brune à grise, très raide.		CF-1		29	18					
					CF-2		100	28					
2													
4													
			Devient ferme à raide à 5,1m.										
6													
8													
10	36,87 9,65 36,77 9,75		Till probable. FIN DU FORAGE		CF-3		100	poids des tiges					
12													
14													
16													

ESSAI DE RÉSISTANCE AU CISAILLEMENT SCISSOMÈTRE NILCON

Appareil no: CH-050 **Constante K :** 1.124
Opérateur: Christian Boucher

Dossier no:	T-1779 (605898)
Localisation:	Développement du Centre d'Apprentissage de Rigaud (ASFC) 435, chemin de la Grande-Ligne Rigaud, Québec
Forage no:	F-7-08
Date:	24 novembre 2008

$$S_u = 9.81 \times C \times K \times (A_s - A_f) = \text{kPa}$$

[illegible]

NOTES:

Refus à: 9.66 m

RAPPORT DE FORAGE

CLIENT:



PROJET: Étude géotechnique Chenil-Hangar

SITE: 475 Ch. Grande-Ligne, Rigaud

NO PROJET: L-15-1847

DATE DU FORAGE: 2015-11-21

SONDAGE: **TF-15-01**

NIVEAU D'EAU: 44.54 m

DATE EAU: 2015-11-21

TYPES D'ÉCHANTILLONS		TYPES D'ÉCHANTILLONEURS		TESTS LABORATOIRE				Scissomètre (Su) ◇ intacte (Sur) ◆ remanié Pénétromètre (Cu) △ intacte (Cur) ▲ remanié Pénétration dynamique × - - - - ×									
	Remanié	CF	Cuillère fendue	AG	Analyse granulométrique												
	Non remanié	TS	Tube à parois mince (Shelby)	C	Consolidation (kPa)												
	Perdu	EP	Échantillonneur à piston	γ _t	Poids volumique (kN/m³)												
	Carotte	CD	Carrotier à diamant	LL	Limite de liquidité (%)												
				LP	Limite de plasticité (%)												
PROFONDEUR-m	STRATIGRAPHIE			EAU	ÉCHANTILLONS			LABORATOIRE et TESTS IN SITU	ESSAIS								
	ÉLÉVATION-m PROFONDEUR-m	DESCRIPTION SOL	PROFIL SOL	PIÉZOMÈTRE	ÉCHANTILLON TYPE et NO	TYPES	RÉCUPÉRATION %		N	TENEUR EN EAU %	(Remanié: ◆ / ◇ ; (Intacte) △) RÉSIST CISAILEMENT N/D 50 100 150 200 N 20 40 60 80 TENEUR EN EAU ET LIMITES (%) L.P. L.L. 20 40 60 80						
1 2 3 4 5 6 7 8 9	47.00 0.00 46.95 0.05	Niveau SOL VÉGÉTAL Noir, humide avec végétation. ARGILE SILTEUSE - SILT ARGILEUX Brune avec trace et joint de sable, humide avec une consistance ferme et à 1m devient raide à très raide.		N.E. 2.5 m - 2015-11-21	CF-01		100	7	34.7	γ _t = 19.29 kN/m³ Cu=100kPa LL=46% LP=25%							
	1	CF-02				100	20	33.7	γ _t = 19.13 kN/m³ Cu=175kPa LL=60% LP=39%								
		CF-03				100	17	33	γ _t = 19.19 kN/m³ Cu=130kPa LL=63% LP=39%								
		CF-04				100	23	41.1	γ _t = 18.25 kN/m³ Cu=110kPa LL=66% LP=39%								
	2	44.60 2.40			SILT ARGILEUX Grise, saturée d'une consistance ferme,	TS-05		0									
		3			43.60 3.40	COUCHE D'ARGILE, rougâtre ferme	CF-06		100	7		50.8	γ _t = 17.61 kN/m³ Cu=60kPa LL=82 LP=49%				
	4				43.00 4.00	ARGILE SILTEUSE, grisâtre ferme, à 4.5m la consistance devient à très molle.	CF-07		100	2		47.2	γ _t = 17.99 kN/m³ LL=83 LP=45%				
		5					CF-08		100	4		71.9	γ _t = 15.91 kN/m³ LL=84% LP=50%				
							CF-09		100	0		48.5	LL=81% LP=61%				
	6 7 8 9												Pén_dyn, N'=0 Pén_dyn, N'=3 Pén_dyn, N'=5 Pén_dyn, N'=4 Pén_dyn, N'=6 Pén_dyn, N'=14				
8			39.38 7.62	SABLE SILTEUX Gris, saturé d'une compacité compacte.							CF-10				100		
			38.47 8.53	Fin du forage													



JOURNEAUX ASSOC
Division LAB JOURNEAUX INC

Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6

Référence:

Coordonnées:

Technicien: C.R. & S.K.

Vérifié par: N.L.J.

PAGE

1/1

RAPPORT DE FORAGE

CLIENT:



PROJET: Étude géotechnique Chenil-Hangar

SITE: 475 Ch. Grande-Ligne, Rigaud

SONDAGE: **TF-15-02**

NO PROJET: L-15-1847

NIVEAU D'EAU: 44.55 m

DATE DU FORAGE: 2015-11-21

DATE EAU: 2015-11-21

TYPES D'ÉCHANTILLONS		TYPES D'ÉCHANTILLONEURS		TESTS LABORATOIRE			Scissomètre (Su) ◇ intacte				
	Remanié	CF	Cuillère fendue	AG	Analyse granulométrique		Pénétromètre (Cu) △ intacte				
	Non remanié	TS	Tube à parois mince (Shelby)	C	Consolidation (kPa)						
	Perdu	EP	Échantillonneur à piston	γ _t	Poids volumique (kN/m³)		(Cur) ▲ remanié				
	Carotte	CD	Carrotier à diamant	LL	Limite de liquidité (%)		Pénétration dynamique × - - - - ×				
				LP	Limite de plasticité (%)						
PROFONDEUR -m	STRATIGRAPHIE			EAU	ÉCHANTILLONS			ESSAIS			
	ÉLÉVATION -m PROFONDEUR -m	DESCRIPTION SOL	PROFIL SOL	PIEZOMÈTRE	ÉCHANTILLON TYPE et NO	TYPES	RÉCUPÉRATION %	N	TENEUR EN EAU %	LABORATOIRE et TESTS IN SITU	(Remanié): ◆ / ◇ (Intacte) RÉSIST CISAILEMENT N/D 50 100 150 200 N 20 40 60 80 L.P. L.L. TENEUR EN EAU ET LIMITES (%) 20 40 60 80
1	47.00 0.00 46.95 0.05	Niveau SOL VÉGÉTAL Noir, humide avec végétation. ARGILE SILTEUSE - SILT ARGILEUX Brune, humide avec trace de sable d'une consistance ferme à très raide.		N.E. 2.5 m - 2015-11-21	CF-01		50	8	36.3	γ _t = 19.32 kN/m³ Cu=220kPa	
	CF-02				100	30	33.1	γ _t = 18.86 kN/m³ Cu=180kPa			
	TS-03				100		36.9	γ _t = 18.97 kN/m³ Cu=220kPa			
2	45.20 1.80	SILT ARGILEUX Grise, rougâtre avec signe d'oxidation, humide d'une consistance très raide devenant ferme à 3.6m.			CF-04		100	13		Cu=180kPa	
3	43.60 3.40	COUCHE D'ARGILE, rougâtre ferme			TS-05		50		59	γ _t = 16.9 kN/m³ LL=79% LP=44%	
4	43.00 4.00	ARGILE SILTEUSE, grisâtre ferme			CF-06		100	6	60	γ _t = 16.75 kN/m³	
	CF-07				100	4	67	γ _t = 16.76 kN/m³			
5					CF-08		100	5	66.8		
6											
7					CF-09		100	5	75.7		
8	39.69 7.32	Probable ment dépôt de sable silteux, lâche, saturé..							Pén_dyn, N'=7 Pén_dyn, N'=9 Pén_dyn, N'=7 Pén_dyn, N'=8 Pén_dyn, N'=9		
9	38.47 8.53	Fin du forage							Pén_dyn, N'=8		


JOURNEAUX ASSOC
 Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6

Référence:

Coordonnées:

Technicien: C.R. & S.K.

Vérifié par: N.L.J.

PAGE

1/1

RAPPORT DE FORAGE

CLIENT:



PROJET: Étude géotechnique Chenil-Hangar

SITE: 475 Ch. Grande-Ligne, Rigaud

SONDAGE: **TF-15-03**

NO PROJET: L-15-1847

NIVEAU D'EAU: 44.50 m

DATE DU FORAGE: 2015-11-21

DATE EAU: 2015-11-21

TYPES D'ÉCHANTILLONS		TYPES D'ÉCHANTILLONEURS		TESTS LABORATOIRE			Scissomètre (Su) ◇ intacte					
	Remanié	CF Cuillère fendue		AG Analyse granulométrique			(Sur) ◆ remanié					
	Non remanié	TS Tube à parois mince (Shelby)		C Consolidation (kPa)			Pénétromètre (Cu) △ intacte					
	Perdu	EP Échantillonneur à piston		γ _t Poids volumique (kN/m³)			(Cur) ▲ remanié					
	Carotte	CD Carotier à diamant		LL Limite de liquidité (%)			Pénétration dynamique × - - - - ×					
				LP Limite de plasticité (%)								
PROFONDEUR-m	STRATIGRAPHIE			EAU	ÉCHANTILLONS			ESSAIS				
	ÉLÉVATION-m PROFONDEUR-m	DESCRIPTION SOL	PROFIL SOL	PIEZOMÈTRE	ÉCHANTILLON TYPE et NO	TYPES	RÉCUPÉRATION %	N	TENEUR EN EAU %	LABORATOIRE et TESTS IN SITU	(Remanié): ◆ / ◇ (Intacte) RÉSIST CISAILEMENT N/D 50 100 150 200 N 20 40 60 80 L.P. L.L. TENEUR EN EAU ET LIMITES (%) 20 40 60 80	
	47.00	Niveau		N.E. 2.5 m - 2015-11-21								
	0.00	SOL VÉGÉTAL										
46.95	Noir, humide avec végétation.		CF-01			60	6	33.1	γ _t = 19.1 kN/m³			
0.05	ARGILE SILTEUSE - SILT ARGILEUX		CF-02			100	19	35.1				
1		Brune, humide et d'une consistance ferme.										
		À 0.5m il y a des intrusions de couleur										
		blanche et la consistance devient raide.										
2	44.87				CF-03		100	11	36.4	γ _t = 19.13 kN/m³		
	2.13	SILT ARGILEUX			CF-04		100	28	37.7	γ _t = 18.95 kN/m³		
3		Grise, saturée avec une consistance très										
		raide.										
		À 3.5m la couleur devient rougâtre.										
4	43.60			TS-05		30		51	γ _t = 16.8 kN/m³			
	3.40	COUCHE D'ARGILE, rougâtre ferme.							LL=70% LP=36			
5	43.00			CF-06		100	16	55.4				
	4.00											
6												
7												
8	39.68									Pén_dyn, N'=10		
	7.32	Probablement dépôt de sable silteux lâche,								Pén_dyn, N'=8		
		saturé.								Pén_dyn, N'=8		
9	38.47									Pén_dyn, N'=9		
	8.53	Fin du forage								Pén_dyn, N'=9		


JOURNEAUX ASSOC
 Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6

Référence:

Coordonnées:

Technicien: C.R. & S.K.

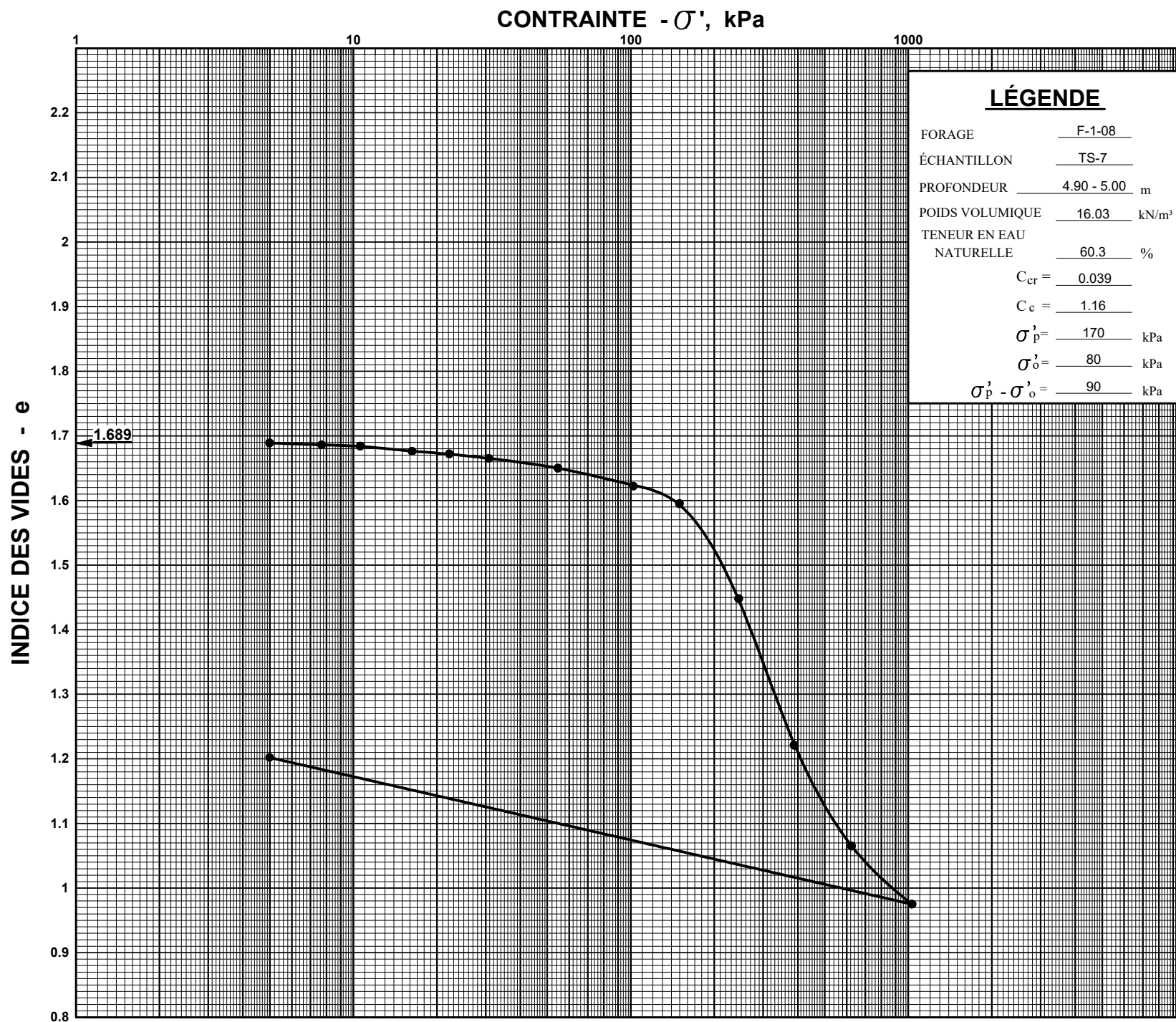
Vérifié par: N.L.J.

PAGE

1/1

ANNEXE B

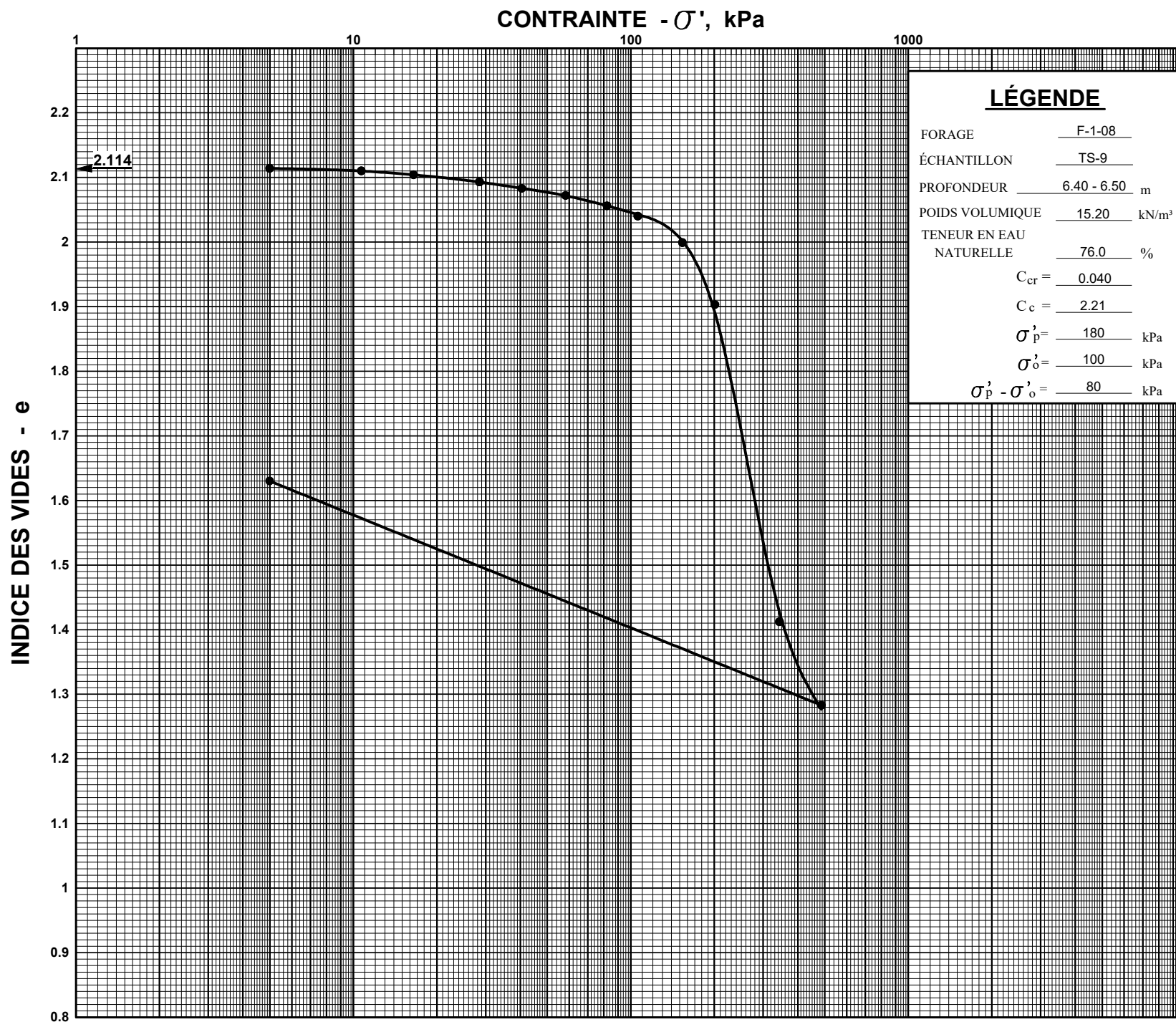
GRAPHIQUES DES ESSAIS DE CONSOLIDATION



Terratech

ESSAI DE CONSOLIDATION

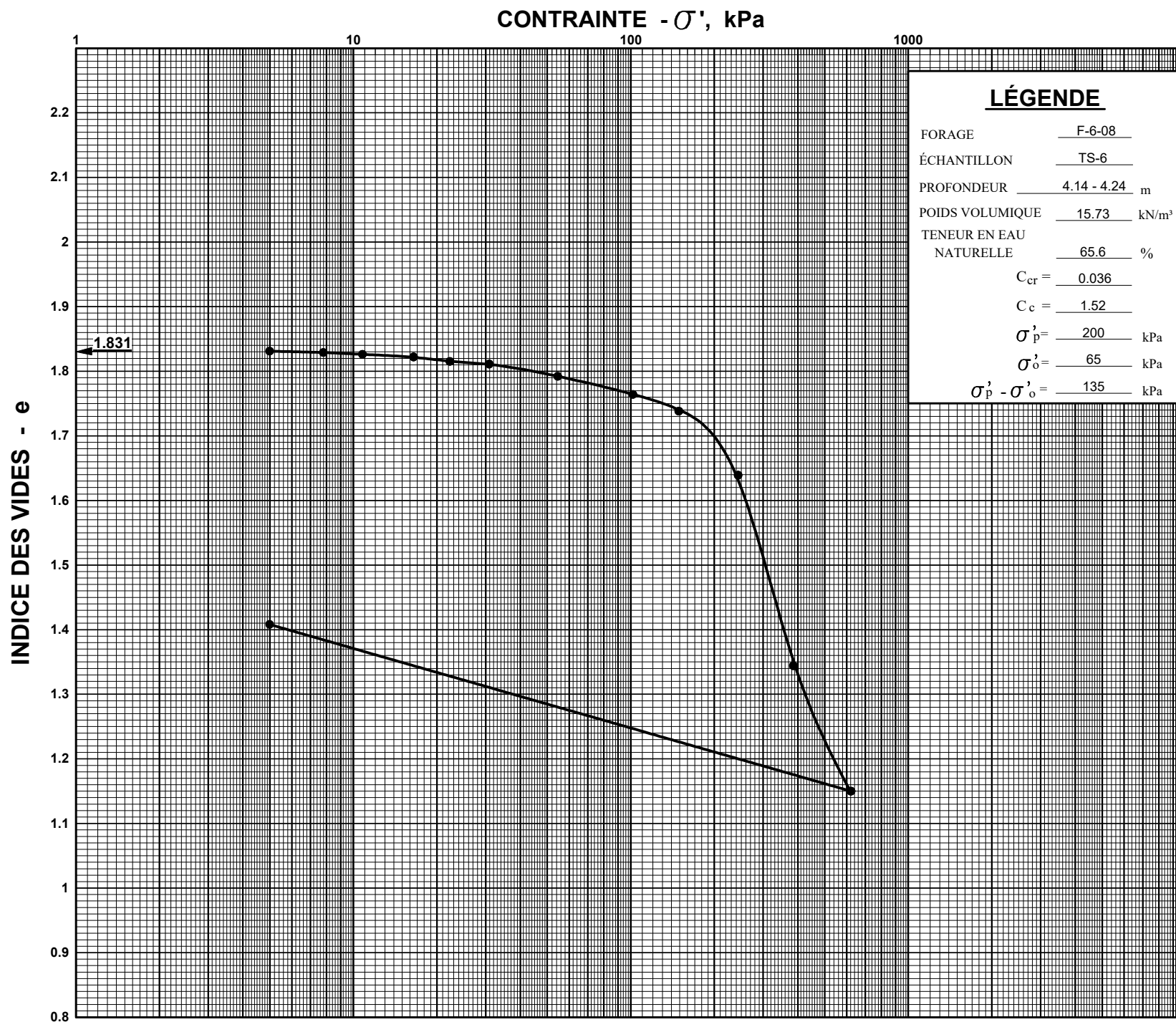
ANNEXE C
FIGURE 6
PROJET T-1779



Terratech

ESSAI DE CONSOLIDATION

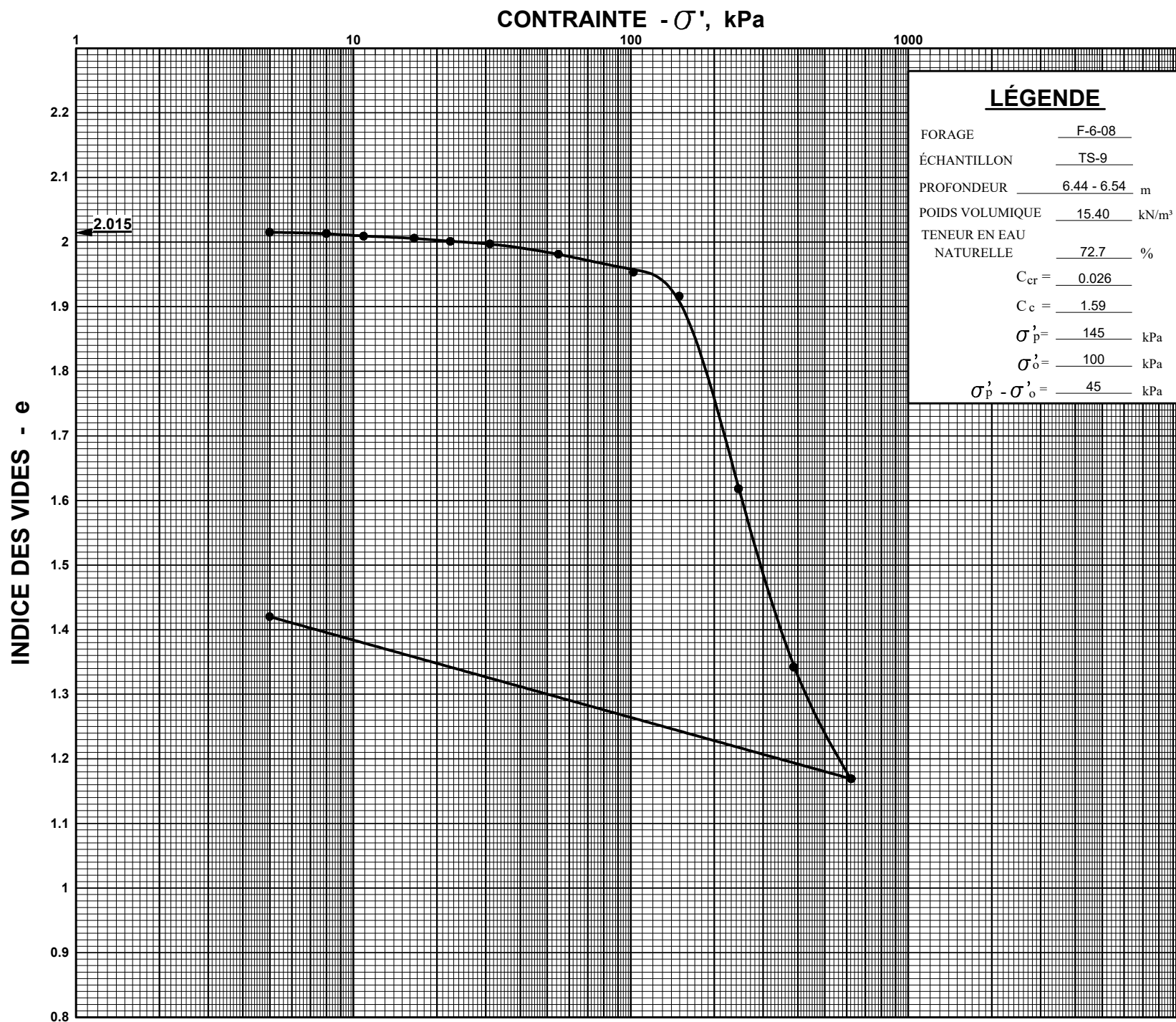
ANNEXE C
FIGURE 7
PROJET T-1779



Terratech

ESSAI DE CONSOLIDATION

ANNEXE C
FIGURE 8
PROJET T-1779



Terratech

ESSAI DE CONSOLIDATION

ANNEXE C
FIGURE 9
PROJET T-1779



JOURNEAUX ASSOC
Division LAB JOURNEAUX INC.

Tel.: (514) 630-4997

Fax.: (514) 630-8937

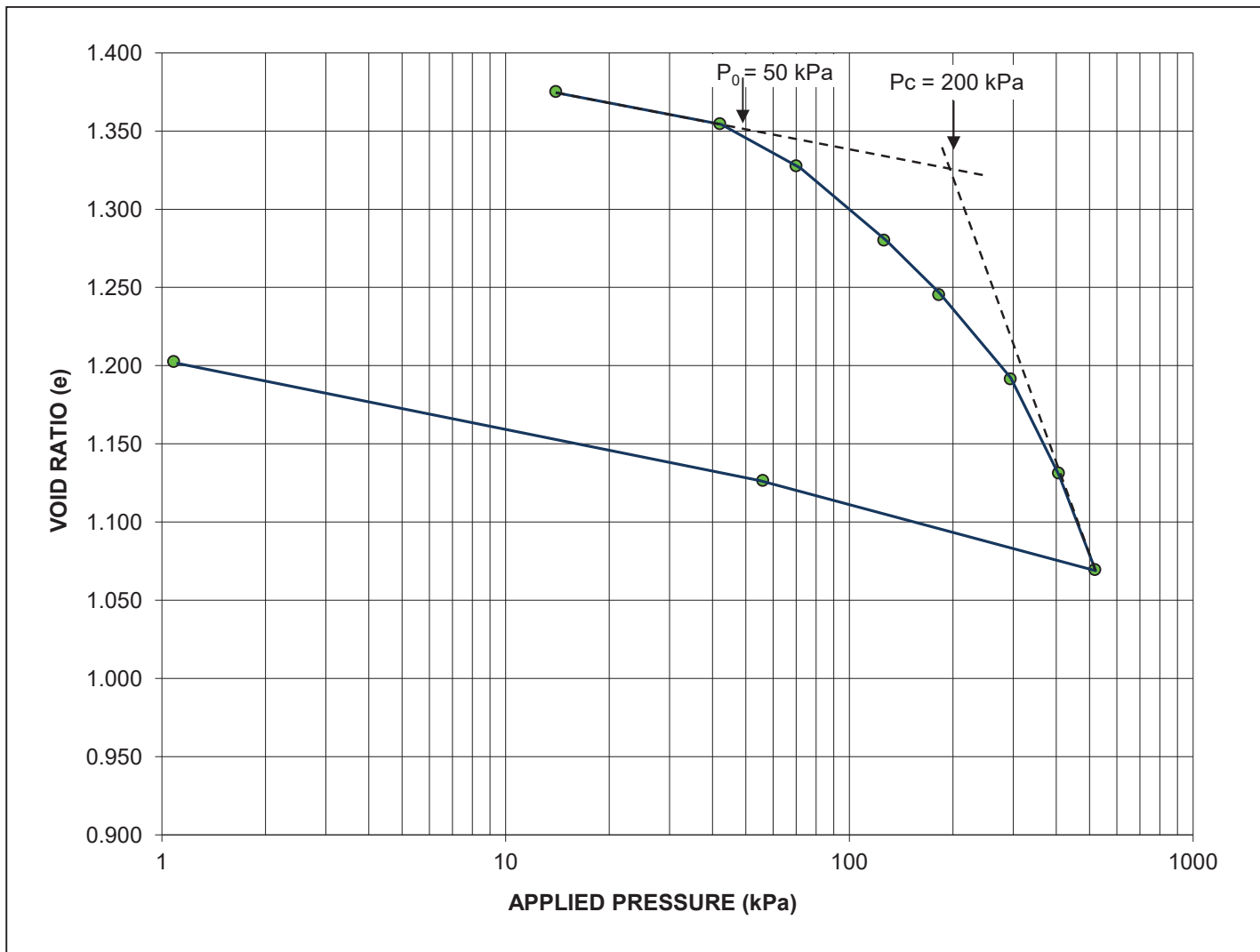
**ONE DIMENSIONAL
CONSOLIDATION
TEST**

Client: **Brookfield Solutions Globales Intégrées Ca**
Projet No.: **L-15-1847**
Projet : **Étude géotechnique pour hanger sur le site**
Date: **04/12/15**

Forage: **TF-02**
Profondeur : **3 m**

Échantillons: **TS-5**
Description: **Argile Silteux Grise**

Date de forage: **21/11/15**



LL : **79**
PI : **44**

Cu : **kPa**

TEST SUMMARY

	SAMPLE CHARACTERISTICS		COMPRESSIBILITY PROPERTIES	
	INITIAL STATE	FINAL STATE		
w	48.54 %	44.75 %	σ_p' : Consolidation pressure	200 kPa
γ	16.56 kN/m³	16.58 kN/m³	σ_{vo}' : Vertical effective stress	50 kPa
γ_d	11.15 kN/m³	11.46 kN/m³	$\sigma_p' - \sigma_{vo}'$: Overconsolidation difference	150 kPa
Sr	95.29 %	92.09 %	Cv: Coefficient of consolidation	m²/s
e	1.375	1.131	Cmv: Coefficient of compressibility	N/A kPa⁻¹
			COMPRESSION INDEX	
Dr	estimated	measured		
DIMENSIONS				
Dia. (cm) 6.350 Height (cm) 1.905			C _i : compression Index	

Sampled by: C.R & S. K.

Date: 15-11-21

Analysed by: N. Journeaux

Date: 15-12-04

**ONE DIMENSIONAL
CONSOLIDATION
TEST**

 Client: **Brookfield Solutions Globales Intégrées Ca**

 Project No.: **L-15-1847**

 Project : **Étude géotechnique pour hanger sur le site**

 Date: **04/12/15**

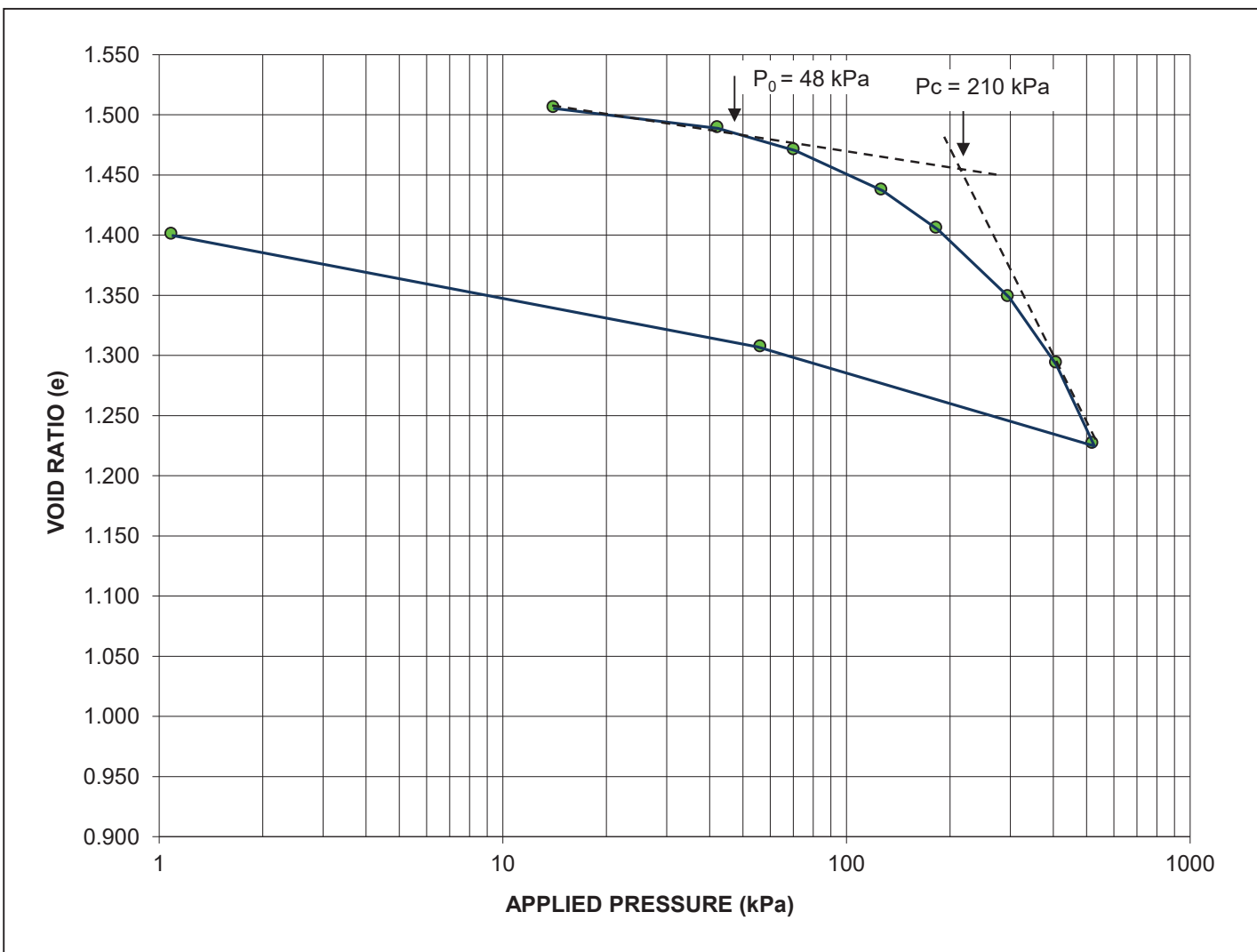
 Forage: **TF-03**

 Échantillons: **TS-5**

 Date de forage: **21/11/15**

Profondeur :

3 m

 Description: **Argile Silteux Grise**

 LL : **70**

 Cu : **kPa**

 PI : **36**
TEST SUMMARY

	SAMPLE CHARACTERISTICS		COMPRESSIBILITY PROPERTIES	
	INITIAL STATE	FINAL STATE		
w	52.15 %	50.00 %	σ_p' : Consolidation pressure	210 kPa
γ	16.08 kN/m³	16.38 kN/m³	σ_{vo}' : Vertical effective stress	48 kPa
γ_d	10.57 kN/m³	10.92 kN/m³	$\sigma_p' - \sigma_{vo}'$: Overconsolidation difference	162 kPa
Sr	93.44 %	94.73 %	Cv: Coefficient of consolidation	m ² /s
e	1.507	1.228	Cmv: Coefficient of compressibility	N/A kPa⁻¹
			COMPRESSION INDEX	
Dr	estimated	measured		
DIMENSIONS				
Dia. (cm) 6.350 Height (cm) 1.905			C _i : compression Index	

Sampled by: C.R & S. K.

Date: 15-11-21

Analysed by : N. Journeaux

Date: 15-12-04



JOURNEAUX ASSOC

Division LAB JOURNEAUX INC.

801 Bancroft Pointe-Claire, QC H9R 4L6
T (514) 630-4997 F (514) 630-8997

APPENDIX 3

Travaux publics et Services gouvernementaux Canada (TPSGC)

ÉTUDE GÉOTECHNIQUE ET CARACTÉRISATION ENVIRONNEMENTALE SOMMAIRE DES SOLS

**Implantation d'un nouveau hangar et
agrandissement du chenil de l'ASFC
Collège des douanes
475, chemin de la Grande-Ligne
Rigaud (Québec)**

Octobre 2019

025-P-0019200-0-01-001-GE-R-0001-00

RAPPORT FINAL



Rédigé par :

A handwritten signature in blue ink, appearing to read "Hajar Armouzi".

Hajar Armouzi, ing. jr
Chargée de discipline - Géotechnique
Membre de l'OIQ n° 5040302

A handwritten signature in blue ink, appearing to read "Philippe-Alexandre Charette".
A circular professional seal for a geologist. The outer ring contains the text "GÉOLOGUE" at the top and "QUÉBEC" at the bottom. The center contains a fleur-de-lis and the text "PHILIPPE-A. CHARETTE # 1916".
2019-10-29

Philippe-Alexandre Charette, géo., EESA®
Chargé de projet – Environnement
Membre de l'OGQ n° 1916

Révisé par :

Mathieu Langevin
-- Ingénieur - OIQ

Signature numérique de Mathieu Langevin -- Ingénieur - OIQ
Date : 2019.10.30 09:01:20 -04'00'

Mathieu Langevin, ing.
Chef d'équipe et Gestionnaire de projets – Géotechnique et Géologie
Membre de l'OIQ n° 130131

A handwritten signature in blue ink, appearing to read "Frédéric Girard".

Frédéric Girard, géo., M.Sc.
Chef de projet – Géoenvironnement
Membre de l'OGQ n° 1705

Sommaire exécutif

Englobe Corp. (Englobe) a été mandatée par Travaux publics et Services gouvernementaux Canada (TPSGC) afin de réaliser une étude géotechnique jumelée à une étude de caractérisation environnementale sommaire des sols sur la propriété du Collège des Douanes sise au 475, chemin de la Grande-Ligne à Rigaud, dans la province de Québec. Cette étude est effectuée dans le cadre de l'agrandissement projeté du chenil présent sur le site ainsi que de la construction projetée d'un nouveau hangar.

Dans le cadre de ces travaux, deux forages stratigraphiques et 10 sondages manuels ont été réalisés sur la propriété entre le 29 juillet et le 1^{er} août 2019. Les forages stratigraphiques ont été réalisés dans l'emprise de l'agrandissement projeté du chenil alors que les sondages manuels, lesquels ont été effectués à l'aide d'une tarière manuelle, ont été effectués en partie dans le secteur de l'agrandissement du chenil et en partie dans le secteur projeté de la mise en place d'un nouveau hangar. Par ailleurs, afin de valider la géométrie des semelles du chenil existant sur le site, un puits d'exploration de faible profondeur a été effectué près de celui-ci. Enfin, afin de déterminer la qualité environnementale et les options de gestion hors site possible, un empilement de sols mis en place sur la propriété lors de travaux d'excavation antérieurs d'environ 3 000 m³ a également été échantillonné à des fins environnementales.

Suivant la réalisation des travaux de terrains, trois échantillons représentatifs des sols ont été soumis à des essais de laboratoire géotechniques, soit des analyses granulométriques (3 échantillons), des analyses sédimentométriques (2 échantillons), des limites de consistances (2 échantillons) et des teneurs en eau (2 échantillons). À des fins environnementales, 21 échantillons de sols prélevés au sein des sondages et 19 échantillons de sols prélevés au sein de l'empilement de sols ont été sélectionnés et soumis à des analyses chimiques en laboratoire pour l'un ou l'autre des paramètres suivants : hydrocarbures pétroliers (HP) F1 à F4, HP C₁₀-C₅₀, hydrocarbures aromatiques polycycliques (HAP), composés organiques volatils (benzène, toluène, éthylbenzène et xylènes) et métaux (14 éléments). Ces paramètres ont été retenus afin de permettre de déterminer le mode de gestion applicable à ces sols pour une gestion hors site de ceux-ci lors des travaux projetés.

Les résultats obtenus lors de la caractérisation chimique sur les sols ont été comparés aux *Recommandations canadiennes pour la qualité de l'environnement* (RQSe) et le *Standard pancanadien relatif aux hydrocarbures pétroliers* (SPHP) du Conseil Canadien des Ministres de l'Environnement (CCME). De façon plus précise, les recommandations pour une vocation commerciale – contact écologique avec le sol - ont généralement été retenues pour le secteur investigué de la propriété en accord avec TPSGC. À noter que ces valeurs ne sont applicables que pour le secteur investigué. Ailleurs sur le site, les valeurs applicables aux recommandations pour un usage résidentiel et parc seraient applicables. Les résultats obtenus ont également été comparés aux critères A, B et C du Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés (PSRTC) du ministère de l'Environnement et de la Lutte aux changements climatiques (MELCC) du Québec afin de déterminer les possibilités de gestion hors site en fonction des normes provinciales en vigueur.

Les concentrations obtenues en HP F1-F4, HAP et BTEX lors de la réalisation des analyses chimiques ont toutes présentées des valeurs inférieures aux recommandations applicables du RQS du CCME et/ou aux critères A du Guide d'intervention – PSRTC. Des concentrations supérieures au RQS du CCME en métaux (chrome) ont toutefois été obtenues dans la majorité des échantillons analysés au droit des sondages effectués dans le secteur de l'agrandissement du chenil et du nouveau hangar projeté (16 des 21 échantillons analysés). Dans le cas de l'empilement, la même situation a été notée pour 5 des 19 échantillons de sols analysés. Enfin, 23 des 40 échantillons de sols analysés ont présenté des concentrations dans la plage A-B en métaux.

En fonction des résultats obtenus, des sols présentant des concentrations supérieures aux recommandations applicables des RQS du CCMES ont été mis au jour sur la propriété. De ce fait, des travaux de réhabilitation environnementale seraient requis dans le secteur investigué à priori. Rappelons toutefois que l'objectif des investigations effectuées était de déterminer le mode de gestion hors site des sols devant être excavés et non de statuer sur la qualité environnementale des sols en place. Par ailleurs, étant donné que la quasi-totalité des anomalies en chrome relevées sur le site est retrouvée dans le dépôt naturel cohérent d'argile silteuse, il est fort probable que ces anomalies soient d'origine naturelle et non anthropique. Seule la réalisation d'investigations environnementales additionnelles permettrait de valider cette hypothèse hors de tout doute.

Étant donné les résultats obtenus lors des présentes investigations, les sols présentant des concentrations supérieures aux recommandations du CCME devront être éliminés hors site advenant leur excavation et ne pourront être remis en place sur la propriété. Ces sols pourront être acheminés vers un site d'élimination autorisé par le MELCC en vertu des dispositions de la grille de gestion des sols contaminés excavés du Guide d'intervention – PSRTC. Il en va de même pour les sols non conformes mis au jour au sein de l'empilement de sols présents sur le site étudié. Basé sur une méthode théorique de polygonation, un volume de l'ordre de 2 100 m³ de sols non conformes a été évalué en place dans le secteur des travaux d'aménagement projetés sur le site.

Abstract

Englobe Corp. (Englobe) has been mandated by Public Services and Procurement Canada (PSPC) to perform a geotechnical investigation combined to a limited soils environmental characterization at the Canada Border Services Agency (CBSA) College's site located at 475 de la Grande-Ligne Road in Rigaud (Quebec). This investigation has been conducted as part of the projected expansion of the kennel located on the site as well as the projected construction of a new hangar.

As part of these works, two (2) stratigraphic boreholes and ten (10) manual soundings were carried out on the property between July 29 and August 01, 2019. The stratigraphic boreholes have been carried out within the limits of the kennel's projected expansion whereas manual soundings that have been carried out using a manual auger, have been carried out in part in the sector of the kennel's expansion and, in part, in the projected sector of the new hangar. Moreover, in order to validate the geometry of the existing kennel's footing, a shallow exploratory well has been performed in its vicinity. Finally, in order to determine the environmental quality and possible off-site management options, a pile of soils that has been set up on the property as part of previous works during which 3,000 m² of soils had been excavated has also been sampled for environmental purposes.

Following fieldworks, three (3) representative soils samples have been submitted to geotechnical laboratory testing, i.e.: particle-size analysis (three (3) samples), sedimentation analysis (two (2) samples), Atterberg limits (two (2) samples) and water content (two (2) samples). For environmental purposes, 21 soils samples collected from the soundings and 19 soils samples collected from the pile of soils have been selected and submitted to chemical analysis for one or several of the following parameters: petroleum hydrocarbons (PHC) F1 to F4, PHC C₁₀-C₅₀, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) (benzene, toluene, ethylbenzene and xylenes) and metals (14). These parameters have been retained to determine the applicable off-site management mode for these soils during the projected works.

Results obtained during the soils characterization have been compared to the *Canadian Environmental Quality Guidelines* (CEQGs) and *Canada-wide Standard for Petroleum Hydrocarbons* (PHC CWS) of the Canadian Council of Ministers of the Environment (CCME). More precisely, in agreement with PSPC, the recommendations for a commercial vocation – ecological contact with soils – have generally

been retained for the investigated sector of the property. It should be noted that these values only apply to the investigated sector. Elsewhere on the site, values applicable to the recommendations for a residential and park use would apply. The results obtained have also been compared to the criteria ("A", "B" and "C") of the *Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés* (Intervention Guide – Protection of Soils and Rehabilitation of Contaminated Sites (Intervention Guide) of the *ministère de l'Environnement et de la Lutte aux changements climatiques* (MELCC) (Ministry of the Environment and Fight against Climate Change) in order to determine the off-site management options with regards to the current provincial norms.

PHC F1-F4, PAHs and BTEX concentrations measured from chemical analyses have all shown values below the CCME's CEQGs and/or the criteria "A" of the Intervention Guide. However, metals (chromium) concentrations exceeding the CCME's CEQGs have been measured in most of the analyzed samples collected from the kennel's expansion sector and new projected hangar (16 out of the 21 samples). As for the pile, the same results have been obtained for 5 of the 19 soils samples. Finally, 23 of the 40 soils samples have shown metals concentrations comprised within the "A-B" range.

Based on the results obtained, soils with concentrations exceeding the applicable CCME's CEQGs have been encountered on the property. Thus, environmental rehabilitation works would be required a priori in the investigated sector. It should be reminded though that these investigations aimed at determining the off-site management mode of the soils to excavate, and not to determine the environmental quality of soils in place. Moreover, since almost all the issues involving chromium have been encountered in the silty clay cohesive natural deposit, it is highly likely that these issues are due to natural reasons and not anthropic ones. Only additional environmental investigations would validate this assumption without question.

Given the results obtained as part of these investigations, soils with concentrations exceeding the CCME's recommendations shall be disposed of off-site if they are excavated, and they shall not be put back on the property. These soils shall be sent to a disposal site authorized by the MELCC under the provisions of the Intervention Guide's *Grille de gestion des sols contaminés excavés* (Management grid for contaminated excavated soils). The same will apply to non-compliant soils encountered within the pile of soils present on the investigated site.

Based on a theoretical polygonization method, a volume in the range of 2,100 m³ of non-compliant soils has been evaluated on the site in the area of the projected work.

Équipe de réalisation

Client

Travaux publics et Services
gouvernementaux Canada (TPSGC)

M. Simon Langlois, spécialiste en environnement
Direction des biens immobiliers

Englobe Corp.

Chargé de projet	M. Philippe-Alexandre Charette, géo. EESA
Planification et suivi des travaux de terrain	M. Philippe-Alexandre Charette, géo. EESA
Rédaction du rapport et interprétation des résultats	<u>Volet géotechnique :</u> Mme Hajar Armouzi, ing. jr. <u>Volet environnement :</u> M. Philippe-Alexandre Charette, géo. EESA® <u>Réviser technique</u> M. Mathieu Langevin, ing. sr – Volet géotechnique M. Frédéric Girard, géo., M.Sc. - Volet environnement
Réalisation des travaux de terrain	M. Louis Bouchard, tech. sr
Validation de la stratigraphie	M. Philippe-Alexandre Charette, géo. EESA
Essais de laboratoire	Laboratoire d'Englobe de Laval
Mise en page	Mme Isabelle Lafrenière

Sous-traitants

Réalisation des forages	Forage André Roy inc.
Réalisation du puits d'exploration	Les Entreprises Gaétan Jr
Localisation des services souterrains privés	Promark Telecon
Arpentage des sondages	Les Services Topo F. Martin
Réalisation des analyses chimiques	Laboratoire de chimie analytique Bureau Veritas

Registre des émissions		
N° de révision	Date	Description
00	2019-10-29	Rapport final
0A	2019-09-24	Rapport préliminaire

Distribution	
Nombre de copies	Destinataire
1 original + 1 copie reliée et 1 copie électronique (pdf)	M. Simon Langlois simon.langlois@tpsgc-pwgsc.gc.ca

Propriété et confidentialité

« Ce document est destiné exclusivement aux fins qui y sont mentionnées. Toute utilisation du rapport doit prendre en considération l'objet et la portée du mandat en vertu duquel le rapport a été préparé ainsi que les limitations et conditions qui y sont spécifiées et l'état des connaissances scientifiques au moment de l'émission du rapport. Englobe Corp. ne fournit aucune garantie ni ne fait aucune représentation autre que celles expressément contenues dans le rapport.

Ce document est l'œuvre d'Englobe Corp. Toute reproduction, diffusion ou adaptation, partielle ou totale, est strictement prohibée sans avoir préalablement obtenu l'autorisation écrite d'Englobe et de son Client. Pour plus de certitude, l'utilisation d'extraits du rapport est strictement interdite sans l'autorisation écrite d'Englobe et de son Client, le rapport devant être lu et considéré dans sa forme intégrale.

Aucune information contenue dans ce rapport ne peut être utilisée par un tiers sans l'autorisation écrite d'Englobe et de son Client. Englobe Corp. se dégage de toute responsabilité pour toute reproduction, diffusion, adaptation ou utilisation non autorisée du rapport.

Si des essais ont été effectués, les résultats de ces essais ne sont valides que pour l'échantillon décrit dans le présent rapport.

Les sous-traitants d'Englobe qui auraient réalisé des travaux au chantier ou en laboratoire sont dûment évalués selon la procédure relative aux achats de notre système qualité. Pour toute information complémentaire ou de plus amples renseignements, veuillez communiquer avec votre chargé de projet. »

Table des matières

1	INTRODUCTION	1
2	DESCRIPTION DU SITE ET DU PROJET	3
2.1	Description du site et du projet.....	3
3	MÉTHODE DE RECONNAISSANCE	5
3.1	Localisation et implantation des sondages.....	5
3.2	Travaux de terrain	5
3.2.1	Forages	5
3.2.2	Aménagement de tubes ouverts	6
3.2.3	Puits d'exploration	6
3.2.4	Sondages manuels	6
3.2.5	Échantillonnage manuel d'un empilement de sols.....	6
3.2.6	Procédures d'échantillonnage des sols	7
3.3	Arpentage.....	8
3.4	Travaux de laboratoire	9
3.4.1	Volet géotechnique	9
3.4.2	Volet environnemental	9
4	NATURE ET PROPRIÉTÉS DES MATÉRIAUX.....	11
4.1	Sommaire de la stratigraphie	11
4.2	Pierre concassée.....	11
4.3	Remblai	12
4.4	Sol naturel	12
4.4.1	Dépôt cohérent.....	12
4.4.2	Dépôt de till	13
5	CONFIGURATION DES SEMELLES EXISTANTES.....	14
6	EAU SOUTERRAINE.....	15
7	DISCUSSION ET RECOMMANDATIONS – VOLET GÉOTECHNIQUE.....	16
7.1	Mise en contexte	16
7.2	Paramètres sismiques.....	16
7.2.1	Potentiel de liquéfaction des sols.....	16
7.2.2	Catégorie d'emplacement	16
7.2.3	Accélération spectrale.....	16
7.3	Excavations	17
7.3.1	Recommandations générales	17
7.3.2	Pentes d'excavations temporaires	17
7.3.3	Soutènement temporaire.....	18
7.4	Drainage lors des travaux de construction	19

7.5	Fondations superficielles	19
7.5.1	Profondeur de pénétration du gel	19
7.5.2	Implantation des fondations et préparation de l'assise	19
7.5.3	Résistances géotechniques aux états limites	20
7.5.3.1	État limite ultime (ÉLU) lié à la capacité portante	20
7.5.3.2	Résistance géotechnique à l'état de tenue de service, ELTS	21
7.6	Dalle sur sol (chauffée)	22
7.7	Remblayage des murs de fondation et poussées latérales	22
7.8	Recommandations générales	23
7.8.1	Sensibilité du sol au remaniement	23
7.8.2	Surveillance de chantier	23
7.8.3	Conditions hivernales	24
8	DISCUSSION ET RECOMMANDATIONS – VOLET ENVIRONNEMENTAL	25
8.1	Choix des critères comparatifs	25
8.2	Résultats et interprétation des analyses chimiques	25
8.3	Interprétation des résultats de caractérisation environnementale des sols	27
8.4	Contrôle de la qualité sur les sols	28
8.5	Évaluation des volumes de sols affectés en place	29
8.6	Conclusions environnementales	30
8.7	Recommandations environnementales	31

Tableaux

Tableau 1	Localisation des stations d'échantillonnage de l'empilement EMP-1 – MTM NAD 83, Fuseau 8.....	7
Tableau 2	Essais géotechniques réalisés en laboratoire	9
Tableau 3	Résumé des unités stratigraphiques au droit des sondages réalisés lors de ce mandat.....	11
Tableau 4	Résultats de l'analyse granulométrique – Matériau de remblai	12
Tableau 5	Résultats des essais de détermination des limites de consistance et des teneurs en eau naturelle – Dépôt cohérent.....	13
Tableau 6	Résultats des analyses granulométriques et sédimentométriques – Dépôt cohérent.....	13
Tableau 7	Mesure du niveau de l'eau souterraine dans le forage le 6 août 2019	15
Tableau 8	Accélération spectrale et accélération maximale du sol pour un site de classe C17	
Tableau 9	Paramètres de conception pour le soutènement temporaire	18
Tableau 10	Paramètres géotechniques.....	21
Tableau 11	Résistances géotechniques pondérées aux ÉLU pour les semelles filantes et carrées.....	21
Tableau 12	Résistances géotechniques à L'ELTS pour des semelles conventionnelles	21
Tableau 13	Paramètres géotechniques pour le calcul de la poussée des terres	23
Tableau 14	Résultat d'analyses chimiques réalisées sur les sols en laboratoire en comparaison avec les critères provinciaux (critères A, B et C) ou recommandations fédérales (RQS).....	26

Figures

Figure 1	Localisation générale du site étudié	3
Figure 2	Localisation des emprises étudiées et aménagements projetés – Collège des Douanes	4

Annexes

Annexe A	Portée de l'étude géotechnique et environnementale
Annexe B	Rapport photographique
Annexe C	Figures
Annexe D	Tableaux
Annexe E	Note explicative et rapports de sondages
Annexe F	Résultats des essais en laboratoire
Annexe G	Procédures de prélèvement, de transport et de conservation des échantillons
Annexe H	Certificats analytiques
Annexe I	Cadre législatif et réglementaire et Guide d'intervention - PSRTC du MELCC

1 Introduction

Les services professionnels d'Englobe Corp. (Englobe) ont été retenus par Travaux Publics et Services gouvernementaux Canada (TPSGC) afin d'effectuer une étude géotechnique et une caractérisation environnementale sommaire des sols dans le cadre d'implantation d'un nouveau hangar et l'agrandissement du chenil du collège des douanes sis au 475, chemin de la Grande-Ligne à Rigaud, dans la province de Québec.

Cette étude a été menée en accord avec les termes de notre proposition de services professionnels n° 2019-P025-0266-01 datée du 10 mai 2019 et approuvée par le client le 14 mai 2019 via le bon de commande n° 700447111.

Les travaux de reconnaissance sur le terrain avaient pour but de définir la stratigraphie et les propriétés des sols en place ainsi que les conditions de l'eau souterraine dans l'emprise du site à l'étude.

Les informations recueillies au droit des sondages ont permis à Englobe de formuler des recommandations géotechniques pertinentes pour la conception du projet, en particulier en ce qui concerne :

- ▶ La nature, les propriétés et la stratigraphie des sols porteurs;
- ▶ Le niveau de l'eau souterraine;
- ▶ La protection des fondations contre le gel;
- ▶ L'exécution des travaux d'excavation;
- ▶ Les pentes d'excavation et le soutènement temporaire dans les sols;
- ▶ Le drainage temporaire et permanent;
- ▶ La catégorie d'emplacement à utiliser dans le calcul des charges sismiques conformément au CNBC 2010;
- ▶ Les résistances géotechniques aux états limites des sols conformément au Code national du bâtiment du Canada 2010 (CNBC 2010);
- ▶ Le remblayage des excavations;
- ▶ Toutes autres recommandations géotechniques pertinentes au projet.

Simultanément à l'étude géotechnique, une étude de caractérisation environnementale sommaire des sols a été réalisée par notre firme afin de valider la qualité environnementale des sols présents au droit des sondages effectués ainsi qu'au sein d'un empilement de sols présent sur le site afin de déterminer le mode de gestion hors site de ceux-ci lors des travaux d'excavation projetés sur le site. Par ailleurs, étant donné que la propriété correspond à un site sous juridiction fédérale, les résultats obtenus lors des présentes investigations ont été comparés aux recommandations fédérales applicables afin de déterminer leur possibilité de réutilisation d'un point de vue environnemental sur le site.

Il est toutefois important de relever que les résultats obtenus lors des présentes investigations environnementales ne représentent que les conditions aux points des sondages et n'excluent en rien la possibilité de retrouver ailleurs sur le site à l'étude des concentrations différentes à celles mesurées ou des contaminants de natures différentes.

Le présent rapport contient la description du projet et du site à l'étude, les méthodes de reconnaissance, les résultats des sondages ainsi que l'analyse des données. Un chapitre est consacré à l'interprétation des résultats de terrain, des essais de laboratoire et d'analyses chimiques et aux recommandations géotechniques et environnementales.

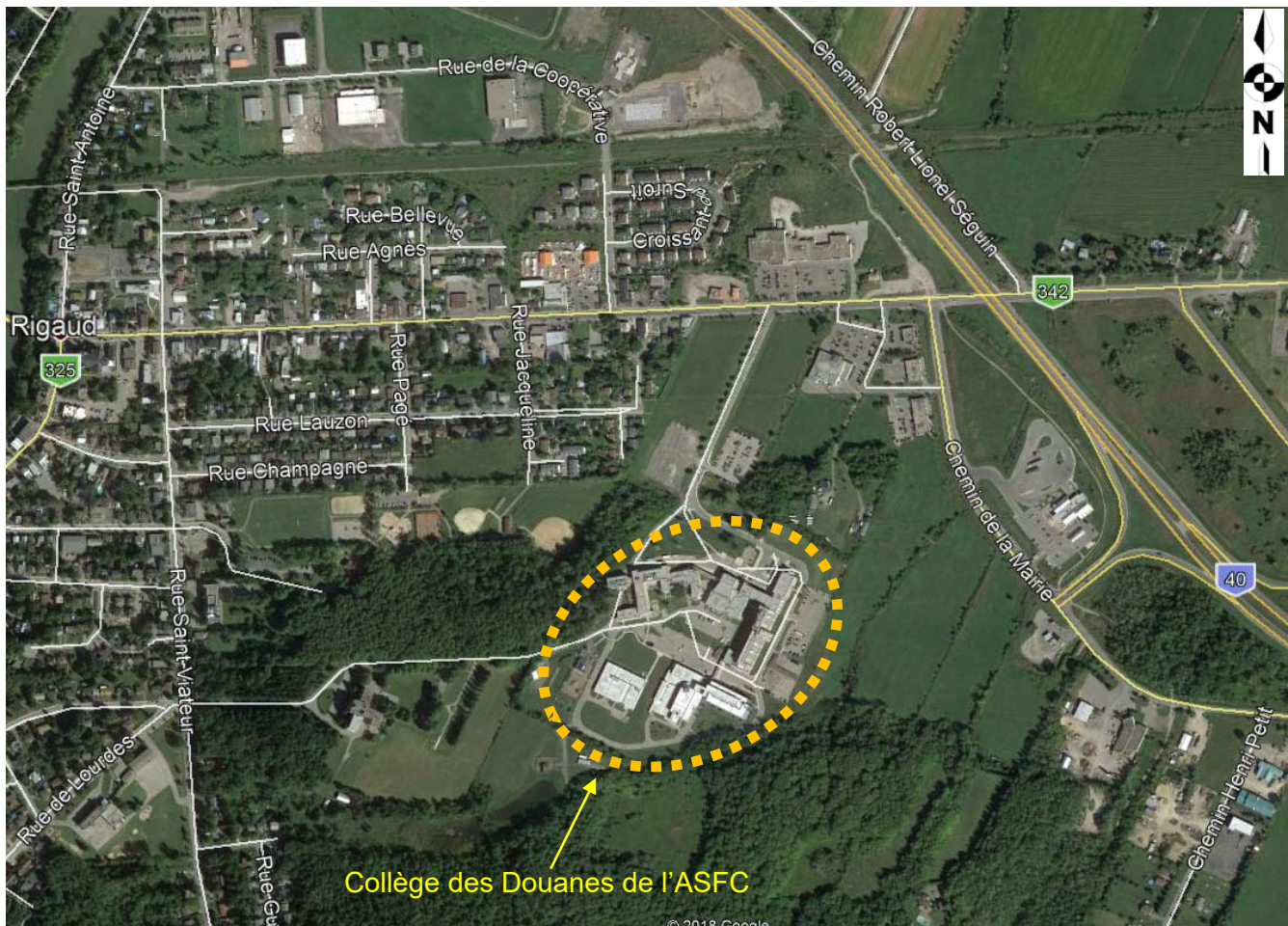
La portée et les limitations du présent rapport sont précisées à l'annexe A. Ces commentaires s'avèrent importants pour une bonne compréhension des informations contenues dans le rapport et doivent être considérés comme faisant partie intégrante de celui-ci.

2 Description du site et du projet

2.1 Description du site et du projet

Le site à l'étude est situé sur le terrain du Collège des Douanes de l'Agence des Services Frontaliers du Canada (ASFC). De façon plus précise, le site étudié est situé au 475, chemin de la Grande-Ligne dans la Ville de Rigaud, province de Québec. On pourra se référer à la figure 1 ci-dessous afin de visualiser l'emprise du site étudié par rapport aux principales rues du secteur.

Figure 1 Localisation générale du site étudié



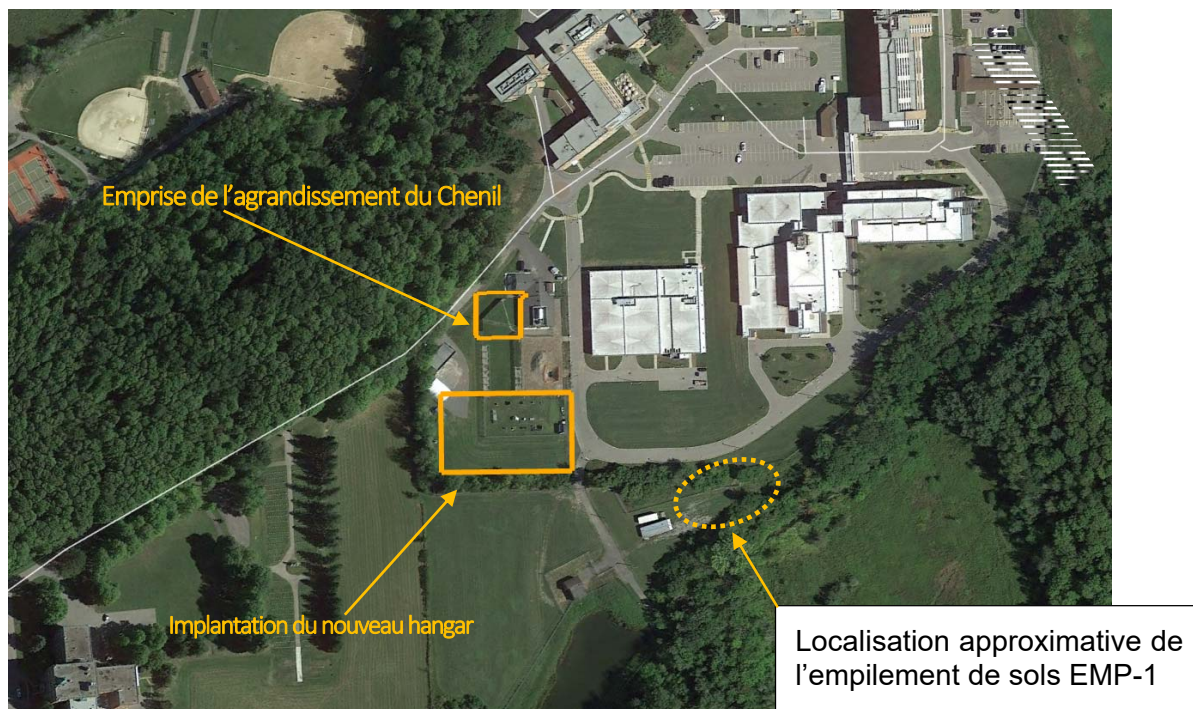
Selon les informations disponibles, la construction d'un nouveau hangar d'entraînement composé d'un seul étage et sans sous-sol et l'agrandissement du chenil sont projetés sur le site à l'étude.

L'agrandissement du chenil comprend les aménagements suivants :

- ▶ Ajout de 12 enclos intérieurs et 12 autres extérieurs;
- ▶ Implantation d'un nouveau bureau de technicien avec 5 stations de travail;
- ▶ Implantation d'une nouvelle salle de conciergerie;
- ▶ Nouvel accès pavé.

Le site à l'étude est actuellement vacant et de topographie relativement plane. La surface du site est généralement herbacée. La figure ci-dessous illustre la localisation des secteurs investigués sur la propriété à l'étude.

Figure 2 Localisation des emprises étudiées et aménagements projetés – Collège des Douanes



On pourra se référer aux photographies terrestres présentées à l'annexe B afin de visualiser l'occupation du site investigué lors de la réalisation des présentes investigations.

3 Méthode de reconnaissance

3.1 Localisation et implantation des sondages

Préalablement à la réalisation des sondages, la localisation des services publics et privés souterrains (électricité, gaz, téléphone, aqueduc, égouts, etc.) a été effectuée à l'aide de demandes de localisation auprès d'Info-Excavation. Finalement, l'entreprise Promark Telecon a été mandatée, le 29 août 2019, pour effectuer une localisation des infrastructures souterraines privées.

Suivant ces étapes, les sondages ont été implantés sur le site par notre inspecteur de terrain au droit de l'emprise des aménagements projetés.

3.2 Travaux de terrain

Les travaux de terrain ont consisté en la réalisation de deux forages, un puits d'exploration et dix sondages manuels. Un empilement de sols de remblai, mis en place sur la propriété lors de travaux antérieurs d'excavation des sols, a également été échantillonné de façon manuelle. Les forages et le puits d'exploration ont été réalisés dans l'emprise projetée de l'agrandissement du chenil alors les sondages manuels ont été dûment répartis dans l'emprise du hangar projeté. À noter que les sondages manuels et l'empilement ont uniquement été échantillonnés à des fins environnementales et qu'aucun échantillon de sols n'a été prélevé au sein du puits d'exploration, celui-ci étant réalisé uniquement afin de permettre l'observation de la géométrie des semelles de fondation du bâtiment existant abritant le chenil.

Les rapports détaillés des sondages réalisés sont présentés à l'annexe E du présent document tandis que leur localisation est montrée à la figure 1 de l'annexe C.

3.2.1 Forages

Dans le cadre des présentes investigations, deux forages, désignés TF-01-19 et TF-02-19, ont été effectués dans l'emprise de l'agrandissement projeté du chenil les 29 et 30 août 2019. Ces forages ont été réalisés à l'aide d'une foreuse de type CME-55 montée sur chenilles de la compagnie Forage André Roy inc. sous la supervision constante de notre inspecteur spécialisé en géotechnique et environnement. Ces forages ont atteint des profondeurs respectives de 5,49 m et 9,10 m.

Lors de la réalisation des forages, l'échantillonnage des sols a été effectué à l'aide d'un carottier fendu normalisé de 51 mm de diamètre extérieur (calibre B). Lors du prélèvement de ces échantillons, l'indice de pénétration standard « N_{SPT} » a été mesuré selon les exigences de la norme ASTM-D-1586.

Deux essais scissométriques, permettant de mesurer la résistance au cisaillement à l'état intact et remanié du dépôt cohérent, ont été réalisés au droit des deux forages. Ces essais ont été interrompus à 5,90 m de profondeur suivant l'atteinte du refus.

3.2.2 Aménagement de tubes ouverts

Afin de déterminer la profondeur de l'eau souterraine, un tube ouvert a été installé au droit du forage TF-02-19.

Ce tube ouvert est composé d'une section crépinée en CPV de 19 mm de diamètre intérieur relié à un tube plein de même matériau et diamètre. L'espace annulaire entre le tubage de PVC et les parois du forage a été comblé, de façon générale, par un sable de silice au niveau de la crépine jusqu'au bouchon de bentonite près de la surface. Ce tube ouvert a été terminé en surface par une boîte de service en aluminium de 150 mm de diamètre installée à égalité du sol.

Le détail de cet aménagement est illustré sur le rapport du forage TF-02-19 inclus à l'annexe E.

3.2.3 Puits d'exploration

Un puits d'exploration, numéroté PU-01-19, a été effectué en bordure du chenil existant, le 31 juillet 2019. Ce puits d'exploration a été réalisé à l'aide d'une rétrocaveuse de marque Caterpillar, modèle 420 E, de la firme Excavation Gaétan Jr Inc. Le puits d'exploration a atteint une profondeur de 0,75 m correspondant à la profondeur du mur de fondation existant. Rappelons que le but de ce puits d'exploration était de définir le niveau d'assise et le type des fondations en place. Suivant ces travaux, le puits d'exploration a été remblayé avec les matériaux excavés remis en place dans l'ordre inverse de leur excavation et par couches successives. Les matériaux ont été compactés par le godet de la rétrocaveuse au fur et à mesure qu'ils étaient remis dans l'excavation.

Les informations concernant une partie des fondations du bâtiment existant sont présentées sur la figure 1 à l'annexe C.

3.2.4 Sondages manuels

Dix sondages manuels, identifiés TA-01-19 à TA-10-19, ont été effectués sur le site les 31 juillet et 1^{er} août 2018. Ces sondages ont été effectués dans le secteur projeté de l'agrandissement du chenil (TA-01-19 et TA-02-19) ou d'un nouveau hangar (TA-03-19 à TA-10-19) par notre inspecteur de terrain à l'aide d'une tarière manuelle et ont atteint des profondeurs allant de 800 mm à 900 mm. Rappelons que ces sondages ont été réalisés uniquement à des fins environnementales afin de déterminer la qualité environnementale des sols qui seront excavés lors des travaux d'aménagement projeté dans ce secteur.

3.2.5 Échantillonnage manuel d'un empilement de sols

Afin de déterminer la qualité environnementale d'un empilement de sols de remblai mis en place sur la propriété du Collège des Douanes lors de travaux d'excavation antérieurs, notre firme a procédé, le 31 juillet 2019, à des travaux d'échantillonnage manuel de cet empilement.

De façon plus précise, l'empilement a d'abord été localisé sur le site avec un représentant de TPSGC, celui-ci ne se trouvant pas dans le secteur des travaux d'aménagement projetés sur le site. Cet empilement a ensuite été mesuré puis segmenté en plusieurs sections afin de permettre son échantillonnage en fonction du volume de sol estimé en place. Selon ce relevé, un empilement de 40 m de longueur par 17 m de largeur et de 4 à 5 m de hauteur était

présent sur le site, pour un volume de l'ordre de 3 000 m³. Étant donné l'envergure de l'empilement, la rétrocaveuse utilisée lors de la réalisation du puits d'exploration a été utilisée afin de réaliser 20 ouvertures dans l'empilement préliminairement à son échantillonnage. Suivant cette étape, 20 échantillons composites de sols, désignés EMP1-E1 à EMP1-E20, ont été prélevés le même jour. Il est toutefois pertinent de relever que l'échantillon EMP1-E7 a été perdu suite à ces travaux.

Le tableau suivant présente la localisation des différentes stations d'échantillonnage au sein de l'empilement (coordonnées GPS). À noter que des piquets ont été laissés en place sur l'empilement afin d'identifier chacun des secteurs concernés.

Tableau 1 Localisation des stations d'échantillonnage de l'empilement EMP-1 – MTM NAD 83, Fuseau 8

Station d'échantillonnage – EMP-1	Coordonnées Nord (m)	Coordonnées Est (m)
1	5037395	242840
2	5037393	242840
3	5037388	242842
4	5037384	242841
5	5037392	242850
6	5037391	242851
7	5037388	242850
8	5037383	242848
9	n.d.	n.d.
10	5037389	242856
11	5037387	242855
12	5037382	242853
13	5037395	242861
14	5037389	242860
15	5037386	242859
16	5037385	242857
17	5037391	242863
18	5037389	242868
19	5037390	242871
20	5037390	242877

On pourra également se référer aux figures 6 et 7 à l'annexe C afin de visualiser l'emplacement des différentes stations d'échantillonnage au sein de l'empilement EMP-1.

3.2.6 Procédures d'échantillonnage des sols

Les procédures de prélèvement, de transport et de conservation des échantillons prélevés à des fins environnementales ont été réalisées en tenant compte des méthodologies proposées dans le *Guide de caractérisation* du ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) du Québec et les cahiers aux fins d'échantillonnage

associés ainsi qu'en tenant compte des procédures édictées dans les Guides sur la caractérisation environnementale des sites dans le cadre de l'évaluation des risques pour l'environnement et la santé humaine, volume 1 à 4, du CCME. Avant chaque prélèvement, les instruments (truelle, carottier fendu ou autre) pouvant avoir été en contact avec les échantillons ont été nettoyés conformément aux recommandations du *Guide d'échantillonnage à des fins d'analyses environnementales*. Les procédures de prélèvement sont présentées plus en détail à l'annexe G.

Compte tenu des méthodes d'investigation par sondages et que ces travaux ont été effectués dans un contexte de caractérisation, les échantillons sont de type ponctuel et ont été prélevés afin d'éviter toute dilution d'une éventuelle contamination. Aucun échantillon composé n'a été formé lors de la caractérisation environnementale du sol.

Dans le cas des forages, l'échantillonnage environnemental des sols a été effectué par l'enfoncement d'une cuillère fendue de calibre standard « B » de 51 mm de diamètre extérieur.

Dans le cas de l'empilement de sols, chaque section de la pile a été échantillonnée de façon individuelle. De façon plus précise, entre 3 et 5 sous-échantillons de sols ont été prélevés dans chaque section de l'empilement avant d'être homogénéisés puis récupérés dans les contenants dédiés du laboratoire analytique (échantillons de type composite). Si requis, les sols destinés à l'analyse de composés volatils ont été prélevés de façon ponctuelle localement.

Les échantillons destinés à l'analyse des volatils ont été prélevés à l'aide d'échantillonneurs à usage unique de type « Terracore » ou « seringues » puis préservés au sein de fioles préalablement préparées par le laboratoire analytique et contenant du méthanol comme préservatif en accord avec les guides d'échantillonnage à des fins environnementales. Les échantillons destinés à l'analyse des composés non volatils ont été prélevés dans des contenants réservés à cette fin et fournis par le laboratoire de chimie analytique sous-traitant. Enfin, des échantillons de sols ont également été prélevés au sein de sacs de plastique afin de permettre la réalisation d'essais géotechniques.

Les échantillons recueillis ont été décrits afin d'identifier la nature et le type de sol. Les intervalles de profondeurs de prélèvement des échantillons dans les sondages sont notés dans les rapports de sondage à l'annexe E. À noter qu'aucun rapport de sondage n'a été produit pour les sols de remblai prélevés au sein de l'empilement de sols.

3.3 Arpentage

Une fois les sondages complétés, un relevé de nivellement géodésique a été effectué par une firme d'arpentage privée, soit Les Services Topo F. Martin, le 6 août 2019. Les coordonnées X, Y et Z des sondages ont été relevées à l'aide d'un GPS de haute précision, en système de coordonnées SCOPQ-NAD 83 basé sur la projection MTM (fuseau 8). Toutes les élévations présentées dans ce rapport sont géodésiques.

3.4 Travaux de laboratoire

3.4.1 Volet géotechnique

Tous les échantillons prélevés dans les sondages ont été transportés à notre laboratoire de géotechnique pour les besoins d'analyses, d'identification et de classification. Ils ont tous fait l'objet d'un examen visuel attentif de la part d'un géotechnicien.

Différents échantillons des sols prélevés des forages, jugés représentatifs, ont été soumis à des essais en laboratoire afin de compléter les informations recueillies au moment des travaux de chantier. Le tableau 2 ci-dessous présente la répartition des essais réalisés.

Tableau 2 Essais géotechniques réalisés en laboratoire

Forage n°	Échantillon n°	Profondeur (m)	Analyse granulométrique (LC 21-040)	Sédimentométrie (NQ 2501-0250)	Limites de consistance (BNQ 2501-092)	Teneur en eau (NQ 2501-170)
TF-01-19	CF-1A	0,00 – 0,25	✓	-	-	-
	CF-5	2,44 – 3,05	✓	✓	-	-
	CF-6	3,05 – 3,66	-	-	✓	✓
TF-02-19	CF-4	1,83 – 2,44	✓	✓	✓	✓

Tous les échantillons prélevés dans les forages et n'ayant pas servi aux essais de laboratoire seront conservés pour une période de 3 mois à compter de la date de fin des travaux de chantier. Après quoi, ils seront détruits à moins qu'un avis écrit quant à leur destination nous soit transmis.

Les résultats des essais en laboratoire sont présentés dans les colonnes appropriées des rapports de forage à l'annexe E et sous forme de graphiques à l'annexe F.

3.4.2 Volet environnemental

Tous les échantillons prélevés à des fins environnementales dans les forages ont été vérifiés en chantier afin de déceler la présence d'indices organoleptiques (visuel et olfactif) typiques d'une contamination par des produits pétroliers. À cet effet, aucun indice typique d'une contamination par des produits pétroliers n'a été décelé sur les échantillons environnementaux.

Le programme analytique pour les sols a été établi en collaboration avec TPSGC en fonction des principaux contaminants demandés par les sites autorisés d'élimination de sol et en fonction de la vocation fédérale de la propriété, ainsi qu'en tenant compte des recommandations présentées à l'annexe IX du *Guide de caractérisation des terrains* du MELCC. Les échantillons de sols soumis pour analyses chimiques ont été sélectionnés selon leur nature, leur profondeur et les indices visuels ou olfactifs de contamination détectés en chantier (texture, couleur, odeur, présence de débris). Les paramètres analytiques suivants ont été retenus : les hydrocarbures pétroliers (HP) C₁₀-C₅₀, les hydrocarbures aromatiques polycycliques (HAP), les métaux extractibles totaux (As, Ag, Ba, Cd, Co, Cr, Cu, Sn, Mn, Mo, Ni, Pb, Se et Zn), le benzène, le toluène, l'éthylbenzène et les xylènes totaux (BTX) et hydrocarbures pétroliers (HP) F1 à F4. Le tableau D.1 de l'annexe D résume la nature et le nombre d'analyses effectuées sur les échantillons de sols dans le cadre des présentes

investigations. Au total, 40 échantillons de sols ont été analysés pour l'un ou l'autre des paramètres retenus.

Par ailleurs, Englobe maintient un système d'assurance et de contrôle de la qualité à l'intérieur de tous les projets qui lui sont confiés. Celui-ci inclut une réunion de démarrage, l'élaboration d'un programme de travail au chantier, des procédures d'échantillonnage standardisées, le tout conçu de façon à assurer la flexibilité nécessaire aux exigences de chaque projet et à assurer le niveau de qualité requis. De plus, toujours en conformité avec les *Guides d'échantillonnage à des fins d'analyses environnementales* du MELCC, un minimum de 10 % des échantillons analysés l'est en duplicata de terrain dans un but de contrôle et d'assurance de la qualité. Rappelons qu'un duplicata de terrain consiste en 2 sous-échantillons provenant d'un seul échantillon homogénéisé, qu'il soit ponctuel ou composé. Dans le cadre des présentes investigations environnementales, lesquelles doivent être considérées comme étant sommaire, un total de quatre duplicatas de terrain ont été analysés en laboratoire, soit pour environ 10 % des échantillons de sols analysés.

Les analyses chimiques réalisées dans le cadre du mandat ont été confiées au laboratoire Bureau Veritas de Montréal (anciennement Maxxam) lequel est dûment accrédité par le MELCC pour l'analyse des paramètres visés en vertu du programme d'accréditation des laboratoires d'analyse environnementale (PALA, article 118.6 de la LQE). Les méthodes analytiques et les limites de détection (LDR) des appareils utilisés par le laboratoire sont présentées aux certificats d'analyses chimiques joints à l'annexe H.

Laboratoire accrédité : Le laboratoire sous-traitant applique également un programme d'assurance et contrôle de la qualité sur l'ensemble de ses procédures analytiques. Le programme d'assurance qualité comprend une série d'activités destinées à vérifier le bon fonctionnement de l'ensemble des démarches associées à l'obtention des résultats d'analyses chimiques. Le programme de contrôle de qualité, quant à lui, s'applique à un ensemble d'activités et de vérifications intra-laboratoires. Ce programme de contrôle définit toutes les étapes essentielles du processus analytique appliqué à un échantillon spécifique depuis la réception et l'entreposage jusqu'à la validation des résultats. Le programme prévoit également jusqu'à cinq types de contrôle de la qualité de la procédure analytique : blancs de méthode analytique, duplicata, échantillons fortifiés, matériau de référence et les étalons analogues (« surrogates »).

Englobe a consulté le contrôle qualité du laboratoire afin de s'assurer que les éventuelles anomalies ont été rapportées et que les commentaires fournis correspondent à des situations qui n'impactent pas la qualité des résultats fournis.

4 Nature et propriétés des matériaux

4.1 Sommaire de la stratigraphie

La présente section traite des unités stratigraphiques mises en évidence à l'emplacement des sondages réalisés dans le cadre de la présente étude. Les formations stratigraphiques rencontrées comprennent :

- ▶ Pierre concassée;
- ▶ Matériaux de remblai;
- ▶ Dépôt cohérent;
- ▶ Dépôt de till.

La description détaillée des matériaux rencontrés à l'emplacement des sondages peut être consultée sur les rapports individuels de sondages à l'annexe E.

Le tableau 3 résume la stratigraphie interceptée au droit des sondages.

Tableau 3 Résumé des unités stratigraphiques au droit des sondages réalisés lors de ce mandat

Sondage n°	Profondeur (m)				
	Pierre concassée	Matériaux de remblai	Sol naturel		Fin de sondage
			Dépôt cohérent	Dépôt de till	
TF-01-19	--	0,00 – 0,25	0,25 – ≥ 5,45	--	5,45
TF-02-19	0,00 – 0,20	--	0,20 – 6,33	6,33 -- ≥ 9,09	9,09
PU-01-19	0,00 – 0,75	--	--	--	0,75
TA-01-19	--	0,00 – 0,15	0,15 – 0,80	--	0,80
TA-02-19	--	0,00 – 0,35	0,35 – 0,80	--	0,80
TA-03-19	--	--	0,00 – 0,80	--	0,80
TA-04-19	0,00 – 0,20	--	0,20 – 0,80	--	0,80
TA-05-19	0,00 – 0,30	--	0,30 – 0,90	--	0,90
TA-06-19	0,00 – 0,25	--	0,25 – 0,80	--	0,80
TA-07-19	--	0,00 – 0,15	0,15 – 0,80	--	0,80
TA-08-19	--	0,00 – 0,25	0,25 – 0,80	--	0,80
TA-09-19	--	0,00 – 0,20	0,20 – 0,80	--	0,80
TA-10-19	--	0,00 – 0,25	0,25 – 0,80	--	0,80

4.2 Pierre concassée

Une couche de pierre concassée de calibre apparent 0-20 mm a été interceptée en surface, au droit des sondages TF-02-19, PU-01-19, TA-04-19, TA-05-19 et TA-06-19, sur des épaisseurs allant de 200 mm à 750 mm. La compacité apparente de ce matériau semble compacte

4.3 Remblai

Des matériaux de remblai ont été rencontrés directement en surface au droit de l'ensemble des sondages sauf pour les sondages TF-02-19, PU-01-19 et de TA-03-19 à TA-06-19. Ce remblai est composé d'un mélange de silt et de sable en proportions variables avec des traces de gravier de couleur brune. Aucune matière résiduelle n'a été relevée dans ces sols. La présence de matière organique a été également remarquée. Le remblai est de compacité moyenne et a des épaisseurs allant de 150 mm à 350 mm. La compacité apparente de cette couche se qualifie de compacte.

Une analyse granulométrique a été réalisée sur un échantillon représentatif des matériaux de remblai. Le tableau 4 résume les résultats obtenus. Le rapport d'analyse est présenté à l'annexe F.

Tableau 4 Résultats de l'analyse granulométrique – Matériau de remblai

Forage n°	Éch. n°	Prof. (m)	% passant et dimension des particules		
			Gravier > 5 mm	Sable < 5 mm et > 80 µm	Silt et argile < 80 µm
TF-01-19	CF-1A	0,00 – 0,25	2,1	58,3	39,6

4.4 Sol naturel

4.4.1 Dépôt cohérent

Directement sous les matériaux de remblai ou la pierre concassée, un dépôt cohérent a été intercepté dans tous les sondages sauf pour le sondage TA-03-19 où il a été rencontré directement en surface.

Le dépôt cohérent est décrit comme une argile et silt avec des traces de sable de couleur brune en surface et devenant grise à partir de 3,05 m profondeur.

Deux profils de résistance au cisaillement à l'état intact et remanié ont été réalisés in situ à l'emplacement des forages TF-01-19 et TF-02-19, à partir des profondeurs 2,9 m et 3,3 m respectivement. Les valeurs de résistance au cisaillement à l'état intact (4 essais pour chaque forage) varient entre 55 et 184 kPa, qualifiant la consistance de ce dépôt de très raide en surface à raide en profondeur. Les valeurs mesurées à l'état remanié varient de 5,1 et 9,4 kPa. La sensibilité des argiles au remaniement (St), exprimée par le rapport des valeurs de résistance à l'état intact (Cu) et remanié (Cur), est qualifiée de forte à très forte.

Des essais de détermination des limites de consistance, des teneurs en eau naturelle ainsi que des analyses granulométriques et sédimentométriques du dépôt cohérent ont été effectués sur des échantillons représentatifs.

Tableau 5 Résultats des essais de détermination des limites de consistance et des teneurs en eau naturelle – Dépôt cohérent

Forage n°	Éch. n°	Prof. (m)	W _n (%)	W _L (%)	W _p (%)	IP (%)	IL (%)	Classification USCS
TF-01-19	CF-6	3,05 – 3,66	43,9	67	30	37	0,4	CH
TF-02-19	CF-4	1,83 – 2,44	39,6	70	31	39	0,2	CH

W_n : teneur en eau naturelle

W_L : limite de liquidité

W_p : limite de plasticité

I_p : indice de plasticité (indice calculé)

I_L : indice de liquidité (indice calculé)

Tableau 6 Résultats des analyses granulométriques et sédimentométriques – Dépôt cohérent

Forage n°	Éch. n°	Prof. (m)	% passant et dimension des particules			
			Gravier > 5 mm	Sable < 5 mm et > 80 µm	Silt ou silt et argile < 80 µm	Argile
TF-01-19	CF-5	2,44 – 3,05	0,0	0,8	39,2	60,0
TF-02-19	CF-4	1,83 – 2,44	0,0	0,4	41,7	57,9

Les résultats de ces essais confirment qu'il s'agit d'une argile et silt en surface devenant argile silteuse en profondeur.

4.4.2 Dépôt de till

Un dépôt de till a été intercepté directement en dessous du dépôt cohérent au droit du forage TF-02-19. Le till se compose d'un mélange de sable, de gravier et de silt en proportions variables. Il est de couleur grise.

L'indice de pénétration standard « N_{SPT} » a été mesuré à plusieurs reprises dans cette couche, qualifiant sa compacité de moyenne à très dense profonde.

L'échantillonnage du forage s'est terminé dans le dépôt granulaire à une profondeur de 9,09 m.

5 Configuration des semelles existantes

La tranchée d'exploration a permis de définir la configuration et le niveau d'assise du mur de fondation du bâtiment existant.

Dans la tranchée PU-01-19, le mur de fondation en béton a une hauteur de 0,60 m mesurée par rapport à la surface du terrain actuel. Le mur repose directement sur la pierre concassée. Aucune semelle n'a été rencontrée.

Le rapport illustrant la tranchée de reconnaissance est présenté à l'annexe E.

6 Eau souterraine

Un tube ouvert a été installé avant le retrait du tubage dans les sols au droit du forage TF-02-19. Le tableau 7 ci-dessous présente la mesure relevée le 6 août 2019. À noter que la profondeur de l'eau souterraine est présentée par rapport au niveau du sol.

Tableau 7 Mesure du niveau de l'eau souterraine dans le forage le 6 août 2019

Forage n° [Élévation (m)]	Type d'installation	Profondeur du niveau d'eau (m) [Élévation (m)]
TF-02-19 [47,42]	Tube ouvert de 19 mm de diamètre	5,61 [41,81]

Les informations relatives aux conditions d'eau souterraine doivent être interprétées avec circonspection puisque les conditions se rapportent uniquement à celles observées à l'endroit et à la date indiqués dans ce rapport. Il est important de noter que le niveau de l'eau dans les sols peut être influencé par plusieurs facteurs, tels que les précipitations, la fonte des neiges et les modifications apportées au milieu physique. Ainsi, le niveau de l'eau souterraine peut varier avec les saisons et les années.

Au moment des travaux d'excavation, l'eau souterraine (si rencontrée) devra être entièrement évacuée de façon à travailler en conditions sèches.

7 Discussion et recommandations – Volet géotechnique

7.1 Mise en contexte

Le projet consiste en l'agrandissement du chenil du collège des douanes composé d'un étage et l'implantation d'un nouveau hangar qui seront situés à l'adresse civique 475, chemin de la Grande-Ligne dans la Ville de Rigaud.

Les commentaires et recommandations présentés dans les paragraphes suivants sont basés sur les résultats des travaux sur le terrain et en laboratoire, de même que sur les informations et les plans qui nous ont été transmis par le client à ce jour.

7.2 Paramètres sismiques

7.2.1 Potentiel de liquéfaction des sols

La liquéfaction des sols se définit comme une perte de résistance presque totale qui peut se produire dans des dépôts granulaires lâches et saturés sous l'effet d'événements sismiques. Le phénomène de liquéfaction s'accompagne de deux effets importants; d'abord, une perte de résistance des sols de support et ensuite, des tassements qui se développent lorsque les pressions dans l'eau des pores se dissipent.

Compte tenu de l'indice de plasticité ($I_p > 12$) des sols en place et de la granulométrie de ceux-ci, le site ne présente pas de potentiel de liquéfaction.

7.2.2 Catégorie d'emplacement

Le Code de construction du Québec : Chapitre I Bâtiment (CCQ 2008), incluant le Code national du bâtiment (CNB) 2010, détermine des catégories d'emplacement en fonction de la réponse sismique pour le dimensionnement parasismique de structure de bâtiment. La catégorie d'emplacement est déterminée en fonction de la nature et des caractéristiques des sols estimées à partir des travaux d'investigation géotechnique réalisés dans le cadre de ce projet. Dans le cas particulier du site à l'étude, la catégorie d'emplacement « D » peut être considérée

7.2.3 Accélération spectrale

Les valeurs d'accélération spectrale pour différentes périodes ainsi que la valeur de l'accélération maximale du sol (PGA) pour différentes villes et municipalités sont indiquées dans le Code national du bâtiment (CNB 2010). Dans le secteur à l'étude, les données d'accélération spectrale et d'accélération maximale du sol sont indiquées au tableau suivant. Les données présentées sont pour un site de classe C. Le concepteur doit ajuster les valeurs en fonction de la catégorie d'emplacement du site.

Tableau 8 Accélération spectrale et accélération maximale du sol pour un site de classe C

Localisation du site à l'étude	Données sismiques pour un site de classe C				
	Sa (0,2)	Sa (0,5)	Sa (1,0)	Sa (2,0)	PGA
475, che de la Grande-Ligne Rigaud (45.476055; -74.291084)	0,570	0,300	0,145	0,067	0,364

Référence : Outil d'interpolation Ressources Naturelles Canada – Aléa sismique CNB 2015 :
<http://www.seismescanada.mcan.gc.ca/hazard-alea/interpolat/calc-fr.php>

7.3 Excavations

7.3.1 Recommandations générales

Les excavations requises pour rejoindre le niveau d'implantation des fondations pourront être effectuées en tranchées ouvertes. Compte tenu des niveaux supposés d'implantation des fondations, les excavations seront effectuées au travers de la couche de matériaux de remblai, de pierre concassée et, en partie, dans le dépôt cohérent. Afin d'éviter le remaniement du dépôt cohérent, les excavations dans cette couche doivent être effectuées à l'aide d'un godet sans dents, muni d'une plaque.

Les matériaux de remblai et de pierre concassée, de même que les sols contenant des matériaux délétères et/ou impropres à la construction, doivent être excavés à l'emplacement des fondations et structures projetées.

La surface exposée du sol naturel doit être uniforme, lisse et non remaniée. De plus, elle doit être vérifiée et approuvée par un professionnel en géotechnique ou par son représentant afin de déceler toute zone molle, impropre ou instable à la construction et ainsi pouvoir apporter les correctifs appropriés.

De plus, lors de l'exécution des excavations près des murs de fondation du bâtiment adjacent déjà existant, l'entrepreneur doit mettre en œuvre toutes les mesures utiles et nécessaires à la protection des fondations du bâtiment et des matériaux qui les supportent.

7.3.2 Pentes d'excavations temporaires

Pour les besoins de construction, comme il s'agit d'excavations temporaires, l'entrepreneur est responsable de leur stabilité ainsi que de la sécurité des travailleurs, de l'ouvrage à construire et des structures avoisinantes, quand cette sécurité dépend de la stabilité des pentes temporaires.

À titre indicatif aux concepteurs, et ce, pour des fins d'estimation des volumes de sols, nous recommandons de limiter les pentes des talus temporaires d'excavation à :

- ▶ 2 horizontales pour 1,0 verticale dans les matériaux de remblai et le dépôt cohérent.

Si les excavations demeurent ouvertes pour des périodes de plus de quelques jours, il est recommandé que des inspections quotidiennes soient effectuées par du personnel spécialisé en géotechnique, afin de déceler les risques de glissement et de déterminer les mesures à prendre pour corriger les situations dangereuses.

Il est important de s'assurer de garder une distance au moins égale à la profondeur de l'excavation entre le sommet du talus et la base des matériaux entreposés au chantier. Cette condition doit être respectée en tout temps à moins que des études particulières ne soient effectuées pour chaque cas spécifique. Il en est de même lorsque des structures ou de la machinerie sont situées à proximité des excavations.

Par ailleurs, il est important de considérer que l'utilisation de boîtes de tranchées ne constitue pas un système de soutènement des terres efficace. Elles doivent être considérées uniquement comme un système permettant la protection des travailleurs. Pour assurer la stabilité des pentes, l'entrepreneur doit excaver les parois à des inclinaisons permettant leur stabilité durant toute la durée des travaux de chantier.

7.3.3 Soutènement temporaire

Advenant que des pentes non supportées stables et sécuritaires ne puissent être aménagées, un système d'étalement temporaire des terres est recommandé.

Le système de soutènement temporaire doit être conçu en tenant compte de la stratigraphie des sols en place (telle qu'indiquée précédemment), de l'emplacement de la nappe d'eau souterraine, ainsi que de la géométrie des ouvrages existants (trottoirs, résidences, conduites existantes, etc.).

Il est recommandé que le soutènement temporaire soit mis en place de façon à soutenir l'ensemble des sols.

Le tableau 9 présente les paramètres géotechniques à considérer pour la conception des systèmes de soutènement permanent et temporaire.

Tableau 9 Paramètres de conception pour le soutènement temporaire

Paramètres	Dépôt cohérent	Matériaux de remblai / Pierre concassée
Court terme		
Angle de frottement interne	0°	-
Résistance au cisaillement non drainé c_u (kPa)	Voir rapport de forage	-
Poids volumique humide des terres (kN/m ³)	16	-
Long terme		
Angle de frottement interne	28°	28°
Cohésion (kPa)	6	-
Poids volumique humide des terres (kN/m ³)	16	19
Poids volumique déjaugé (kN/m ³)	6	9
Coefficient de poussée active K_a^*	0,36	0,36
Coefficient des sols au repos K_o^*	0,53	0,53
Coefficient de poussée passive K_p^*	2,77	2,77

* Cas de parois verticales et surface de talus horizontale ($\beta = 0^\circ$).

Les surcharges créées par la présence des structures adjacentes au projet doivent être considérées dans le calcul des efforts latéraux.

7.4 Drainage lors des travaux de construction

Compte tenu du niveau d'implantation des fondations projetées et sur la base des mesures du niveau d'eau souterraine, la nappe d'eau pourrait être interceptée en fonction de la saison où les travaux sont réalisés. De plus, des eaux d'infiltration et de ruissellement pourraient s'accumuler au fond des excavations.

Ainsi, un système adéquat et efficace pourra être utilisé pour évacuer l'eau au fur et à mesure de son infiltration dans les excavations dans le but de réaliser les travaux dans un environnement sec.

Le dépôt de sol sous-jacent contient une teneur élevée en particules fines. Une protection contre le remaniement serait recommandée au moyen d'une couche de béton maigre d'un minimum de 75 mm d'épaisseur

7.5 Fondations superficielles

7.5.1 Profondeur de pénétration du gel

Selon la base de données d'Environnement Canada (Normales climatiques au Canada 1981-2010), l'indice de gel moyen est de 933°C-jour dans le secteur le plus près du site à l'étude.

La profondeur anticipée correspondante pour la pénétration du gel dans les sols est donc évaluée à 1,8 m. Par conséquent, les fondations exposées à l'action du gel doivent être recouvertes de sol sur une épaisseur minimale de 1,8 m afin de les protéger contre les effets néfastes du gel pour une structure non chauffée. Pour un bâtiment chauffé, la profondeur de gel à considérer est de 1,5 m. Cette protection contre le gel peut également être obtenue par l'utilisation d'isolant thermique. Afin de déterminer le dimensionnement de l'isolant, il est recommandé de se référer à l'article de E.I. Robinsky et K.E. Bessflug intitulé « Design of Insulated Foundations », paru dans l'édition du mois de septembre 1973 du « Journal of the Soils Mechanics and Foundation Division » de l'A.S.C.E., en utilisant une valeur de l'indice de gel de 933°C-jour.

7.5.2 Implantation des fondations et préparation de l'assise

La mise en place des fondations de l'agrandissement devra être faite de façon à éviter l'addition de contrainte avec les fondations du bâtiment existant.

Nous recommandons de transmettre les charges des constructions projetées par l'intermédiaire de semelles conventionnelles ancrées dans le dépôt cohérent. En l'absence des informations par rapport au niveau d'assise des futures fondations, nous supposons que ces dernières seront implantées à une profondeur de 1,5 m.

La surface d'appui des fondations devra être uniforme, horizontale et les matériaux ne devront pas être remaniés. De plus, le fond d'excavation devra être vérifié et approuvé par un professionnel en géotechnique ou par son représentant de façon à déceler tout matériau mou ou impropre à la construction et à procéder aux correctifs appropriés. L'entrepreneur devra mettre en œuvre une technique d'excavation appropriée afin d'éviter le remaniement et/ou la

déstabilisation des matériaux exposés au fond des excavations et de ne pas travailler là où les excavations ont été complétées.

La différence de niveau entre le fond de l'excavation et le niveau d'installation du coussin granulaire des fondations doit être comblée par un matériau granulaire ayant les caractéristiques suivantes :

- ▶ Contient moins de 15 % de particules fines ($< 80 \mu\text{m}$);
- ▶ Est exempt de matières organiques et de matériaux potentiellement gonflants (shale, schiste pyriteux, etc.) et devra être certifié DB;
- ▶ Ne contient pas de particules supérieures à 100 mm et de matériaux impropres à la construction;
- ▶ Présente une granulométrie étalée et une teneur en eau facilitant son compactage au moment des travaux;
- ▶ Présente une granulométrie dont le coefficient d'uniformité est supérieur à 6 (un sable uniforme de type « SP » (sable fin) n'est pas recommandé pour le remblai contrôlé, car le degré de compaction de ce type de matériau peut être difficile à contrôler).

Le remblai structural doit être mis en place par couches de 300 mm d'épaisseur, ou moins, avant le compactage et densifié à au moins 95 % de la valeur maximale de la densité sèche mesurée en laboratoire lors d'un essai à énergie de compactage modifiée (Proctor modifiée).

7.5.3 Résistances géotechniques aux états limites

Les résistances géotechniques aux états limites demandés dans le CNB, ainsi que ceux calculés dans le cadre de ce projet, sont les suivants :

- ▶ Les états limites ultimes;
- ▶ Les états limites de tenue en service.

L'état limite ultime porte principalement sur les mécanismes d'effondrement de la structure et donc sur la sécurité, tandis que l'état limite de tenue en service correspond aux mécanismes qui limitent ou empêchent l'usage prévu de la structure notamment, les tassements totaux.

7.5.3.1 État limite ultime (ÉLU) lié à la capacité portante

Compte tenu de la consistance raide à très raide du dépôt naturel d'argile, la résistance géotechnique à l'état limite ultime (rupture par cisaillement) sera contrôlée par les paramètres à court terme du dépôt, donc par sa résistance au cisaillement non drainé (C_u) et en considérant un angle de friction (ϕ) égal à 0.

Ainsi, la résistance géotechnique (q_{ult}) ultime peut être évaluée à partir de la relation suivante conformément au « *Manuel Canadien d'ingénierie des fondations – 4^e édition, 2006* » :

$$q_{ult} = q' N_q S_q + 0,5 \gamma' B N_\gamma S_\gamma + c' N_c S_c$$

Les paramètres géotechniques présentés au tableau 10 sont utilisés pour les fins de calcul de la résistance géotechnique à l'état ultime pour des fondations appuyées sur le dépôt naturel d'argile silteuse.

Les détails de calcul sont présentés au chapitre 10 du Manuel Canadien d'ingénierie des fondations, édition 2013.

Tableau 10 Paramètres géotechniques

Paramètres de calcul	Dépôt d'argile
Cohésion non drainée de conception recommandée, C_u (kPa)	140 (Silt et argile avec des $N_{\text{moy}} > 10$)
Angle de frottement interne non drainé, ϕ_u (°)	0°
Coefficient de portance pour la cohésion, N_c	5,1
Coefficient de portance des terres, N_q	1
Coefficient de portance pour le poids du sol, N_γ	0
Poids volumique humide (γ)	16,0 kN/m ³
Poids volumique déjaugé (γ')	6,0 kN/m ³

S_c , S_q , S_γ sont des coefficients de forme permettant de tenir compte de la géométrie de la semelle, pour notre cas, nous supposons qu'ils sont négligeables.

Les résultats des résistances géotechniques aux états ultimes, ELU, sont présentés au tableau 11 ci-dessous pour des semelles conventionnelles implantées à une profondeur de 1,5 m ou plus.

Tableau 11 Résistances géotechniques pondérées aux ÉLU pour les semelles filantes et carrées

	Semelle (B= 3,0m ou moins)
ÉLU (kPa)	600
ÉLU pondérée (kPa)	300

Les résultats mentionnés au tableau 11 supposent des fondations implantées à une profondeur 1,8 m ou plus. Un coefficient de tenue (facteur de résistance) de 0,5 a été appliqué aux valeurs de résistances géotechniques à l'état limite ultime précitées pour obtenir les valeurs pondérées.

7.5.3.2 Résistance géotechnique à l'état de tenue de service, ELTS

La pression de tassement à l'état limite de tenue en service a été estimée à l'aide de la théorie de la consolidation unidimensionnelle.

Une valeur de réaction géotechnique aux états limites de tenue en service (ELTS) de l'ordre de **150 kPa** est recommandée pour le dimensionnement des **fondations filantes de 1 m de largeur maximum** prenant assise au niveau du dépôt d'argile.

En ce qui concerne l'utilisation de **semelles carrées**, les résultats des résistances géotechniques aux états de tenue de service, ELTS, sont présentés au tableau 12 ci-dessous.

Tableau 12 Résistances géotechniques à L'ELTS pour des semelles conventionnelles

	Semelle filante (B ≤ 1,0 m)	Semelle carrée (B = 1,0 m)	Semelle carrée (B = 2,0 m)	Semelle carrée (B = 3,0 m)
ELTS (kPa)	150	250	200	125

Le tassement total engendré par de telles pressions devrait être inférieur à 25 mm tandis que le tassement différentiel devrait être inférieur à 20 mm.

Ces valeurs de tassement présupposent cependant que les surfaces d'assise au niveau des semelles seront libres de toute boue et de tout sol remanié avant de procéder au coulage du béton de propreté.

De plus, cette valeur de résistance géotechnique à l'état limite de tenue de service se définit comme la pression qui peut être transmise au sol par un empattement carré ou rectangulaire en sus du poids actuel des terres. En conséquence, le poids du sol sus-jacent à l'empatement ne doit pas être inclus dans le calcul de la pression transmise par l'empatement.

Ces valeurs de capacité portante sont valables à condition que le niveau du terrain en place ne soit pas rehaussé ou remblayé. Tout rehaussement du terrain viendrait augmenter les tassements et ainsi diminuer les capacités portantes présentées. Advenant le cas où le site devait être rehaussé, les calculs devront être révisés.

7.6 Dalle sur sol (chauffée)

Les recommandations suivantes s'appliquent pour une dalle chargée à un maximum de 5 kPa.

Suite à l'excavation de la couche de remblai et, s'il y a lieu, des sols contenant des matériaux délétères et/ou impropres à la construction, le fond de l'excavation devra être uniforme et non remanié. Le fond de l'excavation devra être vérifié et approuvé par un professionnel en géotechnique ou par son représentant de façon à déceler toute zone impropre à la construction et à procéder aux correctifs appropriés.

La différence d'élévation entre le fond de l'excavation jusqu'à 300 mm sous le niveau d'installation de la dalle doit être comblée par un matériau granulaire satisfaisant aux exigences physiques et granulométriques d'un granulat de calibre MG 112 dont le coefficient d'uniformité est supérieur à 6 (préférentiellement un sable pour son poids volumique faible). Ces matériaux doivent être compactés à au moins 95 % de la masse volumique sèche maximale du matériau, telle que déterminée à l'essai avec énergie de compactage modifiée (norme NQ 2501-255).

Des joints de construction doivent être prévus aux endroits appropriés en fonction des éléments structuraux, de telle sorte que les charges structurales soient transmises uniquement aux éléments de fondations et de façon à éviter une fissuration erratique de la dalle du tablier de circulation des véhicules.

7.7 Remblayage des murs de fondation et poussées latérales

Le remblayage des excavations le long des murs de fondation devra se faire à l'aide de matériaux d'emprunt granulaires satisfaisant aux exigences d'un matériau granulaire de type MG 112 (CCDG) ou l'équivalent. Ces matériaux doivent être mis en place en couches d'une épaisseur maximale de 300 mm et doivent être densifiés au moins à 95 % de la masse volumique sèche maximale obtenue lors de l'essai avec énergie de compactage modifiée (NQ 2501-255).

Il est recommandé d'installer un drain périphérique avec exutoire afin d'éviter une accumulation d'eau (souterraine et d'infiltration) qui pourrait favoriser l'action du gel.

De plus, lors du remblayage extérieur, au contact des excavations avec les sols en place, des transitions de 2,0 horizontale pour 1,0 verticale doivent être effectuées jusqu'à 1,8 m sous le niveau du terrain fini si des structures (voies d'accès et/ou circulation, trottoir, dalles, etc.) sont prévues, pour limiter les effets du gel sur ces structures.

Les propriétés des matériaux granulaires utilisés pour le remblayage latéral à l'extérieur des murs de fondation sont indiquées au tableau 13.

Tableau 13 Paramètres géotechniques pour le calcul de la poussée des terres

Paramètres	Matériau granulaire MG 112 compacté à 95 % du Proctor modifié
Poids volumique humide (i)	20 kN/m ³
Angle de frottement interne (i ^o)	34 ^o
Coefficient de poussée au repos K _o	0,44*
Coefficient de poussée active K _a	0,28*
Coefficient de poussée passive K _p	3,54*

* S'applique seulement pour un mur vertical et une surface de talus horizontal.

7.8 Recommandations générales

7.8.1 Sensibilité du sol au remaniement

Compte tenu de sa teneur élevée en particules fines, le dépôt sous-jacent au site sera extrêmement sensible au remaniement causé par les intempéries (pluie, gel et fonte des neiges) ou par la circulation des ouvriers et de la machinerie de chantier. Un remaniement excessif des surfaces d'assise peut entraîner une perte de résistance des sols et, subséquemment, des tassements dépassant l'amplitude prévue.

7.8.2 Surveillance de chantier

Il est recommandé de faire inspecter les travaux de fondation par un personnel compétent en géotechnique qui s'assurera que les semelles sont placées sur les sols appropriés, capables de supporter les pressions des nouvelles structures dans des conditions sécuritaires.

Les opérations de remblayage et de compactage doivent également faire l'objet d'un suivi approprié pour s'assurer que des matériaux conformes sont employés et que les degrés de compactage adéquats sont atteints.

De plus, il est suggéré que les travaux de remblayage des excavations fassent l'objet d'une surveillance assidue, puisque le comportement à long terme des structures sus-jacentes dépend en grande mesure de la qualité et du succès de ces opérations.

7.8.3 Conditions hivernales

La pénétration du gel dans le sol peut causer des problèmes aux structures. Les commentaires suivants sont présentés afin de les minimiser :

- ▶ Pendant la construction, les sols de fondation exposés doivent être convenablement protégés contre les effets du gel au moyen de matériaux isolants, tels que de la paille, de l'isolant rigide, des abris chauffés;
- ▶ Par ailleurs, des précautions à long terme doivent également être prises afin que les trottoirs ou le pavage n'interfèrent pas avec l'ouverture des portes durant l'hiver lorsque les sols sont sujets à des soulèvements dus au gel;
- ▶ Ce problème potentiel peut être minimisé de plusieurs façons, dont notamment en conservant un seuil adéquat entre les portes extérieures et le terrain, en prévoyant l'emploi de sections de dalle structurale ou encore en utilisant un remblai granulaire bien gradué et bien drainé d'une épaisseur suffisante conjointement avec un drainage positif, etc.;
- ▶ Afin de permettre une transition entre les remblais granulaires peu gélifs et les sols naturels généralement plus susceptibles au gel et ainsi minimiser l'amplitude des soulèvements différentiels sous l'action du gel, il est important d'excaver les tranchées de servitudes en prévoyant des pentes de talus appropriées dans la zone d'influence du gel.

8 Discussion et recommandations – Volet environnemental

8.1 Choix des critères comparatifs

La propriété à l'étude étant sous juridiction fédérale, les critères applicables pour la qualité environnementale des sols en place sur la propriété correspondent à ceux édictés dans les *Recommandations canadiennes pour la qualité de l'environnement* et le *Standard pancanadien relatif aux hydrocarbures pétroliers* (SPHP) du CCME. De façon plus précise, les sols en place sur la propriété ont été comparés aux seuils précisés dans le CCME pour la qualité des sols, environnement et santé humaine – contact écologique avec les sols, en fonction de la vocation commerciale du secteur investigué de la propriété pour des sols à grains fins (RQS_e). Ces recommandations ont été retenues étant donné qu'aucun usage sensible n'est effectué dans le secteur investigué, seul un chenil pour chiens et un hangar utilisé pour des fins d'entreposage y étant présents. À noter qu'ailleurs sur la propriété, les recommandations pour l'usage résidentiel et parc devraient être retenues pour le site étudié en raison de la présence d'usage sensible (présence d'usagers demeurant sur le site pour de longues durées). Les recommandations retenues ont été déterminées par le Client à partir du «Protocole d'élaboration de recommandations pour la qualité des sols en fonction de l'environnement et de la santé humaine» publié par le CCME en 2006.

À noter qu'aucune recommandation n'existe dans le CCME pour l'analyse des HP C₁₀-C₅₀, paramètre intégrateur privilégié dans la juridiction provinciale. Au niveau du CCME, l'analyse des fractions F2 à F4 est préconisée pour l'analyse des teneurs en hydrocarbures pétroliers.

Par ailleurs et à des fins de gestion hors site des sols devant être excavés, les résultats des analyses chimiques ont également été comparés aux valeurs A, B et C des critères génériques provincial du Guide d'interprétation – Protection des sols et réhabilitation des terrains contaminés (Guide d'intervention - PSRTC) du MELCC ainsi qu'aux valeurs limites de l'annexe I du «*Règlement sur l'enfouissement des sols contaminés*» (RESC).

Au bénéfice du lecteur, une description des critères du Guide d'intervention - PSRTC du MELCC et du cadre législatif et réglementaire pour la mise en œuvre des travaux de caractérisation de site est fournie à l'annexe I. Ce contexte a été considéré afin de déterminer les critères, valeurs limites et normes applicables retenus pour le terrain à l'étude.

8.2 Résultats et interprétation des analyses chimiques

Le tableau 14 ci-après résume les résultats des analyses chimiques réalisées sur les échantillons des sols en comparaison avec les recommandations canadiennes sur la qualité des sols (RQS) – santé humaine et environnement contact écologique avec les sols, volet commercial, et les critères du Guide d'intervention - PSRTC du MELCC.

Tableau 14 Résultat d'analyses chimiques réalisées sur les sols en laboratoire en comparaison avec les critères provinciaux (critères A, B et C) ou recommandations fédérales (RQS)

Sondage n°	Éch. n° / Stratigraphie	Prof. (m)	HP C ₁₀ -C ₅₀	HAP	Métaux*	BTEX	HP F1	HP F2 – F4
TF-01-19	CF-01A / Remblai	0 – 0,25	< A	< A < RQS	< A < RQS	-	-	-
	CF-01B / Argile s.	0,25 – 0,61	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
	CF-04 / Argile s.	1,83 – 2,44	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
TF-02-19	CF-01B / Argile s.	0,20 – 0,61	< A	< A < RQS	A-B > RQS	-	-	-
	CF-03 / Argile s.	1,22 – 1,83	< A	< A < RQS	A-B > RQS	-	-	-
TA-01-19	1 / Remblai	0 – 0,15	< A	< A < RQS	A-B < RQS	-	-	-
	3 / Argile s.	0,40 – 0,60	< A	< A < RQS	A-B > RQS	-	-	-
TA-02-19	2 / Sols org.	0,20 – 0,35	< A	< A < RQS	< A < RQS	< A	< RQS	< RQS
	3 / Argile s.	0,35 – 0,60	< A	< A < RQS	A-B > RQS	-	-	-
TA-03-19	2 / Argile s.	0,20 – 0,40	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
TA-04-19	3 / Argile s.	0,40 – 0,60	< A	< A < RQS	A-B > RQS	-	-	-
TA-05-19	2 / Argile s.	0,30 – 0,50	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
TA-06-19	2 / Argile s.	0,25 – 0,40	< A	< A < RQS	A-B > RQS	-	-	-
TA-07-19	1 / Remblai	0 – 0,15	< A	< A < RQS	A-B > RQS	-	-	-
	3 / Argile s.	0,40 – 0,60	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
TA-08-19	1 / Remblai	0 – 0,25	< A	< A < RQS	A-B > RQS	-	-	-
	2 / Argile s.	0,25 – 0,40	< A	< A < RQS	A-B > RQS	-	-	-
TA-09-19	1 / Remblai	0 – 0,20	< A	< A < RQS	< A < RQS	-	-	-
	2 / Argile s.	0,20 – 0,40	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
TA-10-19	1 / Remblai	0 – 0,25	< A	< A < RQS	< A < RQS	-	-	-
	2 / Argile s.	0,25 – 0,40	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
Empilement de sols EMP-1								
EMP-1	E-1 / Remblai	n.a.	< A	< A < RQS	< A < RQS	-	-	-
	E-2 / Remblai	n.a.	< A	< A < RQS	< A < RQS	< A	< RQS	< RQS
	E-3 / Remblai	n.a.	< A	< A < RQS	< A < RQS	-	-	-
	E-4 / Remblai	n.a.	< A	< A < RQS	< A < RQS	< A	< RQS	< RQS
	E-5 / Remblai	n.a.	< A	< A < RQS	A-B > RQS	-	-	-
	E-6 / Remblai	n.a.	< A	< A < RQS	< A < RQS	< A	< RQS	< RQS
	E-8 / Remblai	n.a.	< A	< A < RQS	< A < RQS	< A	< RQS	< RQS
	E-9 / Remblai	n.a.	< A	< A < RQS	< A < RQS	-	-	-
	E-10 / Remblai	n.a.	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
	E-11 / Remblai	n.a.	< A	< A < RQS	< A < RQS	-	-	-
	E-12 / Remblai	n.a.	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
	E-13 / Remblai	n.a.	< A	< A < RQS	< A < RQS	-	-	-
	E-14 / Remblai	n.a.	< A	< A < RQS	A-B > RQS	< A	< RQS	< RQS
	E-15 / Remblai	n.a.	< A	< A < RQS	< A < RQS	-	-	-
	E-16 / Remblai	n.a.	< A	< A < RQS	< A < RQS	< A	< RQS	< RQS

Tableau 14 (suite) Résultat d'analyses chimiques réalisées sur les sols en laboratoire en comparaison avec les critères provinciaux (critères A, B et C) ou recommandations fédérales (RQS)

Sondage n°	Éch. n° / Stratigraphie	Prof. (m)	HP C ₁₀ -C ₅₀	HAP	Métaux*	BTEX	HP F1	HP F2 – F4
EMP-1	E-17 / Remblai	n.a.	< A	< A < RQS	< A < RQS	-	-	-
	E-18 / Remblai	n.a.	< A	< A < RQS	A-B < RQS	< A	< RQS	< RQS
	E-19 / Remblai	n.a.	< A	< A < RQS	A-B > RQS	-	-	-
	E-20 / Remblai	n.a.	< A	< A < RQS	< A < RQS	< A	< RQS	< RQS

* Métaux : Ag, As, Ba, Cd, Co, Cr, Cu, Sn, Mn, Mo, Ni, Pb, Se et Zn

L'analyse des résultats obtenus lors des analyses chimiques permet de relever les principaux points suivants :

- ▶ La totalité des résultats obtenus en HAP et HP F1 à F4 respecte les seuils fixés du CCME pour un usage commercial pour l'emprise à l'étude de la propriété (RQS – environnement et santé humaine et SPHP). La totalité des concentrations mesurées a même été sous la limite de détection rapportée du laboratoire pour ces paramètres;
- ▶ Des concentrations supérieures au RQS – vocation commerciale en métaux (chrome) ont été obtenues pour 16 des 21 échantillons de sols analysés dans les forages ou sondages manuels et pour 5 des 19 échantillons de sols prélevés au sein de l'empilement de sol. La majorité de ces anomalies ont été notées au sein de sols naturels cohérents;
- ▶ L'ensemble des résultats obtenus en HP C₁₀-C₅₀, BTEX et HAP a présenté des concentrations inférieures au critère A du Guide d'intervention – PSRTC, voir même généralement sous la LDR du laboratoire;
- ▶ Des concentrations dans la plage A-B en métaux (Cr, Cu, Ni, Pb et/ou Co) ont été relevées au sein de 23 des 40 échantillons de sols analysés lors des présentes investigations. À noter que 14 de ces 23 échantillons de sols ont été prélevés au sein de sols naturels. En ce qui concerne les 9 autres échantillons, ceux-ci ont été prélevés au sein de sol de remblai au droit des forages ou sondages manuels (3 échantillons) ou dans l'empilement de sols (6 échantillons – remblai de type argileux).

Les résultats des analyses sur les échantillons des sols en place et au sein de l'empilement EMP-1, en comparaison avec les recommandations canadiennes de qualité des sols ou aux critères du Guide d'intervention PSRTC du MELCC, sont présentés aux tableaux D.2 et D.3 de l'annexe D, sur les figures 2, 3, 6 et 7 à l'annexe C, sur les rapports de sondage à l'annexe E et dans les certificats d'analyses chimiques inclus à l'annexe H.

8.3 Interprétation des résultats de caractérisation environnementale des sols

En somme, plus de 75 % des échantillons de sols prélevés au sein des forages TF-01-19 et TF-02-19 et des sondages manuels TA-01-19 à TA-10-19 ont présenté des concentrations en métaux (chrome) supérieures à la valeur commerciale des recommandations canadiennes sur la qualité des sols, santé et environnement du CCME. De ce fait, ces sols ne sont pas conformes avec l'usage actuel du secteur investigué de la propriété étudiée et des travaux de réhabilitation environnementale seraient a priori requis dans ces secteurs. Par ailleurs, à la lueur des résultats obtenus, nous sommes d'avis que tous les sols naturels argileux présents

dans le secteur caractérisé devraient être considérés comme présentant une concentration en chrome supérieure aux valeurs applicables des RQS du CCME pour la vocation commerciale retenue pour le secteur étudié.

Dans le cas de l'empilement de sols, 5 des 19 échantillons de sols analysés, soit environ 30 %, ont présenté des concentrations supérieures à la valeur commerciale des RQS_e du CCME pour le même paramètre. Les secteurs non conformes de cet empilement (échantillons E-5, E-10, E-12, E-14 et E-19) devront donc être éliminés hors site selon les règles de l'art applicable au domaine provincial.

Au niveau provincial, on note que l'ensemble des concentrations mesurées en HP C₁₀-C₅₀, BTEX et HAP ont présenté des concentrations inférieures au critère A du Guide d'intervention – PSRTC du MELCC. Des concentrations dans la plage A-B en métaux (Cr, Cu, Co, Pb et/ou Ni) ont été relevées au sein 17 des 21 échantillons de sols analysés dans les sondages effectués sur le site et dans 6 des 19 échantillons de sols analysés au sein de l'empilement. Étant donné que ces sols présentent des concentrations supérieures au critère A, ceux-ci ne pourront être gérés sans restriction advenant leur excavation. Ceux-ci pourront être acheminés vers un site d'élimination autorisé, le cas échéant. À noter que seuls deux échantillons de sols ont présenté une concentration en métaux dans la plage A-B du Guide d'intervention – PSRTC tout en étant inférieure aux valeurs du RQS du CCME.

À noter que la présente section ne correspond pas à un avis légal. Celle-ci a été rédigée en fonction de notre connaissance des normes et règles applicables en environnement et à partir de notre expérience dans des dossiers similaires. Il revient au Client de mandater un avisé légal pour toute interprétation fine de la réglementation provinciale et fédérale applicable sur la propriété.

8.4 Contrôle de la qualité sur les sols

Le tableau D.4 de l'annexe D présente les résultats analytiques relatifs aux échantillons de sols dupliqués ainsi que le pourcentage de différence relative entre les résultats obtenus pour les échantillons parents et leurs duplicata.

Le pourcentage de différence relative est la différence absolue entre deux valeurs (l'échantillon original et l'échantillon duplicata de terrain), divisée par la moyenne des deux valeurs, multipliée par cent. Il est à noter que seuls les paramètres pour lesquels la concentration mesurée est de 10 fois supérieure à la limite de détection rapportée (LDR) par le laboratoire ont été pris en compte dans les calculs permettant d'obtenir une différence relative entre l'échantillon parent et son duplicata.

Pour l'ensemble des résultats obtenus en HP C₁₀-C₅₀, HP F-1 à F-4, HAP et pour environ la moitié des métaux, il a été impossible de calculer la différence relative correspondante étant donné que ceux-ci sont situés sous les limites de détection ou inférieurs à 10 fois la LDR. Pour le reste des métaux, des écarts variant entre 0 et 39 % ont été calculés. De façon plus précise, sur la trentaine d'écarts relatifs mesurés, seuls deux résultats ont été supérieurs à 30 %. Ces résultats ont d'ailleurs été obtenus pour des sols de remblai prélevés au sein de l'empilement. De ce fait, nous sommes d'avis que ces écarts sont associés à l'hétérogénéité des sols de remblai en empilement. Le contrôle de la qualité effectué dans le cadre des présentes investigations est donc jugé satisfaisant.

En somme, les résultats d'analyses chimiques obtenus pour les échantillons de sols originaux prélevés lors du présent mandat et leur duplicata correspondant sont, de façon générale, similaires et révèlent une bonne maîtrise des procédures d'analyse et d'échantillonnage. Les différences relatives calculées démontrent également, mais de façon indirecte, une bonne réplicabilité des méthodes analytiques puisque rappelons que l'écart relatif est en fait la sommation de l'erreur de prélèvement et de l'erreur analytique.

Enfin, les limites de détection atteintes par le laboratoire pour l'ensemble des paramètres analysés pour les échantillons de sols sont égales ou inférieures aux valeurs des recommandations du CCME ou aux critères « A » du Guide d'intervention - PSRTC du MELCC.

L'analyse des données fournies par le laboratoire relativement au contrôle de la qualité des procédures analytiques nous permet de croire que leur travail répond à la qualité recherchée. Les données de contrôle interne présentées par le laboratoire démontrent que, de façon générale, les protocoles utilisés sont bien maîtrisés et que, par conséquent, les résultats fournis sont fiables. Les analyses effectuées sur les duplicata de laboratoire, pour leur part, démontrent que ce laboratoire a en général bien manipulé et préparé les échantillons reçus.

8.5 Évaluation des volumes de sols affectés en place

L'estimation théorique des volumes de matériaux en place a été réalisée selon une méthode standard par polygonalement couramment utilisée en environnement. À moins d'indication contraire, l'estimation des volumes repose sur les hypothèses suivantes :

- ▶ L'extension latérale est délimitée par la mi-distance entre les sondages adjacents ou par les limites de la propriété ou des secteurs investigués. De façon générale, une distribution symétrique de la contamination est assumée dans les secteurs où il n'y a plus de sondage. À noter que le plan de localisation du Client a été utilisé afin de déterminer les limites de polygonalement à retenir;
- ▶ L'extension verticale des secteurs affectés est établie en considérant l'intervalle montrant des évidences de contamination similaires établies à partir des résultats analytiques obtenus, de la nature des sols et des observations organoleptiques faites sur les échantillons prélevés (odeurs d'hydrocarbures, présence de débris, appréciation visuelle du pourcentage de sols *versus* des matières résiduelles, etc.). Dans le cas où deux échantillons présenteraient des niveaux de contamination différents et que ces derniers proviennent d'un même horizon stratigraphique et d'un même sondage, la mi-distance a été utilisée entre ces deux échantillons. À noter que la profondeur des sondages a été retenue comme profondeur maximale d'excavation dans le cas présent;
- ▶ Concernant les travaux d'excavation projetés, une profondeur moyenne de 1,8 m a été retenue pour fin d'estimation dans le secteur de l'agrandissement projeté du chenil (forages TF-01-19 et TF-02-19 et sondages manuels TA-01-19 et TA-02-19). À noter que bien que les sondages TA-01-19 et TA-02-19 aient été interrompus à 0,8 m de profondeur, le dépôt cohérent d'argile noté à ces endroits a été confirmé au droit des forages TF-01-19 et TF-02-19 effectués à toute proximité. Dans le secteur de l'aménagement projeté du hangar, une profondeur de l'ordre de 0,8 m a été retenue (sondages TA-03-19 à TA-10-19);
- ▶ Le volume théorique estimé est un volume de matériaux en place qui ne tient pas compte des pentes d'excavation et des différentes profondeurs de contamination pouvant être nivelées lors des travaux d'excavation.

Les volumes ont été calculés selon la méthode et les hypothèses décrites ci-dessus afin d'obtenir un ordre de grandeur des quantités de matériaux. Il est important de mentionner que l'étendue des matériaux peut être plus importante ou moindre que celle estimée, la contamination pouvant être circonscrite au droit même du sondage ou s'étendre jusqu'au suivant. Par ailleurs, rappelons le caractère sommaire des présentes investigations, lequel induit une incertitude additionnelle sur les volumes contaminés évalués en place.

Le détail du calcul des sols contaminés se trouvant sur la propriété à l'étude est fourni au tableau D.5. La localisation des zones de sols contaminés par rapport aux recommandations du CCME ou aux critères applicables du Guide d'intervention - PSRTC est respectivement présentée aux figures 4 et 5.

Sur la base des estimations réalisées, le volume de sols présentant des concentrations supérieures aux recommandations applicables du CCME a été évalué à 2 063 m³ sur la propriété. Le volume de sols présentant une contamination dans la plage A-B a été évalué à 2 066 m³ sur le site.

8.6 Conclusions environnementales

Sur la base des résultats obtenus lors de la réalisation des travaux de caractérisation environnementale sommaire des sols, il apparaît que :

- ▶ Aucune évidence de contamination par des produits pétroliers (coloration ou odeur) n'a été relevé au droit des sols de remblai et naturels prélevés dans le cadre des présentes investigations;
- ▶ La totalité des résultats obtenus lors de la réalisation des analyses chimiques sur les sols en HP F1 à F4 et en HAP a présenté des concentrations inférieures aux valeurs édictées dans les recommandations canadiennes pour la qualité des sols, santé humaine et environnement – vocation commerciale, soit les valeurs fédérales retenues pour le secteur investigué de la propriété. Ces résultats ont été obtenus autant pour les sols prélevés en place au droit des sondages que pour ceux prélevés au sein de l'empilement de sol EMP-1 présent sur la propriété;
- ▶ Des concentrations supérieures en métaux (chrome) à la valeur retenue des recommandations canadiennes pour la qualité des sols, santé humaine et environnement – vocation commerciale ont été obtenues pour la majorité des échantillons de sols analysés et prélevés aux droits des forages ou sondages manuels (16 des 21 échantillons de sols analysés). Ces concentrations, lesquelles pourraient être d'origine naturelle, ont généralement été obtenues au sein du dépôt naturel cohérent présent sur la propriété;
- ▶ 5 des 19 échantillons de sols prélevés au sein de l'empilement de sols EMP-1 ont présenté des concentrations en métaux (chrome) supérieures à la valeur retenue des recommandations canadiennes pour la qualité des sols, santé humaine et environnement – vocation commerciale;
- ▶ La totalité des résultats obtenus en HP C₁₀-C₅₀, HAP et BTEX a présenté des concentrations inférieures aux valeurs A des critères génériques du Guide d'intervention – PSRTC du MELCC;
- ▶ Des concentrations dans la plage A-B du Guide d'intervention en métaux ont été relevées dans 23 des 40 échantillons de sols analysés dans le cadre des présentes investigations;

- En fonction d'une évaluation théorique des volumes de sols contaminés en place, un volume de l'ordre de 2 100 m³ de sols contaminés au-delà des recommandations du CCME applicables dans le secteur investigué et contaminés dans la plage A-B des critères génériques du Guide d'intervention – PSRTC a été évalué en place.

8.7 Recommandations environnementales

En fonction des résultats obtenus lors de la présente CES sommaire des sols, nous sommes d'avis que l'ensemble des sols naturels argileux présents dans le secteur investigué devra être considéré comme présentant une concentration en chrome supérieure à la valeur applicable des recommandations canadiennes de qualité des sols – vocation commerciale du CCME, soit les valeurs applicables sur le site étudié. De ce fait, ces sols ne sont pas conformes à la vocation des lieux et des travaux de réhabilitation environnementale devraient être effectués à priori.

Néanmoins, il est important de préciser que l'objectif des présentes investigations était de déterminer la qualité environnementale des sols pour déterminer leur mode de gestion hors site et non de se prononcer sur la qualité environnementale des sols en place sur la propriété. Il est par ailleurs fort probable que les concentrations retrouvées en chrome sur le site soient d'origine naturelle et non anthropique, ces anomalies ayant généralement été retrouvées au sein du dépôt cohérent d'argile silteuse en place sur le site dans une profondeur variant entre la surface et au plus 2,44 m. On note d'ailleurs que les concentrations retournées en chrome au-delà des valeurs applicables de recommandations du CCME (87 mg/kg) sont similaires, celles-ci variant entre 88 mg/kg et 130 kg/mg pour une valeur moyenne de l'ordre de 110 mg/kg. Il n'est toutefois pas possible de se prononcer hors de tout doute sur ce fait à l'heure actuelle. La réalisation d'une évaluation environnementale de site (ÉES) phase I, jumelée à la réalisation d'une étude de teneur de fond naturelle permettrait de statuer sur le caractère naturel de cette anomalie tout en permettant le calcul de la teneur de fond applicable sur la propriété.

Pour fin de gestion, nous sommes également d'avis que l'ensemble des sols appartenant au dépôt cohérent devra être géré comme étant contaminé dans la plage A-B des critères du Guide d'Intervention – PSRTC à défaut de procéder aux investigations additionnelles mentionnées plus haut.

Dans le cas présent, les sols contaminés dans la plage A-B, lesquels présentent également des concentrations supérieures aux RQS du CCME, ne pourront être remis en place sur le site et devront être éliminés vers un site d'élimination autorisé tel que précisé dans la grille de gestion des sols contaminés excavés incluse au sein du Guide d'Intervention – PSRTC et présentée à l'annexe I du présent rapport.

En ce qui concerne l'empilement de sols, seul 5 des 19 secteurs échantillonnés ont présenté des concentrations supérieures en métaux aux valeurs des recommandations applicables du CCME dans le secteur investigué, soit les secteurs des échantillons EMP1; E-5, E-10, E-12, E-14 et E-19. Ces sols ne pourront donc être réutilisés sur le site et devront obligatoirement être éliminés vers un site d'élimination autorisé par le MELCC. Précisons que les sols présents dans ces secteurs ont tous présenté une contamination dans la plage A-B des critères génériques du Guide d'intervention – PSRTC en métaux. Pour le reste des sols de l'empilement, ceux-ci pourront être réutilisés sur le site pour autant que les propriétés géotechniques de ces sols soient jugées conforme par un géotechnicien au moment desdits

travaux et que leurs concentrations respectent les valeurs applicables des recommandations RQS du CCME en fonction du secteur projeté des travaux (voir dernier paragraphe).

Advenant que des sols doivent être éliminés hors site et que ceux-ci présentent des concentrations supérieures aux valeurs A du Guide d'intervention – PSRTC du MELCC, ceux-ci ne pourront être gérés sans restriction et devront être éliminés vers un site d'élimination autorisé par le MELCC. Enfin, si des sols doivent être importés sur la propriété, ceux-ci devront respecter les valeurs applicables des recommandations du CCME en fonction de la vocation commerciale du secteur investigué du site. Rappelons que pour le reste de la propriété du Collège des Douanes, une vocation résidentielle devra être retenue. Dans tous les cas, la confirmation des valeurs de recommandations applicables, de même que l'autorisation de TPSGC, sera requise avant tout import ou export de sols sur le site.

Annexe A Portée de l'étude géotechnique et environnementale

PORTÉE DE L'ÉTUDE GÉOTECHNIQUE ET ENVIRONNEMENTALE

1.0 *Caractéristiques des sols et du roc*

Les caractéristiques des sols et du roc décrites dans ce rapport proviennent de forages et/ou de sondages effectués à une période donnée et correspondent à la nature du terrain aux seuls endroits où ces mêmes forages et sondages ont été effectués. Ces caractéristiques peuvent varier de façon importante entre les points de forage et de sondage.

Les formations de sol et de roc présentent une variabilité naturelle. Les limites entre les différentes formations présentées sur les rapports doivent donc être considérées comme des transitions entre les formations plutôt que comme des frontières fixes. La précision de ces limites dépend du type et du nombre de sondages, de la méthode de sondage, de la fréquence et de la méthode d'échantillonnage.

Les descriptions des échantillons prélevés ont été faites selon les méthodes d'identification et de classification reconnues et utilisées en géotechnique. Elles peuvent impliquer le recours au jugement et à l'interprétation du personnel ayant réalisé l'examen des matériaux. Celles-ci peuvent être présumées justes et correctes suivant la pratique courante dans le domaine de la géotechnique. Finalement, si des essais ont été effectués, les résultats de ces essais ne sont valides que pour l'échantillon décrit dans le présent rapport.

Les propriétés des sols et du roc peuvent être modifiées de façon importante à la suite d'activités de construction, telles que l'excavation, le dynamitage, le battage de pieux ou le drainage, effectuées sur le site ou sur un site adjacent. Elles peuvent également être modifiées indirectement par l'exposition des sols ou du roc au gel ou aux intempéries.

2.0 *Eau souterraine*

Les conditions d'eau souterraine présentées dans ce rapport s'appliquent uniquement au site étudié. La précision et la représentation de ces conditions doivent être interprétées en fonction du type d'instrumentation mis en place et de la période, de la durée et du nombre d'observations effectuées. Ces conditions peuvent varier selon les précipitations, les saisons et éventuellement les marées. Elles peuvent également varier à la suite d'activités de construction ou de modifications d'éléments physiques sur le site ou dans le voisinage. La problématique de l'ocre ferreuse et ses effets n'est pas couverte par le présent rapport.

3.0 *Utilisation du rapport*

Les commentaires et recommandations donnés dans ce rapport s'adressent principalement à l'équipe de conception du projet. Pour déterminer toutes les conditions souterraines pouvant affecter les coûts et les techniques de construction, le choix des équipements ainsi que la planification des opérations, le nombre de forages ou de sondages nécessaire pourrait être supérieur au nombre de forages ou sondages effectué pour les besoins de la conception. Les entrepreneurs présentant une soumission ou effectuant les travaux doivent effectuer leur propre interprétation des résultats des forages et des sondages et au besoin leur propre investigation pour déterminer comment les conditions en place peuvent influencer leurs travaux ou leur méthode de travail.

Toute modification de la conception, de la position et de l'élévation des ouvrages devra être communiquée rapidement à Englobe de façon à ce que la validité des recommandations présentées puisse être vérifiée. Des travaux complémentaires de terrain ou de laboratoire pourraient éventuellement s'avérer nécessaires.

Le rapport ne doit pas être reproduit, sinon entier, sans l'autorisation de Englobe.

4.0 *Suivi du projet*

L'interprétation des résultats de chantier et de laboratoire et les recommandations présentées dans ce rapport s'appliquent uniquement au site étudié et aux informations disponibles sur le projet au moment de la rédaction du rapport.

Les informations disponibles sur les conditions de terrain et sur l'eau souterraine augmentent au fur et à mesure de l'avancement des travaux de construction. Les conditions de terrain ayant été interprétées et corrélées entre les points de forage et de sondage, Englobe devrait avoir la possibilité de vérifier ces conditions de terrain par des visites de chantier effectuées au fur et à mesure de l'avancement des travaux, afin de confirmer les informations obtenues des forages et sondages. S'il nous est impossible de faire de telles vérifications, Englobe n'assurera aucune responsabilité concernant l'interprétation géotechnique que des tiers feront des recommandations de ce rapport, particulièrement si la conception est modifiée ou que des conditions de terrain différentes à celles décrites dans ce rapport sont rencontrées. L'identification de tels changements requiert de l'expérience et doit être effectuée par un ingénieur géotechnicien expérimenté.

5.0 Environnement

Les informations et commentaires relatifs à la condition environnementale du site doivent être considérés comme sommaires et limités. Ils ne concernent que la qualité environnementale des sols échantillonnés à l'emplacement des forages et sondages et non la qualité environnementale des eaux souterraines.

À moins d'avis contraire, l'interprétation des données, les commentaires et les recommandations environnementales contenus dans ce rapport sont fondés, au meilleur de notre connaissance, sur les politiques, les critères et les règlements environnementaux en vigueur au moment de la réalisation du projet, jusqu'à leurs limites applicables, compte tenu de la nature spécifique du projet et de l'utilisation proposée du terrain. Si ces politiques, critères et règlements sont différents de ceux présumés ou s'ils sont changés après la remise du rapport, Englobe doit être consultée pour réviser les recommandations à la lumière de ces changements. Lorsqu'aucune politique, critère ou réglementation n'est disponible pour permettre l'interprétation des données, les commentaires et recommandations exprimés par Englobe sont basés sur la meilleure connaissance possible des règles acceptées dans la pratique professionnelle s'appliquant au projet concerné.

Les conditions indiquées dans ce rapport correspondent à celles détectées à l'endroit et à la date d'observation indiqués dans ce rapport. Elles peuvent varier dans le temps suite aux activités sur le site à l'étude ou sur des sites adjacents ou encore suite à des événements naturels, à des réactions naturelles ou autres.

Les concentrations décelées dans les échantillons de sols sont déterminées à partir des résultats des analyses chimiques effectuées sur un nombre limité d'échantillons. Les concentrations entre les points d'échantillonnage peuvent varier par rapport aux conditions rencontrées à l'endroit où ont été prélevés les échantillons analysés.

Le fait qu'un paramètre n'a pas été analysé n'exclut pas qu'il soit présent à une concentration supérieure au bruit de fond ou à la limite de détection de ce paramètre.

Annexe B Rapport photographique



PHOTO 1 — Réalisation du forage TF-02-19.



PHOTO 2 — Réalisation du puits d'exploration PU-01-19.

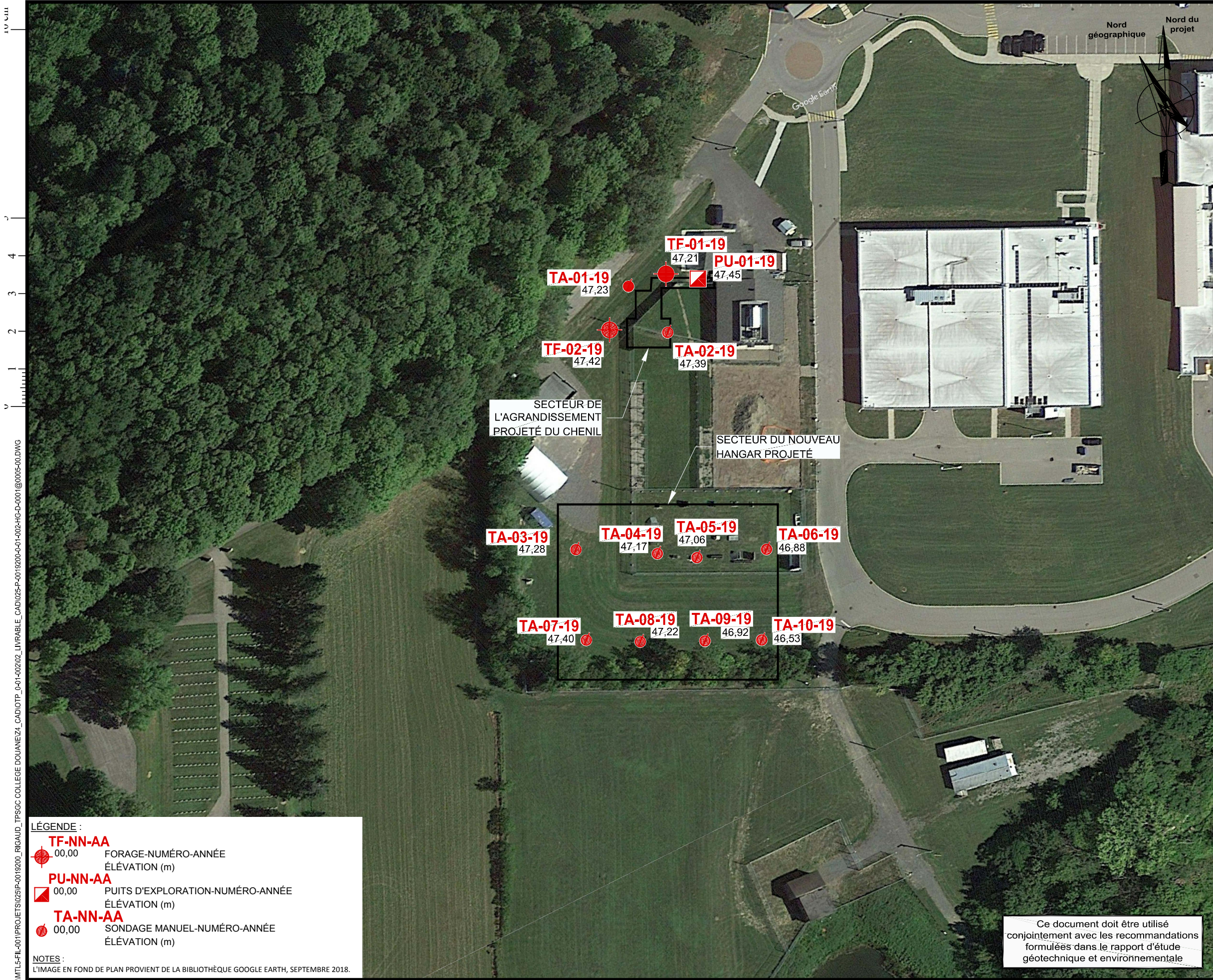


PHOTO 3 — Réalisation de saignées dans l'empilement de sol EMP-1.



PHOTO 4 — Empilement EMP-1 au terme des travaux.

Annexe C Figures



COORDONNÉES DES FORAGES-NAD83 MTM, FUSEAU 8

SONDAGE	Nord (Y)	Est (X)	ÉLÉVATION
PU-01-19	5 037 546,0	242 816,5	47,45
TA-01-19	5 037 552,5	242 799,1	47,23
TA-02-19	5 037 536,9	242 802,9	47,39
TA-03-19	5 037 496,4	242 755,3	47,28
TA-04-19	5 037 485,7	242 774,1	47,17
TA-05-19	5 037 480,1	242 782,9	47,06
TA-06-19	5 037 473,8	242 800,5	46,88
TA-07-19	5 037 473,7	242 746,9	47,40
TA-08-19	5 037 466,9	242 759,5	47,22
TA-09-19	5 037 459,4	242 774,9	46,92
TA-10-19	5 037 452,8	242 788,5	46,53
TF-01-19	5 037 551,0	242 809,5	47,21
TF-02-19	5 037 544,5	242 789,5	47,42

Sceau

Échelle

1:1 000

Ce document est l'œuvre d'Englobe Corp. Toute reproduction, diffusion ou adaptation, partielle ou totale, est strictement interdite sans avoir préalablement obtenu l'autorisation écrite d'Englobe et de son Client. Aucune information contenue dans ce document ne peut être utilisée par un tiers sans l'autorisation écrite d'Englobe et de son Client. Englobe Corp. se dégage de toute responsabilité pour toute reproduction, diffusion, adaptation ou utilisation non autorisée du document.

Client

TPSGC

Englobe Corp.

1200, boul. Saint-Martin O.
bureau 400
Laval, Québec
H7S 2E4
514-281-5151

Projet

IMPLANTATION D'UN NOUVEAU HANGAR ET
AGRANDISSEMENT DU CHENIL DE L'AGENCE
DES SERVICES FRONTALIERS DU CANADA

Collège des Douanes,
475, chemin de la Grande-Ligne, Rigaud (Québec)

Titre

FIGURE 1
LOCALISATION DES SONDAGES

Discipline :	Environnement	Préparé par :	P.-A. Charette, géo. EESA®	Vérifié par :	F. Girard, géo. M.Sc.
Échelle :	1:1 000	Dessiné par :	D. De Miguel, dess.	Approuvé par :	
Date :	07/08/2019	No. de figure :		No. d'enregistrement :	
Mise en page :	Format papier :				
0001	ANSI full bleed B (17,00 x 11,00 pouces)				

Resp.	Projet	OTP	Projet/ Disc	Phase/ Type	Réf. élec. / No.Dessin	Rév.
025	P-0019200	0-01-002	HG	D		0001 00

LÉGENDE :

TF-NN-AA
00,00
FORAGE-NUMÉRO-ANNÉE
ÉLÉVATION (m)

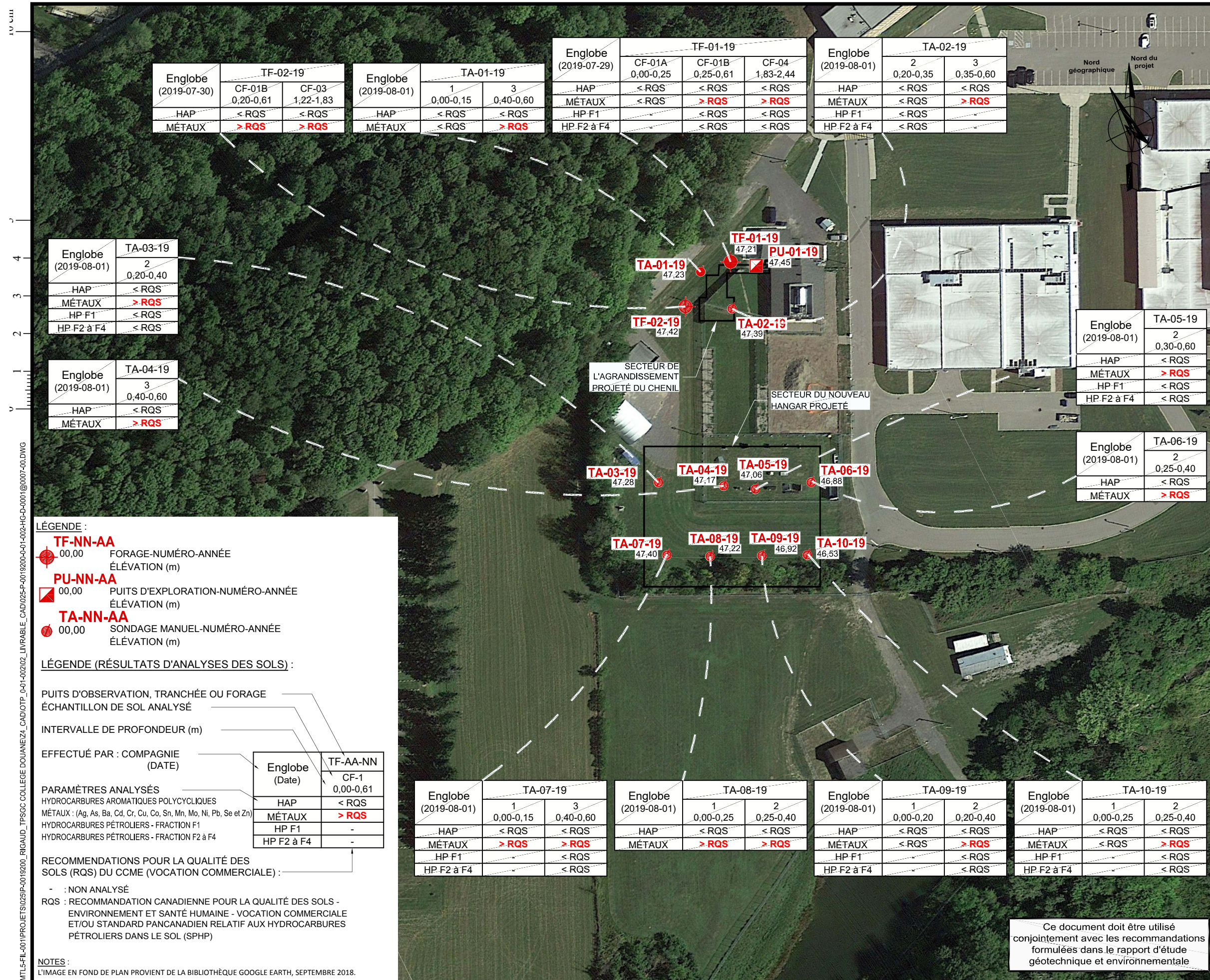
PU-NN-AA
00,00
PUITS D'EXPLORATION-NUMÉRO-ANNÉE
ÉLÉVATION (m)

TA-NN-AA
00,00
SONDAGE MANUEL-NUMÉRO-ANNÉE
ÉLÉVATION (m)

NOTES :

L'IMAGE EN FOND DE PLAN PROVIENT DE LA BIBLIOTHÈQUE GOOGLE EARTH, SEPTEMBRE 2018.

Ce document doit être utilisé
conjointement avec les recommandations
formulées dans le rapport d'étude
géotechnique et environnementale

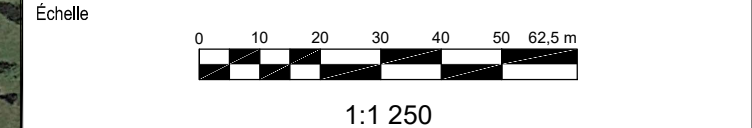


COORDONNÉES DES FORAGES-NAD83 MTM, FUSEAU 8			
SONDAGE	Nord (Y)	Est (X)	ÉLÉVATION
PU-01-19	5 037 546,0	242 816,5	47,45
TA-01-19	5 037 552,5	242 799,1	47,23
TA-02-19	5 037 536,9	242 802,9	47,39
TA-03-19	5 037 496,4	242 755,3	47,28
TA-04-19	5 037 485,7	242 774,1	47,17
TA-05-19	5 037 480,1	242 782,9	47,06
TA-06-19	5 037 473,8	242 800,5	46,88
TA-07-19	5 037 473,7	242 746,9	47,40
TA-08-19	5 037 466,9	242 759,5	47,22
TA-09-19	5 037 459,4	242 774,9	46,92
TA-10-19	5 037 452,8	242 788,5	46,53
TF-01-19	5 037 551,0	242 809,5	47,21
TF-02-19	5 037 544,5	242 789,5	47,42

Sceau



2019-10-29



Ce document est l'œuvre d'Englobe Corp. Toute reproduction, diffusion ou adaptation, **partielle** ou totale, est strictement interdite sans avoir préalablement obtenu l'autorisation écrite d'Englobe et de son Client. Aucune information contenue dans ce document ne peut être utilisée par un tiers sans l'autorisation écrite d'Englobe et de son Client. Englobe Corp. se dégage de toute responsabilité pour toute reproduction, diffusion, adaptation ou utilisation non autorisée du document.

Client

TPSGC

 **Englobe**

Englobe Corp.
1200, boul. Saint-Martin O.
bureau 400
Laval, Québec
H7S 2E4
514-281-5151

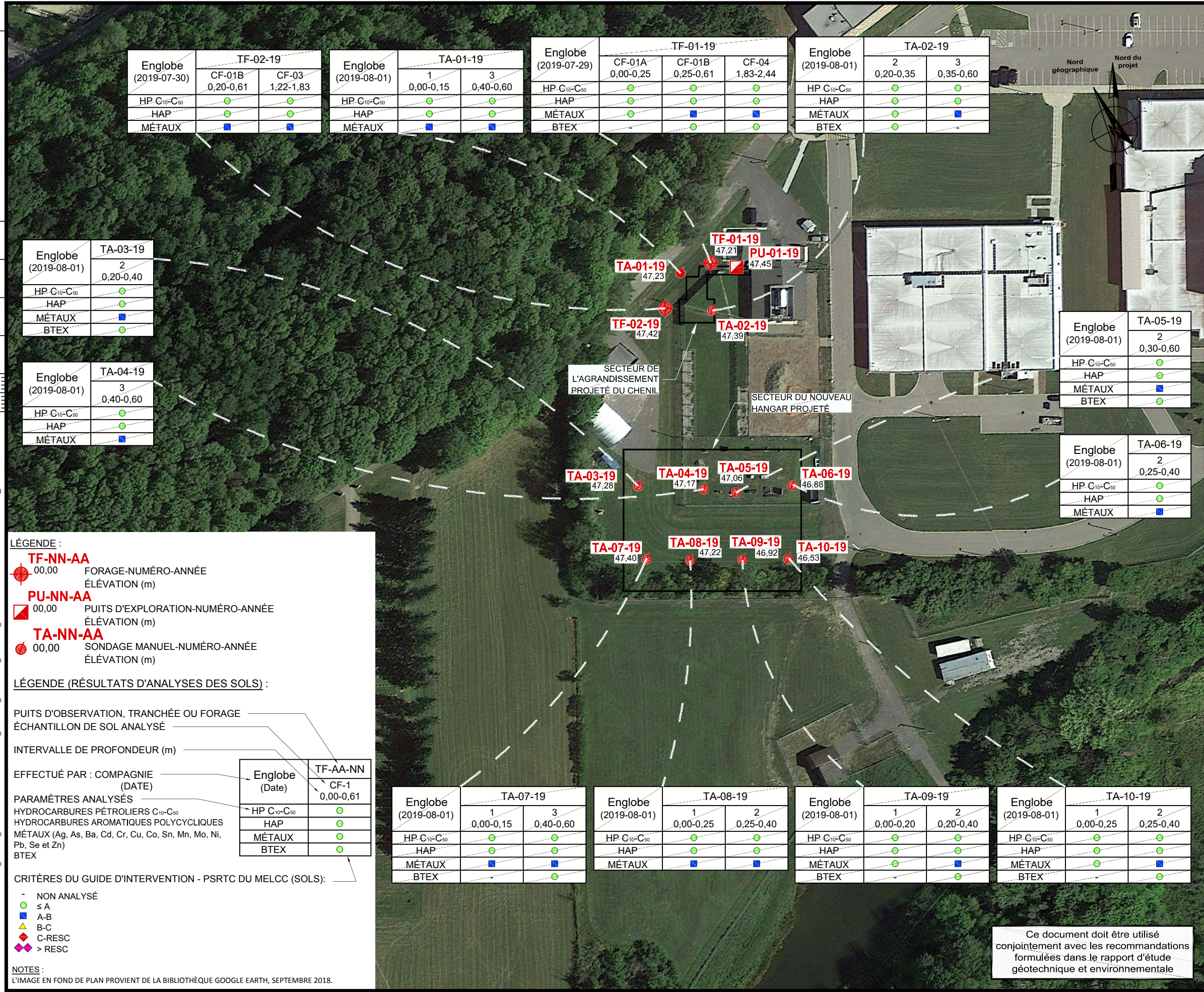
Projet **IMPLANTATION D'UN NOUVEAU HANGAR ET
AGRANDISSEMENT DU CHENIL DE L'AGENCE
DES SERVICES FRONTALIERS DU CANADA**

Collège des Douanes,
475, chemin de la Grande-Ligne, Rigaud (Québec)

Titre	
FIGURE 2	
RÉSULTATS DES ANALYSES CHIMIQUES SUR LES SOLS RECOMMANDATIONS CANADIENNES POUR LA QUALITÉ DES SOLS DU CCME	
Discipline :	Environnement
Échelle :	1:1 250
Date :	07/08/2019
Mise en page :	Format papier : 0002 ANSI full bleed B (17.00 x 11.00 pouces)
Préparé par :	P.-A. Charette, géo. EESA®
Vérifié par :	F. Girard, géo. M.Sc.
Dessiné par :	D. De Miguel, dess.
Approuvé par :	
No. de figure :	
No. d'enregistrement :	

Resp.	Projet	OTP	Projet/ Disc	Phase/ Type	Réf. élec. / No.Dessin	Rév.
025	P-0019200	0-01-002	HG	D		0002 00

\\MTL5-FL-001\PROJETS\025\IP-0019200_RIGAUD_TPSCG COLLEGE DOUANE\24_CAD\OTTP_0-01-002\02_LIVRABLE_CAD\025-P-0019200-0-01-002-HG-D-0001\@0005-00.DWG



COORDONNÉES DES FORAGES-NAD83 MTM, FUSEAU 8

SONDAGE	Nord (Y)	Est (X)	ÉLÉVATION
PU-01-19	5 037 546,0	242 816,5	47,45
TA-01-19	5 037 552,5	242 799,1	47,23
TA-02-19	5 037 536,9	242 802,9	47,39
TA-03-19	5 037 496,4	242 755,3	47,28
TA-04-19	5 037 485,7	242 774,1	47,17
TA-05-19	5 037 480,1	242 782,9	47,06
TA-06-19	5 037 473,8	242 800,5	46,88
TA-07-19	5 037 473,7	242 746,9	47,40
TA-08-19	5 037 466,9	242 759,5	47,22
TA-09-19	5 037 459,4	242 774,9	46,92
TA-10-19	5 037 452,8	242 788,5	46,53
TF-01-19	5 037 551,0	242 809,5	47,21
TF-02-19	5 037 544,5	242 789,5	47,42

Sceau

Échelle

1:1 250

Ce document est l'œuvre d'Englobe Corp. Toute reproduction, diffusion ou adaptation, partielle ou totale, est strictement interdite sans avoir préalablement obtenu l'autorisation écrite d'Englobe et de son Client. Aucune information contenue dans ce document ne peut être utilisée par un tiers sans l'autorisation écrite d'Englobe et de son Client. Englobe Corp. se dégage de toute responsabilité pour toute reproduction, diffusion, adaptation ou utilisation non autorisée du document.

Client

TPSGC

Englobe Corp.
1200, boul. Saint-Martin O.
bureau 400
Laval, Québec
H7S 2E4
514-281-5151

Projet

IMPLANTATION D'UN NOUVEAU HANGAR ET AGRANDISSEMENT DU CHENIL DE L'AGENCE DES SERVICES FRONTALIERS DU CANADA

Collège des Douanes,
475, chemin de la Grande-Ligne, Rigaud (Québec)

Titre

FIGURE 3
RÉSULTATS DES ANALYSES CHIMIQUES SUR LES SOLS
GUIDE D'INTERVENTION - PSRTC DU MELCC

Discipline :	Environnement	Préparé par :	P.-A. Charette, géo. EESA®	Vérifié par :	F. Girard, géo. M.Sc.
Échelle :	1:1 250	Dessiné par :	D. De Miguel, dess.	Approuvé par :	
Date :	07/08/2019	No. de figure :		No. d'enregistrement :	
Mise en page :	0003	Format papier :	ANSI full bleed B (17,00 x 11,00 pouces)		

Resp.	Projet	OTP	Projet/ Disc	Phase/ Type	Réf. élec. / No.Dessin	Rév.
025	P-0019200	0-01-002	HG	D		0003 00

Ce document doit être utilisé conjointement avec les recommandations formulées dans le rapport d'étude géotechnique et environnementale

10 cm

5

4

3

2

1

0

SUPERFICIE DES POLYGONES	
SONDAGE	SUPERFICIE (m²)
TF-01-19	60
TF-02-19	30
TA-01-19	21
TA-02-19	75
TA-03-19	363
TA-04-19	376
TA-05-19	328
TA-06-19	288
TA-07-19	342
TA-08-19	364
TA-09-19	374
TA-10-19	275

\\MTL5-FL-001\PROJETS\025\IP-0019200_RIGAUD_TPSCG COLLEGE DOUANE\24_CAD\OTP_0-01-002\02_LIVRABLE_CAD\025-P-0019200-0-01-002-HG-D-0001@0005-00.DWG

RECOMMANDATIONS POUR LA QUALITÉ DES SOLS (RQS) DU CCME (VOCATION COMMERCIALE) :

AIRE D'INFLUENCE DES SONDAGES (POLYGONATION)

< RQS

> RQS

LÉGENDE :

TF-NN-AA

00,00

FORAGE-NUMÉRO-ANNÉE
ÉLÉVATION (m)

PU-NN-AA

00,00

PUITS D'EXPLORATION-NUMÉRO-ANNÉE
ÉLÉVATION (m)

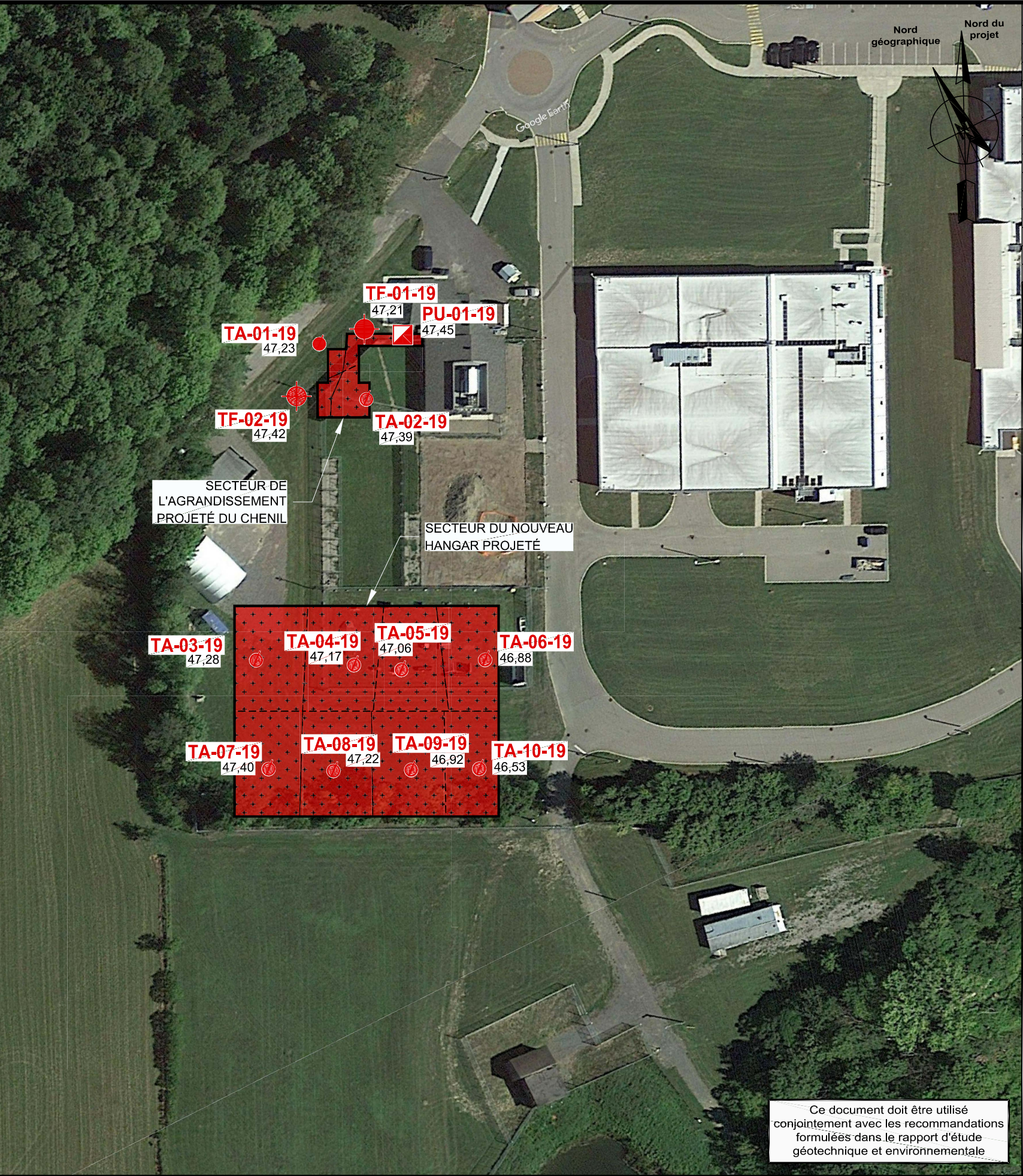
TA-NN-AA

00,00

SONDAGE MANUEL-NUMÉRO-ANNÉE
ÉLÉVATION (m)

NOTES :

L'IMAGE EN FOND DE PLAN PROVIENT DE LA BIBLIOTHÈQUE GOOGLE EARTH, SEPTEMBRE 2018.



Ce document doit être utilisé
conjointement avec les recommandations
formulées dans le rapport d'étude
géotechnique et environnementale

COORDONNÉES DES FORAGES-NAD83 MTM, FUSEAU 8

SONDAGE	Nord (Y)	Est (X)	ÉLÉVATION
PU-01-19	5 037 546,0	242 816,5	47,45
TA-01-19	5 037 552,5	242 799,1	47,23
TA-02-19	5 037 536,9	242 802,9	47,39
TA-03-19	5 037 496,4	242 755,3	47,28
TA-04-19	5 037 485,7	242 774,1	47,17
TA-05-19	5 037 480,1	242 782,9	47,06
TA-06-19	5 037 473,8	242 800,5	46,88
TA-07-19	5 037 473,7	242 746,9	47,40
TA-08-19	5 037 466,9	242 759,5	47,22
TA-09-19	5 037 459,4	242 774,9	46,92
TA-10-19	5 037 452,8	242 788,5	46,53
TF-01-19	5 037 551,0	242 809,5	47,21
TF-02-19	5 037 544,5	242 789,5	47,42

Sceau

GÉOLOGUE

PHILIPPE-A. CHARETTE

1916

QUÉBEC

2019-10-29

Échelle

0 5 10 15 20 25 50 m

1:1 000

Ce document est l'œuvre d'Englobe Corp. Toute reproduction, diffusion ou adaptation, partielle ou totale, est strictement prohibée sans avoir préalablement obtenu l'autorisation écrite d'Englobe et de son Client. Aucune information contenue dans ce document ne peut être utilisée par un tiers sans l'autorisation écrite d'Englobe et de son Client. Englobe Corp. se dégage de toute responsabilité pour toute reproduction, diffusion, adaptation ou utilisation non autorisée du document.

Client

TPSGC

Englobe Corp.

1200, boul. Saint-Martin O.
bureau 400
Laval, Québec
H7S 2E4
514-281-5151

Projet

IMPLANTATION DU NOUVEAU HANGAR ET
AGRANDISSEMENT DU CHENIL DE L'AGENCE
DES SERVICES FRONTALIERS DU CANADA

Collège des Douanes,
475, chemin de la Grande-Ligne, Rigaud (Québec)

Titre

FIGURE 4
ÉTENDUE THÉORIQUE DES SOLS CONTAMINÉS DÉTERMINÉS
PAR MÉTHODE DE POLYGONATION THÉORIQUE
RECOMMANDATIONS DU CCME







Discipline :	Environnement	Préparé par :	P.-A. Charette, géo. EESA®	Vérifié par :	F. Girard, géo. M.Sc.	
Échelle :	1:1 000	Dessiné par :	D. De Miguel, dess.	Approuvé par :		
Date :	07/08/2019	No. de figure :				
Mise en page :	0004	Format papier :	ANSI full bleed B (17,00 x 11,00 pouces)	No. d'enregistrement :		
Resp.	Projet	OTP	Projet/ Disc	Phase/ Type	Réf. élec. / No.Dessin	Rév.
025	P-0019200	0-01-002	HG	D		0004 00

1:0 cm




SUPERFICIE DES POLYGONES	
SONDAGE	SUPERFICIE (m²)
TF-01-19	60
TF-02-19	30
TA-01-19	21
TA-02-19	75
TA-03-19	363
TA-04-19	376
TA-05-19	328
TA-06-19	288
TA-07-19	342
TA-08-19	364
TA-09-19	374
TA-10-19	275

\\MTL5-FL-001\PROJETS\25\IP-0019200_RIGAUD_TPSGC COLLEGE DOUANE\24_CAD\OTTP_0-01-002\02_LIVRABLE_CAD\025-P-0019200-0-01-002-HG-D-0001@0005-00.DWG

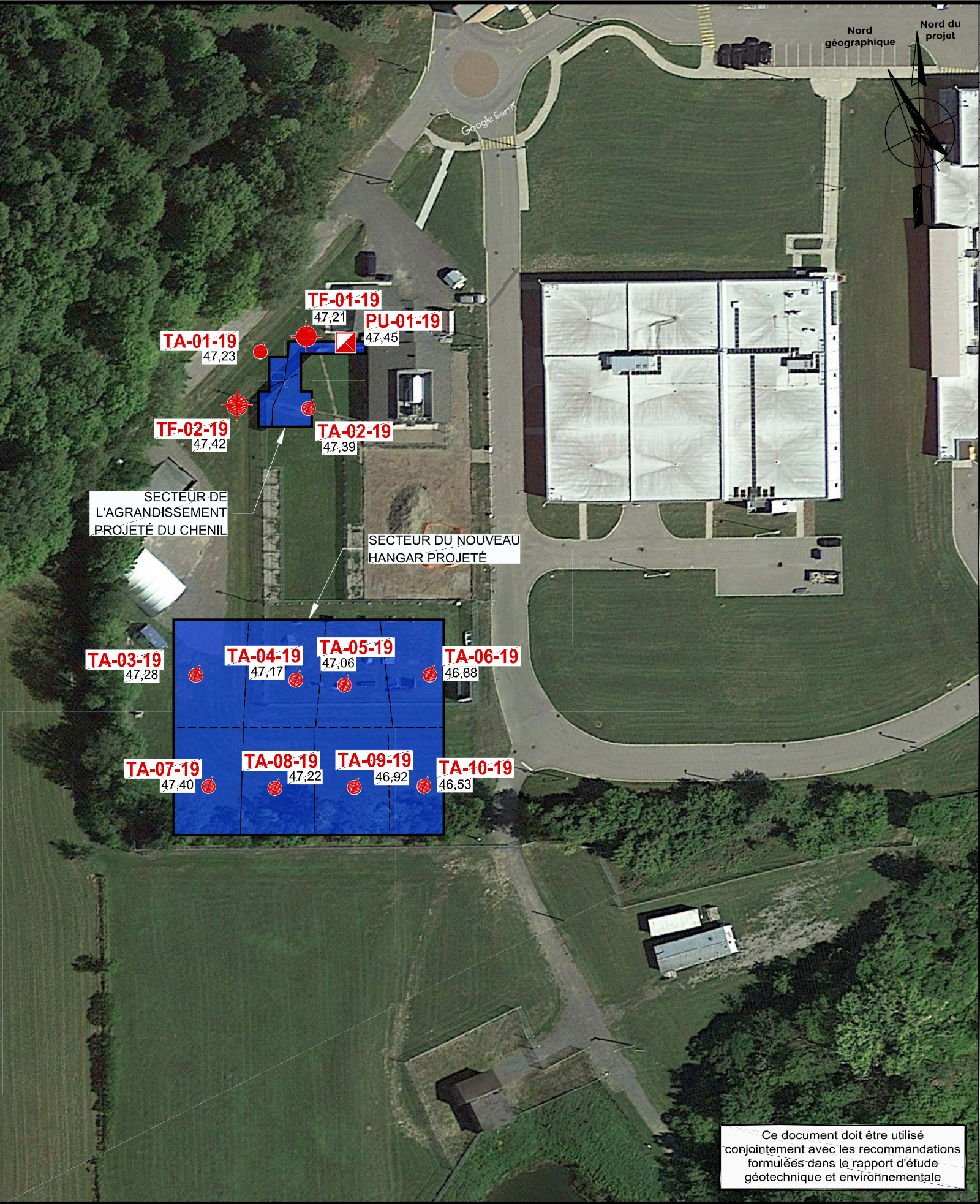
CRITÈRES DU GUIDE D'INTERVENTION - PSRTC DU MELCC :

	AIRE D'INFLUENCE DES SONDAGES (POLYGONATION)
	≤A
	A-B
	B-C
	>C
	≥RESC

LÉGENDE :


	TF-NN-AA 00,00	FORAGE-NUMÉRO-ANNÉE ÉLÉVATION (m)
	PU-NN-AA 00,00	PUITS D'EXPLORATION-NUMÉRO-ANNÉE ÉLÉVATION (m)
	TA-NN-AA 00,00	SONDAGE MANUEL-NUMÉRO-ANNÉE ÉLÉVATION (m)

NOTES :
L'IMAGE EN FOND DE PLAN PROVIENT DE LA BIBLIOTHÈQUE GOOGLE EARTH, SEPTEMBRE 2018.

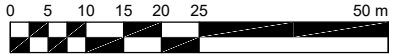


COORDONNÉES DES FORAGES-NAD83 MTM, FUSEAU 8			
SONDAGE	Nord (Y)	Est (X)	ÉLÉVATION
PU-01-19	5 037 546,0	242 816,5	47,45
TA-01-19	5 037 552,5	242 799,1	47,23
TA-02-19	5 037 536,9	242 802,9	47,39
TA-03-19	5 037 496,4	242 755,3	47,28
TA-04-19	5 037 485,7	242 774,1	47,17
TA-05-19	5 037 480,1	242 782,9	47,06
TA-06-19	5 037 473,8	242 800,5	46,88
TA-07-19	5 037 473,7	242 746,9	47,40
TA-08-19	5 037 466,9	242 759,5	47,22
TA-09-19	5 037 459,4	242 774,9	46,92
TA-10-19	5 037 452,8	242 788,5	46,53
TF-01-19	5 037 551,0	242 809,5	47,21
TF-02-19	5 037 544,5	242 789,5	47,42

Sceau



Échelle



1:1 000

Ce document est l'œuvre d'Englobe Corp. Toute reproduction, diffusion ou adaptation, partielle ou totale, est strictement prohibée sans avoir préalablement obtenu l'autorisation écrite d'Englobe et de son Client. Aucune information contenue dans ce document ne peut être utilisée par un tiers sans l'autorisation écrite d'Englobe et de son Client. Englobe Corp. se dégage de toute responsabilité pour toute reproduction, diffusion, adaptation ou utilisation non autorisée du document.

Client

TPSGC



Englobe Corp.
1200, boul. Saint-Martin O.
bureau 400
Laval, Québec
H7S 2E4
514-281-5151

Projet

IMPLANTATION DU NOUVEAU HANGAR ET AGRANDISSEMENT DU CHENIL DE L'AGENCE DES SERVICES FRONTALIERS DU CANADA

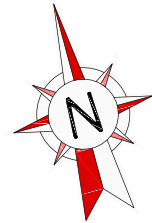
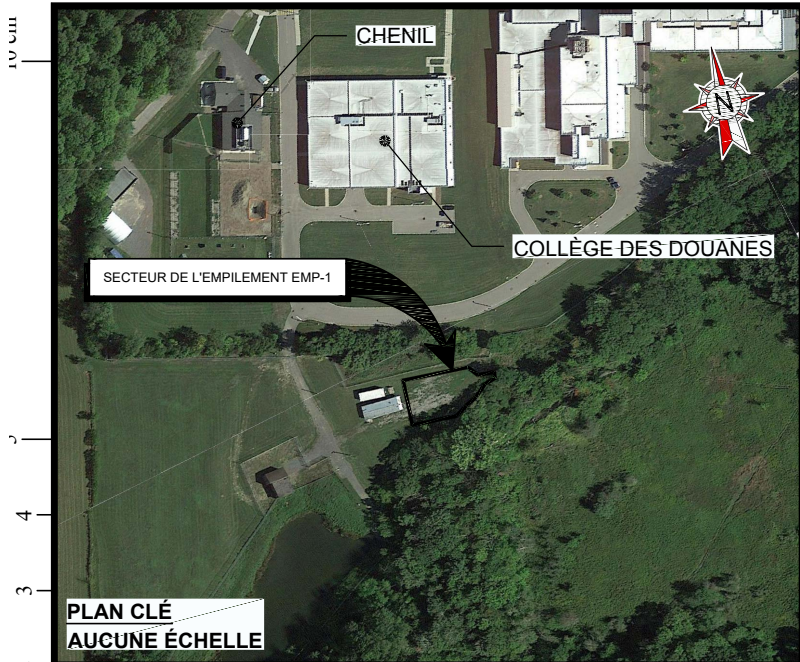
Collège des Douanes,
475, chemin de la Grande-Ligne, Rigaud (Québec)

Titre

FIGURE 5
ÉTENDUE THÉORIQUE DES SOLS CONTAMINÉS DÉTERMINÉS PAR MÉTHODE DE POLYGONATION THÉORIQUE CRITÈRES DU GUIDE D'INTERVENTION PSRTC DU MELCC

Discipline :	Environnement	Préparé par : P.-A. Charette, géo. EESA®	Vérifié par : F. Girard, géo. M.Sc.
Échelle :	1:1 000	Dessiné par : D. De Miguel, dess.	Approuvé par :
Date :	07/08/2019	No. de figure :	
Mise en page : 0005	Format papier : ANSI full bleed B (17,00 x 11,00 pouces)	No. d'enregistrement :	

Resp.	Projet	OTP	Projet/ Disc	Phase/ Type	Réf. élec. / No.Dessin	Rév.
025	P-0019200	0-01-002	HG	D		0005 00



Englobe (2019-07-31)	EMP-1	Englobe (2019-07-31)	EMP-1	Englobe (2019-07-31)	EMP-1	Englobe (2019-07-31)	EMP-1	Englobe (2019-07-31)	EMP-1
HAP	< RQS	HAP	< RQS	HAP	< RQS	HAP	< RQS	HAP	< RQS
MÉTAUX	> RQS	MÉTAUX	< RQS	MÉTAUX	< RQS	MÉTAUX	< RQS	MÉTAUX	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS
HP F1	< RQS
HP F2 à F4	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS
HP F1	< RQS
HP F2 à F4	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS
HP F1	< RQS
HP F2 à F4	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS
HP F1	< RQS
HP F2 à F4	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	> RQS
HP F1	< RQS
HP F2 à F4	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS
HP F1	< RQS
HP F2 à F4	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS
HP F1	< RQS
HP F2 à F4	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	> RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS
HP F1	< RQS
HP F2 à F4	< RQS

Englobe (2019-07-31)	EMP-1
HAP	< RQS
MÉTAUX	< RQS

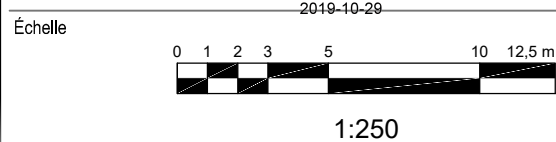
LÉGENDE (RÉSULTATS D'ANALYSES DES SOLS) :

EMPILEMENT
ÉCHANTILLON DE SOL ANALYSÉ
EFFECTUÉ PAR : COMPAGNIE
(DATE)

PARAMÈTRES ANALYSÉS
HYDROCARBURES AROMATIQUES POLYCYCLIQUES
MÉTAUX : (Ag, As, Ba, Cd, Cr, Cu, Co, Sn, Mn, Mo, Ni, Pb, Se et Zn)
HYDROCARBURES PÉTROLIERS - FRACTION F1
HYDROCARBURES PÉTROLIERS - FRACTION F2 à F4

Englobe (Date)	EMP-1 E-N
HAP	< RQS
MÉTAUX	> RQS
HP F1	-
HP F2 à F4	-

RECOMMANDATIONS POUR LA QUALITÉ DES
SOLS (RQS) DU CCME (VOCATION COMMERCIALE) :
- : NON ANALYSÉ
RQS : RECOMMANDATION CANADIENNE POUR LA QUALITÉ DES SOLS - ENVIRONNEMENT
ET SANTÉ HUMAINE - VOCATION COMMERCIALE ET/OU STANDARD PANCANADIEN
RELATIF AUX HYDROCARBURES PÉTROLIERS DANS LE SOLS(SPHP)



Ce document est l'œuvre d'Englobe Corp. Toute reproduction, diffusion ou adaptation, partielle ou totale, est strictement
prohibée sans avoir préalablement obtenu l'autorisation écrite d'Englobe et de son Client. Aucune information contenue
dans ce document ne peut être utilisée par un tiers sans l'autorisation écrite d'Englobe et de son Client. Englobe Corp. se
dégage de toute responsabilité pour toute reproduction, diffusion, adaptation ou utilisation non autorisée du document.

Client

TPSGC



Englobe Corp.

1200, boul. Saint-Martin O.
bureau 400
Laval, Québec
H7S 2E4
514-281-5151

Projet

IMPLANTATION D'UN NOUVEAU HANGAR ET
AGRANDISSEMENT DU CHENIL DE L'AGENCE
DES SERVICES FRONTALIERS DU CANADA

Collège des Douanes,
475, chemin de la Grande-Ligne, Rigaud (Québec)

Titre

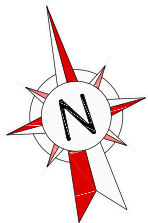
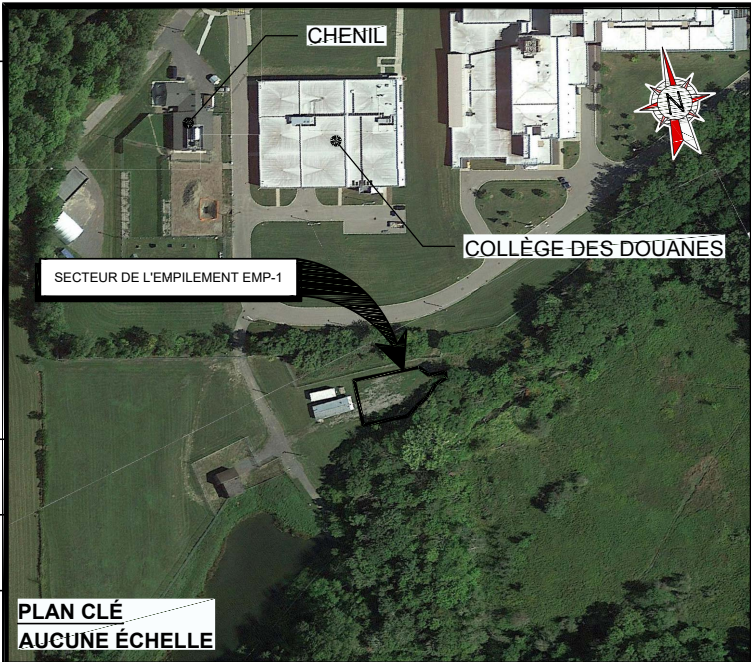
FIGURE 6
LOCALISATION DES POINTS DE PRÉLÈVEMENT AU
SEIN DE L'EMPILEMENT DE SOLS EMP-1 ET RÉSULTATS
DES ANALYSES CHIMIQUES - RQS DU CCME

Discipline :	Environnement	Préparé par : P.-A. Charette, géo. EESA®	Vérifié par : F. Girard, géo. M.Sc.
Échelle :	1:250	Dessiné par : D. De Miguel, dess.	Approuvé par :
Date :	23/10/2019	No. de figure :	
Mise en page : 0006	Format papier : ANSI full bleed B (17.00 x 11.00 pouces)	No. d'enregistrement :	

Resp.	Projet	OTP	Projet/ Disc	Phase/ Type	Réf. élec. / No. Dessin	Rév.
025	P-0019200	0-01-002	HG	D		0006 00

Ce document doit être utilisé
conjointement avec les recommandations
formulées dans le rapport d'étude
géotechnique et environnementale

\\MTL5-FL-001\PROJETS\025\019200_RIGAUD_TPSPGC COLLEGE DOUANE\24_CAD\OTP_0-01-002\02_LIVRABLE_CAD\025-P-0019200-0-01-002-HG-D-001_@0007-00.DWG



LÉGENDE (RÉSULTATS D'ANALYSES DES SOLS) :

EMPILEMENT
ÉCHANTILLON DE SOL ANALYSÉ
EFFECTUÉ PAR : COMPAGNIE
(DATE)

PARAMÈTRES ANALYSÉS
HYDROCARBURES PÉTROLIERS C₁₀-C₅₀
HYDROCARBURES AROMATIQUES POLYCYCLIQUES
MÉTAUX (Ag, As, Ba, Cd, Cr, Cu, Co, Sn, Mn, Mo, Ni, Pb, Se et Zn)
BENZÈNE, TOLUÈNE ET XYLENES (BTEX)

CRITÈRES DU GUIDE D'INTERVENTION
- PSRTC DU MELCC (SOLS):

- NON ANALYSÉ
- ≤ A
- A-B
- B-C
- ▲ C-RESC
- ◆ > RESC

Englobe (Date)	EMP-1
	E-N
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●
BTEX	●

Englobe (2019-07-31)	EMP-1 E-5
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	■

Englobe (2019-07-31)	EMP-1 E-9
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●

Englobe (2019-07-31)	EMP-1 E-10
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	■
BTEX	●

Englobe (2019-07-31)	EMP-1 E-13
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●

Englobe (2019-07-31)	EMP-1 E-14
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	■
BTEX	●

Englobe (2019-07-31)	EMP-1 E-1
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●

Englobe (2019-07-31)	EMP-1 E-6
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●
BTEX	●

Englobe (2019-07-31)	EMP-1 E-2
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●
BTEX	●

Englobe (2019-07-31)	EMP-1 E-3
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●

Englobe (2019-07-31)	EMP-1 E-4
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●
BTEX	●

Englobe (2019-07-31)	EMP-1 E-8
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●
BTEX	●

Englobe (2019-07-31)	EMP-1 E-11
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●

Englobe (2019-07-31)	EMP-1 E-12
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	■
BTEX	●

Englobe (2019-07-31)	EMP-1 E-16
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●
BTEX	●

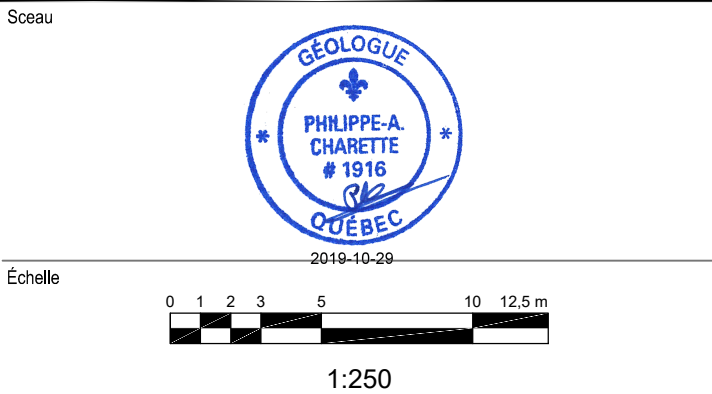
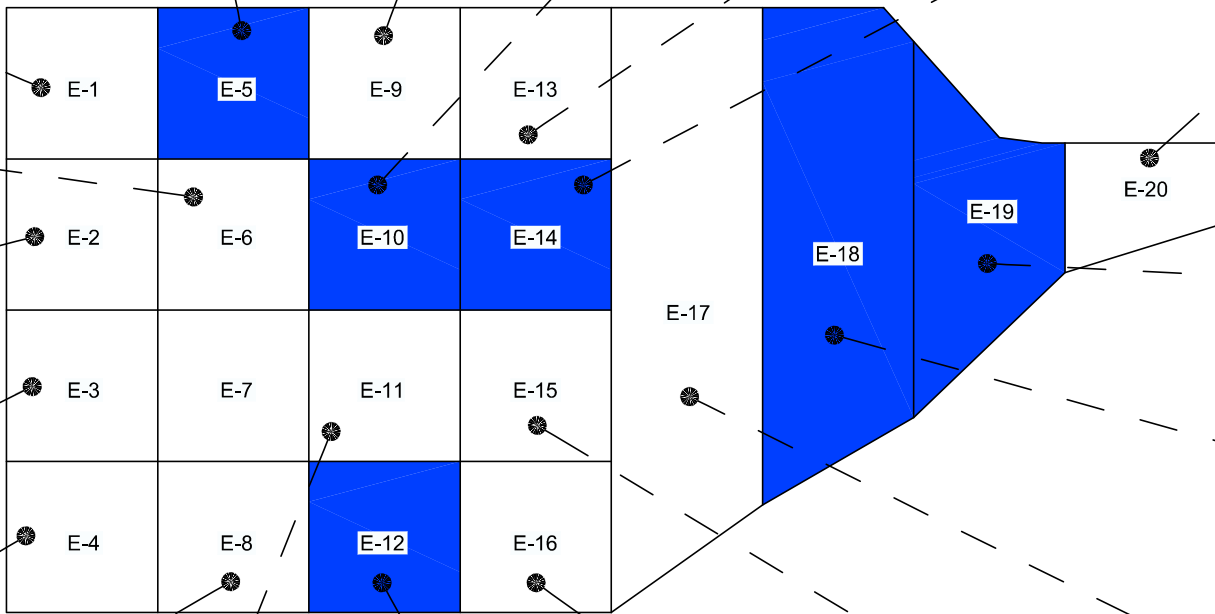
Englobe (2019-07-31)	EMP-1 E-15
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●

Englobe (2019-07-31)	EMP-1 E-20
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●
BTEX	●

Englobe (2019-07-31)	EMP-1 E-19
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	■

Englobe (2019-07-31)	EMP-1 E-18
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	■
BTEX	●

Englobe (2019-07-31)	EMP-1 E-17
HP C ₁₀ -C ₅₀	●
HAP	●
MÉTAUX	●



Ce document est l'œuvre d'Englobe Corp. Toute reproduction, diffusion ou adaptation, partielle ou totale, est strictement interdite sans avoir préalablement obtenu l'autorisation écrite d'Englobe et de son Client. Aucune information contenue dans ce document ne peut être utilisée par un tiers sans l'autorisation écrite d'Englobe et de son Client. Englobe Corp. se dégage de toute responsabilité pour toute reproduction, diffusion, adaptation ou utilisation non autorisée du document.

Client
TPSGC

Englobe Corp.
1200, boul. Saint-Martin O.
bureau 400
Laval, Québec
H7S 2E4
514-281-5151

Projet
**IMPLANTATION D'UN NOUVEAU HANGAR ET
AGRANDISSEMENT DU CHENIL DE L'AGENCE
DES SERVICES FRONTALIERS DU CANADA**

Collège des Douanes,
475, chemin de la Grande-Ligne, Rigaud (Québec)

Titre
**FIGURE 7
LOCALISATION DES POINTS DE PRÉLÈVEMENT AU SEIN DE
L'EMPILEMENT DE SOLS EMP-1 ET RÉSULTATS DES ANALYSES
CHIMIQUES - CRITÈRE DU GUIDE D'INTERVENTION - PSRTC DU MELCC**

Discipline : Environnement	Préparé par : P.-A. Charette, géo. EESA®	Vérifié par : F. Girard, géo. M.Sc.
Échelle : 1:250	Dessiné par : D. De Miguel, dess.	Approuvé par :
Date : 23/10/2019	No. de figure :	No. d'enregistrement :
Mise en page : 0007	Format papier : ANSI full bleed B (17.00 x 11.00 pouces)	

Resp.	Projet	OTP	Projet/ Disc	Phase/ Type	Réf. élec. / No. Dessin	Rév.
025	P-0019200	0-01-002	HG	D		0007 00

Ce document doit être utilisé
conjointement avec les recommandations
formulées dans le rapport d'étude
géotechnique et environnementale

Annexe D Tableaux

Tableau D.1 : Programme analytique

Paramètres	Nombre d'échantillons de sols analysés							
	Forages		Sondages à la tarière manuelle		Empilement de sol		Total	
	Échantillon parent	Duplicata	Échantillon parent	Duplicata	Échantillon parent	Duplicata	Échantillon parent	Duplicata
HP C ₁₀ -C ₅₀	5	1	16	2	19	1	40	4
HAP	5	1	16	2	19	1	40	4
HP F-1	2	1	6	0	10	1	18	2
HP F-2 à F-4	2	1	6	0	10	1	18	2
Métaux ⁽¹⁾	5	1	16	2	19	1	40	4

Notes :

- ⁽¹⁾ : Métaux extractibles totaux : As, Ag, Ba, Cd, Co, Cr, Cu, Sn, Mn, Mo, Ni, Pb et Zn (sols)
 - : Aucune analyse effectuée pour ce paramètre

Tableau D.2 : Sommaire des résultats analytiques pour les échantillons de sols, recommandations canadiennes pour la qualité des sols du CCME

Paramètres	Unités ⁽¹⁾	CCME ⁽²⁾ - RQS _{sh} ⁽³⁾ grains fins (si applicable)	Résultats analytiques										
			TF-01-19; CF-01A	TF-01-19; CF-01B	TF-01-19; CF-04	TF-02-19; CF-01B	TF-02-19; CF-03	TA-01-19; 1	TA-01-19; 3	TA-02-19; 2	TA-02-19; 3	TA-03-19; 2	TA-04-19;3
Forage / Échantillon													
Date d'échantillonnage			2019-07-29	2019-07-29	2019-07-29	2019-07-30	2019-07-30	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01
Profondeur (m)			0 - 0,25	0,25 - 0,61	1,83 - 2,44	0,20 - 0,61	1,22 - 1,83	0 - 0,15	0,40 - 0,60	0,20 - 0,35	0,35 - 0,60	0,20 - 0,40	0,40 - 0,60
Unité stratigraphique			Remblai	Argile silt.	Argile silt.	Argile silt.	Argile silt.	Remblai	Argile silt.	Sols org.	Argile silt.	Argile silt.	Argile silt.
HYDROCARBURES PÉTROLIERS													
F2 (C ₁₀ -C ₁₆)	mg/kg	260	-	<10	<10	-	-	-	-	<10	-	<10	-
F3 (C ₁₆ -C ₃₄)	mg/kg	2500	-	<50	<50	-	-	-	-	<50	-	<50	-
F4 (C ₃₄ -C ₅₀)	mg/kg	6600	-	<50	<50	-	-	-	-	<50	-	<50	-
Ligne de base atteinte à C ₅₀	mg/kg	--	-	YES	YES	-	-	-	-	YES	-	YES	-
VOLATILS													
Benzène	mg/kg	25	-	<0,040	<0,020	-	-	-	-	<0,020	-	<0,040	-
Toluène	mg/kg	330	-	<0,040	<0,020	-	-	-	-	<0,020	-	<0,040	-
Éthylbenzène	mg/kg	430	-	<0,040	<0,020	-	-	-	-	<0,020	-	<0,040	-
o-Xylène	mg/kg	--	-	<0,040	<0,020	-	-	-	-	<0,020	-	<0,040	-
p+m-Xylène	mg/kg	--	-	<0,080	<0,040	-	-	-	-	<0,040	-	<0,080	-
Xylènes (o,m,p)	mg/kg	230	-	<0,080	<0,040	-	-	-	-	<0,040	-	<0,080	-
F1 (C ₆ -C ₁₀)	mg/kg	--	-	<20	<10	-	-	-	-	<10	-	<20	-
F1 (C ₆ -C ₁₀) - BTEX	mg/kg	320	-	<20	<10	-	-	-	-	<10	-	<20	-
MÉTAUX													
Argent (Ag)	mg/kg	40	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Arsenic (As)	mg/kg	12	2	<2,0	2	<2,0	<2,0	2,1	<2,0	<2,0	<2,0	<2,0	<2,0
Baryum (Ba)	mg/kg	2 000	210	160	140	200	160	230	190	110	180	160	160
Cadmium (Cd)	mg/kg	22	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Chrome total (Cr)	mg/kg	87	86	120	100	110	110	53	120	29	110	120	110
Cuivre (Cu)	mg/kg	91	37	54	51	52	48	24	52	14	50	52	50
Cobalt (Co)	mg/kg	300	19	23	20	20	19	13	27	6,7	21	23	20
Étain (Sn)	mg/kg	300	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0
Manganèse (Mn)	mg/kg	--	690	710	620	620	540	810	860	330	650	730	510
Molybdène (Mo)	mg/kg	40	<0,50	<0,50	<0,50	<0,50	<0,50	1,1	<0,50	<0,50	<0,50	<0,50	<0,50
Nickel (Ni)	mg/kg	89	48	72	63	62	63	32	71	18	64	70	65
Plomb (Pb)	mg/kg	260	11	11	9,7	11	8,4	97	11	7,1	10	9,4	8,7
Sélénium (Se)	mg/kg	2,9	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Zinc (Zn)	mg/kg	410	78	93	86	92	87	98	91	48	89	88	86

Notes :

- (1) : Résultats exprimés sur base sèche
- (2) : Conseil canadien des ministres de l'environnement
- (3) : Recommandation canadienne pour la qualité des sols - Environnement et santé humaine - Vocation commerciale, contact avec le sol - RQSsh (6) - grains fins
- : Non analysé
- : Aucun critère ou norme
- 50 : Concentration supérieure au critère RQS_{sh} du CCME (sauf si teneur de fond naturelle est plus élevée que le critère)

Tableau D.2 : Sommaire des résultats analytiques pour les échantillons de sols, recommandations canadiennes pour la qualité des sols du CCME

Paramètres	Unités ⁽¹⁾	CCME ⁽²⁾ - RQS _{sh} ⁽³⁾ grains fins (si applicable)	Résultats analytiques														
			TA-05-19; 2	TA-06-19; 2	TA-07-19; 1	TA-07-19; 3	TA-08-19; 1	TA-08-19; 2	TA-09-19; 1	TA-09-19; 2	TA-10-19; 1	TA-10-19; 2	EMP1; E-1	EMP1; E-2	EMP1; E-3	EMP1; E-4	EMP1; E-5
Forage / Échantillon			2019-08-01	2019-08-01	2019-07-31	2019-07-31	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31
Date d'échantillonnage			2019-08-01	2019-08-01	2019-07-31	2019-07-31	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31
Profondeur (m)			0,30 - 0,50	0,25 - 0,40	0 - 0,15	0,40 - 0,60	0 - 0,25	0,25 - 0,40	0 - 0,20	0,20 - 0,40	0 - 0,25	0,25 - 0,40	-	-	-	-	-
Unité stratigraphique			Argile silt.	Argile silt.	Remblai	Argile silt.	Remblai	Argile silt.	Remblai	Argile silt.	Remblai	Argile silt.	Remblai	Remblai	Remblai	Remblai	Remblai
HYDROCARBURES PÉTROLIERS																	
F2 (C ₁₀ -C ₁₆)	mg/kg	260	<10	-	-	<10	-	-	-	<10	-	<10	-	<10	-	<10	-
F3 (C ₁₆ -C ₃₄)	mg/kg	2500	<50	-	-	<50	-	-	-	<50	-	<50	-	<50	-	<50	-
F4 (C ₃₄ -C ₅₀)	mg/kg	6600	<50	-	-	<50	-	-	-	<50	-	<50	-	<50	-	<50	-
Ligne de base atteinte à C ₅₀	mg/kg	--	YES	-	-	YES	-	-	-	YES	-	YES	-	YES	-	YES	-
VOLATILS																	
Benzène	mg/kg	25	<0,020	-	-	<0,040	-	-	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-
Toluène	mg/kg	330	<0,020	-	-	<0,040	-	-	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-
Éthylbenzène	mg/kg	430	<0,020	-	-	<0,040	-	-	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-
o-Xylène	mg/kg	--	<0,020	-	-	<0,040	-	-	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-
p+m-Xylène	mg/kg	--	<0,040	-	-	<0,080	-	-	-	<0,040	-	<0,040	-	<0,040	-	<0,040	-
Xylènes (o,m,p)	mg/kg	230	<0,040	-	-	<0,080	-	-	-	<0,040	-	<0,040	-	<0,040	-	<0,040	-
F1 (C ₆ -C ₁₀)	mg/kg	--	<10	-	-	<20	-	-	-	<10	-	<10	-	<10	-	<10	-
F1 (C ₆ -C ₁₀) - BTEX	mg/kg	320	<10	-	-	<20	-	-	-	<10	-	<10	-	<10	-	<10	-
MÉTAUX																	
Argent (Ag)	mg/kg	40	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Arsenic (As)	mg/kg	12	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	2,1	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0
Baryum (Ba)	mg/kg	2 000	180	190	180	160	160	170	140	190	110	190	82	120	110	100	190
Cadmium (Cd)	mg/kg	22	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	0,12	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Chrome total (Cr)	mg/kg	87	130	110	110	120	93	120	81	120	73	120	39	61	63	36	100
Cuivre (Cu)	mg/kg	91	53	44	51	52	40	52	28	52	21	47	17	27	29	16	47
Cobalt (Co)	mg/kg	300	21	18	22	21	19	19	16	21	14	22	8,7	13	13	8,6	20
Etain (Sn)	mg/kg	300	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0
Manganèse (Mn)	mg/kg	--	600	610	680	630	630	520	460	550	460	580	330	490	470	530	680
Molybdène (Mo)	mg/kg	40	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	0,56	<0,50
Nickel (Ni)	mg/kg	89	70	56	66	67	52	64	44	66	38	61	23	36	37	22	60
Plomb (Pb)	mg/kg	260	11	9,5	14	10	12	11	14	11	12	10	8,5	9,8	9,2	11	10
Sélénium (Se)	mg/kg	2,9	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Zinc (Zn)	mg/kg	410	99	88	97	90	84	91	76	96	73	93	48	65	68	57	85

Notes :

(1)

: Résultats exprimés sur base sèche

(2)

: Conseil canadien des ministres de l'environnement

(3)

: Recommandation canadienne pour la qualité des sols - Environnement et santé humaine - Vocation commerciale, contact avec le sol - RQSsh (6) - grains fins

-

: Non analysé

--

: Aucun critère ou norme

50

: Concentration supérieure au critère RQS_{sh} du CCME (sauf si teneur de fond naturelle est plus élevée que le critère)

Tableau D.2: Sommaire des résultats analytiques pour les échantillons de sols, recommandations canadiennes pour la qualité des sols du CCME

Paramètres		Unités ⁽¹⁾	CCME ⁽²⁾ - RQS _{sh} ⁽³⁾ grains fins (si applicable)	Résultats analytiques													
Forage / Échantillon				EMP1; E-6	EMP1; E-8	EMP1; E-9	EMP1; E-10	EMP1; E-11	EMP1; E-12	EMP1; E-13	EMP1; E-14	EMP1; E-15	EMP1; E-16	EMP1; E-17	EMP1; E-18	EMP1; E-19	EMP1; E-20
Date d'échantillonnage				2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-29	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31
Profondeur (m)				-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unité stratigraphique				Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai
HYDROCARBURES PETROLIERS																	
F2 (C ₁₀ -C ₁₆)	mg/kg	260	<10	<10	-	<10	-	<10	-	<10	-	<10	-	<10	-	<10	<10
F3 (C ₁₆ -C ₃₄)	mg/kg	2500	<50	<50	-	<50	-	<50	-	<50	-	<50	-	<50	-	<50	<50
F4 (C ₃₄ -C ₅₀)	mg/kg	6600	<50	<50	-	<50	-	<50	-	<50	-	<50	-	<50	-	<50	<50
Ligne de base atteinte à C ₅₀	mg/kg	--	YES	YES	-	YES	-	YES	-	YES	-	YES	-	YES	-	YES	YES
VOLATILS																	
Benzène	mg/kg	25	<0,020	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	<0,020
Toluène	mg/kg	330	<0,020	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	<0,020
Éthylbenzène	mg/kg	430	<0,020	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	<0,020
o-Xylène	mg/kg	--	<0,020	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020	<0,020
p+m-Xylène	mg/kg	--	<0,040	<0,040	-	<0,040	-	<0,040	-	<0,040	-	<0,040	-	<0,040	-	<0,040	<0,040
Xylènes (o,m,p)	mg/kg	230	<0,040	<0,040	-	<0,040	-	<0,040	-	<0,040	-	<0,040	-	<0,040	-	<0,040	<0,040
F1 (C ₆ -C ₁₀)	mg/kg	--	<10	<10	-	<10	-	<10	-	<10	-	<10	-	<10	-	<10	<10
F1 (C ₆ -C ₁₀) - BTEX	mg/kg	320	<10	<10	-	<10	-	<10	-	<10	-	<10	-	<10	-	<10	<10
MÉTAUX																	
Argent (Ag)	mg/kg	40	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Arsenic (As)	mg/kg	12	<2,0	<2,0	<2,0	<2,0	2,2	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0
Baryum (Ba)	mg/kg	2 000	150	130	120	160	130	150	140	140	130	130	150	150	150	150	130
Cadmium (Cd)	mg/kg	22	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Chrome total (Cr)	mg/kg	87	82	74	58	94	72	98	69	95	65	68	81	85	88	78	78
Cuivre (Cu)	mg/kg	91	38	34	27	40	32	44	32	43	29	28	36	40	41	35	35
Cobalt (Co)	mg/kg	300	18	14	12	20	14	16	15	18	13	16	16	17	18	15	15
Etain (Sn)	mg/kg	300	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0
Manganèse (Mn)	mg/kg	--	810	530	510	760	490	510	600	580	590	750	630	600	590	520	520
Molybdène (Mo)	mg/kg	40	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	0,51	<0,50	<0,50	<0,50	<0,50	<0,50
Nickel (Ni)	mg/kg	89	49	43	34	54	41	55	42	57	38	38	47	52	51	46	46
Plomb (Pb)	mg/kg	260	10	10	11	12	12	10	12	9,7	9,8	12	12	10	13	10	10
Sélénium (Se)	mg/kg	2,9	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Zinc (Zn)	mg/kg	410	83	80	74	86	76	81	74	80	73	80	83	77	80	71	71

Notes :

(1)

: Résultats exprimés sur base sèche

(2)

: Conseil canadien des ministres de l'environnement

(3)

: Recommandation canadienne pour la qualité des sols - Environnement et santé humaine - Vocation commerciale, contact avec le sol - RQSsh (6) - grains fins

-

: Non analysé

--

: Aucun critère ou norme

50

: Concentration supérieure au critère RQS_{sh} du CCME (sauf si teneur de fond naturelle est plus élevée que le critère)

Tableau D.2: Sommaire des résultats analytiques pour les échantillons de sols, recommandations canadiennes pour la qualité des sols du CCME (suite)

Paramètres		Unités ⁽¹⁾	CCME ⁽²⁾ - Qualité des sols - Environnement et santé humaine - Vocation commerciale RQS sh ⁽³⁾	Résultats analytiques												
Forage/Échantillon				TF-01-19; CF-01A	TF-01-19; CF-01B	TF-01-19; CF-04	TF-02-19; CF-01B	TF-02-19; CF-03	TA-01-19; 1	TA-01-19; 3	TA-02-19; 2	TA-02-19; 3	TA-03-19; 2	TA-04-19;3	TA-05-19; 2	TA-06-19; 2
Date d'échantillonnage				2019-07-29	2019-07-29	2019-07-29	2019-07-30	2019-07-30	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01
Profondeur (m)				0 - 0,25	0,25 - 0,61	1,83 - 2,44	0,20 - 0,61	1,22 - 1,83	0 - 0,15	0,40 - 0,60	0,20 - 0,35	0,35 - 0,60	0,20 - 0,40	0,40 - 0,60	0,30 - 0,50	0,25 - 0,40
Unité stratigraphique				Remblai	Argile silt.	Argile silt.	Argile silt.	Argile silt.	Remblai	Argile silt.	Sols org.	Argile silt.	Argile silt.	Argile silt.	Argile silt.	Argile silt.
HAP																
Acénaphène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Acénaphthylène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Anthracène	mg/kg	32		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(a)anthracène	mg/kg	10		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(a)pyrène	mg/kg	72		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b)fluoranthène	mg/kg	10		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(j)fluoranthène	mg/kg	--		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(k)fluoranthène	mg/kg	10		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b,j,k)fluoranthène	mg/kg	--		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(c)phénanthrène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(ghi)pérylène	mg/kg	--		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Chrysène	mg/kg	--		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenz(a,h)anthracène	mg/kg	10		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenzo(a,i)pyrène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,h)pyrène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,l)pyrène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
7,12-Diméthylbenzanthracène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluoranthène	mg/kg	180		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluorène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Indéno(1,2,3-cd)pyrène	mg/kg	10		<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
3-Méthylcholanthrène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Naphtalène	mg/kg	22		<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phénanthrène	mg/kg	50		<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040
Pyrène	mg/kg	100		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2-Méthylnaphtalène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1-Méthylnaphtalène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Diméthylnaphtalène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Triméthylnaphtalène	mg/kg	--		<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
ETT relative au B(a)P ⁽⁴⁾	mg/kg	5,3		0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058

- Notes :**
- ⁽¹⁾ : Résultats exprimés sur base sèche
 - ⁽²⁾ : Conseil canadien des ministres de l'environnement
 - ⁽³⁾ : Recommandation canadienne pour la qualité des sols - Environnement et santé humaine - Vocation résidentielle -RQSSh - grains fins
 - ⁽⁴⁾ : Équivalence de Toxicité Totale relative au Benzo(a)pyrène - Un risque accru de cancer pour toute une vie (RACV) de 1 sur 100 000 (10⁻⁵) a été sélectionné
 - ⁽⁵⁾ : Indice de risque cumulatif de cancer
 - : HAP cancérogène utilisés dans le calcul de l'ETT et de l'IRCC
 - : Non analysé
 - : Aucun critère ou norme
 - 50 : Concentration supérieure au critère RQS_E du CCME
 - 50 : Concentration supérieure au critère ETT du CCME

Tableau D.2: Sommaire des résultats analytiques pour les échantillons de sols, recommandations canadiennes pour la qualité des sols du CCME (suite)

Paramètres	Unités ⁽¹⁾	CCME ⁽²⁾ - Qualité des sols - Environnement et santé humaine - Vocation commerciale -RQS sh ⁽³⁾	Résultats analytiques																
			TA-07-19; 1	TA-07-19; 3	TA-08-19; 1	TA-08-19; 2	TA-09-19; 1	TA-09-19; 2	TA-10-19; 1	TA-10-19; 2	EMP1; E-1	EMP1; E-2	EMP1; E-3	EMP1; E-4	EMP1; E-5	EMP1; E-6	EMP1; E-8	EMP1; E-9	EMP1; E-10
Forage/Échantillon																			
Date d'échantillonnage			2019-07-31	2019-07-31	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31
Profondeur (m)			0 - 0,15	0,40 - 0,60	0 - 0,25	0,25 - 0,40	0 - 0,20	0,20 - 0,40	0 - 0,25	0,25 - 0,40	-	-	-	-	-	-	-	-	-
Unité stratigraphique			Remblai	Argile silt.	Remblai	Argile silt.	Remblai	Argile silt.	Remblai	Argile silt.	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai
HAP																			
Acénaphène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Acénaphthylène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Anthracène	mg/kg	32	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(a)anthracène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(a)pyrène	mg/kg	72	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b)fluoranthène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(j)fluoranthène	mg/kg	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(k)fluoranthène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b,j,k)fluoranthène	mg/kg	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(c)phénanthrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(ghi)peryène	mg/kg	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Chrysène	mg/kg	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenz(a,h)anthracène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenzo(a,i)pyrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,h)pyrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,l)pyrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
7,12-Diméthylbenzanthracène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluoranthène	mg/kg	180	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluorène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Indéno(1,2,3-cd)pyrène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
3-Méthylcholanthrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Naphtalène	mg/kg	22	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phénanthrène	mg/kg	50	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040
Pyrène	mg/kg	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2-Méthylnaphtalène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1-Méthylnaphtalène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Diméthylnaphtalène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Triméthylnaphtalène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
ETT relative au B(a)P ⁽⁴⁾	mg/kg	5,3	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058

Notes :

⁽¹⁾

: Résultats exprimés sur base sèche

⁽²⁾

: Conseil canadien des ministres de l'environnement

⁽³⁾

: Recommandation canadienne pour la qualité des sols - Environnement et santé humaine - Vocation résidentielle -RQSsh - grains fins

⁽⁴⁾

: Équivalence de Toxicité Totale relative au Benzo(a)pyrène - Un risque accru de cancer pour toute une vie (RACV) de 1 sur 100 000 (10⁻⁵) a été sélectionné

⁽⁵⁾

: Indice de risque cumulatif de cancer

: HAP cancérogène utilisés dans le calcul de l'ETT

-

: Non analysé

--

: Aucun critère ou norme

50

: Concentration supérieure au critère RQS_E du CCME

50

: Concentration supérieure au critère ETT du CCME

Tableau D.2: Sommaire des résultats analytiques pour les échantillons de sols, recommandations canadiennes pour la qualité des sols du CCME (suite)

Paramètres	Unités ⁽¹⁾	CCME ⁽²⁾ - Qualité des sols - Environnement et santé humaine - Vocation commerciale - RQS sh ⁽³⁾	Résultats analytiques									
			EMP1; E-11	EMP1; E-12	EMP1; E-13	EMP1; E-14	EMP1; E-15	EMP1; E-16	EMP1; E-17	EMP1; E-18	EMP1; E-19	EMP1; E-20
Forage/Échantillon												
Date d'échantillonnage			2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-29	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31
Profondeur (m)			-	-	-	-	-	-	-	-	-	-
Unité stratigraphique			Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai
HAP												
Acénaphène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Acénaphylène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Anthracène	mg/kg	32	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(a)anthracène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(a)pyrène	mg/kg	72	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b)fluoranthène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(j)fluoranthène	mg/kg	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(k)fluoranthène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b,j,k)fluoranthène	mg/kg	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(c)phénanthrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(ghi)pérylène	mg/kg	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Chrysène	mg/kg	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenz(a,h)anthracène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenzo(a,i)pyrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,h)pyrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,l)pyrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
7,12-Diméthylbenzanthracène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluoranthène	mg/kg	180	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluorène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Indéno(1,2,3-cd)pyrène	mg/kg	10	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
3-Méthylcholanthrène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Naphtalène	mg/kg	22	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phénanthrène	mg/kg	50	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040
Pyrène	mg/kg	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2-Méthylnaphtalène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1-Méthylnaphtalène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Diméthylnaphtalène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Triméthylnaphtalène	mg/kg	--	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
ETT relative au B(a)P ⁽⁴⁾	mg/kg	5,3	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058

Notes :

- ⁽¹⁾ : Résultats exprimés sur base sèche
- ⁽²⁾ : Conseil canadien des ministres de l'environnement
- ⁽³⁾ : Recommandation canadienne pour la qualité des sols - Environnement et santé humaine - Vocation résidentielle -RQSsh - grains fins
- ⁽⁴⁾ : Équivalence de Toxicité Totale relative au Benzo(a)pyrène - Un risque accru de cancer pour toute une vie (RACV) de 1 sur 100 000 (10⁻⁵) a été sélectionné
- ⁽⁵⁾ : Indice de risque cumulatif de cancer
- : HAP cancérogène utilisés dans le calcul de l'ETT
- : Non analysé
- : Aucun critère ou norme
- 50

 : Concentration supérieure au critère RQS_E du CCME
- 50

 : Concentration supérieure au critère ETT du CCME

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSTRC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques									
		A ⁽³⁾	B	C	Annexe I										
Forage / Échantillon						TF-01-19; CF-01A	TF-01-19; CF-01B	TF-01-19; CF-04	TF-02-19; CF-01B	TF-02-19; CF-03	TA-01-19; 1	TA-01-19; 3	TA-02-19; 2	TA-02-19; 3	TA-03-19; 2
Date d'échantillonnage						2019-07-29	2019-07-29	2019-07-29	2019-07-30	2019-07-30	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01
Profondeur (m)						0 - 0,25	0,25 - 0,61	1,83 - 2,44	0,20 - 0,61	1,22 - 1,83	0 - 0,15	0,40 - 0,60	0,20 - 0,35	0,35 - 0,60	0,20 - 0,40
Unité stratigraphique						Remblai	Argile silt.	Argile silt.	Argile silt.	Argile silt.	Remblai	Argile silt.	Sols org.	Argile silt.	Argile silt.
HYDROCARBURES PÉTROLIERS															
Hydrocarbures pétroliers (C ₁₀ -C ₅₀)	mg/kg	100	700	3 500	10 000	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
VOLATILS															
Benzène	mg/kg	0,2	0,5	5	5	-	<0,040	<0,020	-	-	-	-	<0,020	-	<0,040
Toluène	mg/kg	0,2	3	30	30	-	<0,040	<0,020	-	-	-	-	<0,020	-	<0,040
Éthylbenzène	mg/kg	0,2	5	50	50	-	<0,040	<0,020	-	-	-	-	<0,020	-	<0,040
o-Xylène	mg/kg	--	--	--	50	-	<0,040	<0,020	-	-	-	-	<0,020	-	<0,040
p+m-Xylène	mg/kg	--	--	--	--	-	<0,080	<0,040	-	-	-	-	<0,040	-	<0,080
Xylènes (o,m,p)	mg/kg	0,4	5	50	50	-	<0,080	<0,040	-	-	-	-	<0,040	-	<0,080
MÉTAUX															
Argent (Ag)	mg/kg	2	20	40	200	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Arsenic (As)	mg/kg	6	30	50	250	2	<2,0	2	<2,0	<2,0	2,1	<2,0	<2,0	<2,0	<2,0
Baryum (Ba)	mg/kg	340	500	2 000	10 000	210	160	140	200	160	230	190	110	180	160
Cadmium (Cd)	mg/kg	1,5	5	20	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Chrome total (Cr)	mg/kg	100	250	800	4 000	86	120	100	110	110	53	120	29	110	120
Cuivre (Cu)	mg/kg	50	100	500	2 500	37	54	51	52	48	24	52	14	50	52
Cobalt (Co)	mg/kg	25	50	300	1 500	19	23	20	20	19	13	27	6,7	21	23
Étain (Sn)	mg/kg	5	50	300	1 500	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0
Manganèse (Mn)	mg/kg	1000 /1210 ⁽⁵⁾	1000 / 3000 ⁽⁵⁾	2 200/3 000 ⁽⁵⁾	11 000	690	710	620	620	540	810	860	330	650	730
Molybdène (Mo)	mg/kg	2	10	40	200	<0,50	<0,50	<0,50	<0,50	<0,50	1,1	<0,50	<0,50	<0,50	<0,50
Nickel (Ni)	mg/kg	50	100	500	2 500	48	72	63	62	63	32	71	18	64	70
Plomb (Pb)	mg/kg	50	500	1 000	5 000	11	11	9,7	11	8,4	97	11	7,1	10	9,4
Sélénium (Se)	mg/kg	1	3	10	-	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Zinc (Zn)	mg/kg	140	500	1 500	7 500	78	93	86	92	87	98	91	48	89	88

Notes :

⁽¹⁾ : Résultats exprimés sur base sèche

⁽²⁾ : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, mars 2019)

⁽³⁾ : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.

⁽⁴⁾ : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)

⁽⁵⁾ : Les valeurs inscrites correspondent aux critères applicables pour les teneurs d'origine anthropique (1 000, 1 000, 2 200 mg/kg respectivement) et les teneurs naturelles en manganèse (1 210, 3 000, 3 000 mg/kg respectivement) tel que stipulé dans le Cadre de gestion des teneurs naturelles en manganèse du MELCC du 17 novembre 2014.

- : Non analysé

-- : Aucun critère ou norme

0,7 : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC

5,9 : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure ou égale aux normes de l'annexe I du RESC

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSTRC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques									
		A ⁽³⁾	B	C	Annexe I										
Forage / Échantillon						TA-04-19;3	TA-05-19; 2	TA-06-19; 2	TA-07-19; 1	TA-07-19; 3	TA-08-19; 1	TA-08-19; 2	TA-09-19; 1	TA-09-19; 2	TA-10-19; 1
Date d'échantillonnage						2019-08-01	2019-08-01	2019-08-01	2019-07-31	2019-07-31	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01
Profondeur (m)						0,40 - 0,60	0,30 - 0,50	0,25 - 0,40	0 - 0,15	0,40 - 0,60	0 - 0,25	0,25 - 0,40	0 - 0,20	0,20 - 0,40	0 - 0,25
Unité stratigraphique						Argile silt.	Argile silt.	Argile silt.	Remblai	Argile silt.	Remblai	Argile silt.	Remblai	Argile silt.	Remblai
HYDROCARBURERS PÉTROLIERS															
Hydrocarbures pétroliers (C ₁₀ -C ₅₀)	mg/kg	100	700	3 500	10 000	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
VOLATILS															
Benzène	mg/kg	0,2	0,5	5	5	-	<0,020	-	-	<0,040	-	-	-	<0,020	-
Toluène	mg/kg	0,2	3	30	30	-	<0,020	-	-	<0,040	-	-	-	<0,020	-
Éthylbenzène	mg/kg	0,2	5	50	50	-	<0,020	-	-	<0,040	-	-	-	<0,020	-
o-Xylène	mg/kg	--	--	--	50	-	<0,020	-	-	<0,040	-	-	-	<0,020	-
p+m-Xylène	mg/kg	--	--	--	--	-	<0,040	-	-	<0,080	-	-	-	<0,040	-
Xylènes (o,m,p)	mg/kg	0,4	5	50	50	-	<0,040	-	-	<0,080	-	-	-	<0,040	-
MÉTAUX															
Argent (Ag)	mg/kg	2	20	40	200	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Arsenic (As)	mg/kg	6	30	50	250	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	2,1	<2,0
Baryum (Ba)	mg/kg	340	500	2 000	10 000	160	180	190	180	160	160	170	140	190	110
Cadmium (Cd)	mg/kg	1,5	5	20	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	0,12
Chrome total (Cr)	mg/kg	100	250	800	4 000	110	130	110	110	120	93	120	81	120	73
Cuivre (Cu)	mg/kg	50	100	500	2 500	50	53	44	51	52	40	52	28	52	21
Cobalt (Co)	mg/kg	25	50	300	1 500	20	21	18	22	21	19	19	16	21	14
Étain (Sn)	mg/kg	5	50	300	1 500	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0
Manganèse (Mn)	mg/kg	1000 /1210 ⁽⁵⁾	944 / 3 000 ⁽⁵⁾	2 200/3 000 ⁽⁵⁾	11 000	510	600	610	680	630	630	520	460	550	460
Molybdène (Mo)	mg/kg	2	10	40	200	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Nickel (Ni)	mg/kg	50	100	500	2 500	65	70	56	66	67	52	64	44	66	38
Plomb (Pb)	mg/kg	50	500	1 000	5 000	8,7	11	9,5	14	10	12	11	14	11	12
Sélénium (Se)	mg/kg	1	3	10	-	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Zinc (Zn)	mg/kg	140	500	1 500	7 500	86	99	88	97	90	84	91	76	96	73

Notes :

⁽¹⁾ : Résultats exprimés sur base sèche

⁽²⁾ : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, mars 2019)

⁽³⁾ : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.

⁽⁴⁾ : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)

⁽⁵⁾ : Les valeurs inscrites correspondent aux critères applicables pour les teneurs d'origine anthropique (1 000, 1 000, 2 200 mg/kg respectivement) et les teneurs naturelles en manganèse (1 210, 3 000, 3 000 mg/kg respectivement) tel que stipulé dans le Cadre de gestion des teneurs naturelles en manganèse du MELCC du 17 novembre 2014.

- : Non analysé

-- : Aucun critère ou norme

0,7 : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC

5,9 : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure ou égale aux normes de l'annexe I du RESC

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSTRC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques									
		A ⁽³⁾	B	C	Annexe I										
Forage / Échantillon						TA-10-19; 2	EMP1; E-1	EMP1; E-2	EMP1; E-3	EMP1; E-4	EMP1; E-5	EMP1; E-6	EMP1; E-8	EMP1; E-9	EMP1; E-10
Date d'échantillonnage						2019-08-01	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31
Profondeur (m)						0,25 - 0,40	-	-	-	-	-	-	-	-	-
Unité stratigraphique						Argile silt.	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai
HYDROCARBURES PÉTROLIERS															
Hydrocarbures pétroliers (C ₁₀ -C ₅₀)	mg/kg	100	700	3 500	10 000	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
VOLATILS															
Benzène	mg/kg	0,2	0,5	5	5	<0,020	-	<0,020	-	<0,020	-	<0,020	<0,020	-	<0,020
Toluène	mg/kg	0,2	3	30	30	<0,020	-	<0,020	-	<0,020	-	<0,020	<0,020	-	<0,020
Éthylbenzène	mg/kg	0,2	5	50	50	<0,020	-	<0,020	-	<0,020	-	<0,020	<0,020	-	<0,020
o-Xylène	mg/kg	--	--	--	50	<0,020	-	<0,020	-	<0,020	-	<0,020	<0,020	-	<0,020
p+m-Xylène	mg/kg	--	--	--	--	<0,040	-	<0,040	-	<0,040	-	<0,040	<0,040	-	<0,040
Xylènes (o,m,p)	mg/kg	0,4	5	50	50	<0,040	-	<0,040	-	<0,040	-	<0,040	<0,040	-	<0,040
MÉTAUX															
Argent (Ag)	mg/kg	2	20	40	200	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Arsenic (As)	mg/kg	6	30	50	250	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0
Baryum (Ba)	mg/kg	340	500	2 000	10 000	190	82	120	110	100	190	150	130	120	160
Cadmium (Cd)	mg/kg	1,5	5	20	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Chrome total (Cr)	mg/kg	100	250	800	4 000	120	39	61	63	36	100	82	74	58	94
Cuivre (Cu)	mg/kg	50	100	500	2 500	47	17	27	29	16	47	38	34	27	40
Cobalt (Co)	mg/kg	25	50	300	1 500	22	8,7	13	13	8,6	20	18	14	12	20
Étain (Sn)	mg/kg	5	50	300	1 500	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0
Manganèse (Mn)	mg/kg	1000 /1210 ⁽⁵⁾	944 / 3 000 ⁽⁵⁾	2 200/3 000 ⁽⁵⁾	11 000	580	330	490	470	530	680	810	530	510	760
Molybdène (Mo)	mg/kg	2	10	40	200	<0,50	<0,50	<0,50	<0,50	0,56	<0,50	<0,50	<0,50	<0,50	<0,50
Nickel (Ni)	mg/kg	50	100	500	2 500	61	23	36	37	22	60	49	43	34	54
Plomb (Pb)	mg/kg	50	500	1 000	5 000	10	8,5	9,8	9,2	11	10	10	10	11	12
Sélénium (Se)	mg/kg	1	3	10	-	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Zinc (Zn)	mg/kg	140	500	1 500	7 500	93	48	65	68	57	85	83	80	74	86

Notes :

⁽¹⁾ : Résultats exprimés sur base sèche

⁽²⁾ : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, mars 2019)

⁽³⁾ : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.

⁽⁴⁾ : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)

⁽⁵⁾ : Les valeurs inscrites correspondent aux critères applicables pour les teneurs d'origine anthropique (1 000, 1 000, 2 200 mg/kg respectivement) et les teneurs naturelles en manganèse (1 210, 3 000, 3 000 mg/kg respectivement) tel que stipulé dans le Cadre de gestion des teneurs naturelles en manganèse du MELCC du 17 novembre 2014.

- : Non analysé

-- : Aucun critère ou norme

0,7 : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC

5,9 : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure ou égale aux normes de l'annexe I du RESC

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSTRC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques									
		A ⁽³⁾	B	C	Annexe I										
Forage / Échantillon						EMP1; E-11	EMP1; E-12	EMP1; E-13	EMP1; E-14	EMP1; E-15	EMP1; E-16	EMP1; E-17	EMP1; E-18	EMP1; E-19	EMP1; E-20
Date d'échantillonnage						2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-29	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31
Profondeur (m)						-	-	-	-	-	-	-	-	-	-
Unité stratigraphique						Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai
HYDROCARBURES PÉTROLIERS															
Hydrocarbures pétroliers (C ₁₀ -C ₅₀)	mg/kg	100	700	3 500	10 000	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
VOLATILS															
Benzène	mg/kg	0,2	0,5	5	5	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020
Toluène	mg/kg	0,2	3	30	30	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020
Éthylbenzène	mg/kg	0,2	5	50	50	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020
o-Xylène	mg/kg	--	--	--	50	-	<0,020	-	<0,020	-	<0,020	-	<0,020	-	<0,020
p+m-Xylène	mg/kg	--	--	--	--	-	<0,040	-	<0,040	-	<0,040	-	<0,040	-	<0,040
Xylènes (o,m,p)	mg/kg	0,4	5	50	50	-	<0,040	-	<0,040	-	<0,040	-	<0,040	-	<0,040
MÉTAUX															
Argent (Ag)	mg/kg	2	20	40	200	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Arsenic (As)	mg/kg	6	30	50	250	2,2	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0	<2,0
Baryum (Ba)	mg/kg	340	500	2 000	10 000	130	150	140	140	130	130	150	150	150	130
Cadmium (Cd)	mg/kg	1,5	5	20	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Chrome total (Cr)	mg/kg	100	250	800	4 000	72	98	69	95	65	68	81	85	88	78
Cuivre (Cu)	mg/kg	50	100	500	2 500	32	44	32	43	29	28	36	40	41	35
Cobalt (Co)	mg/kg	25	50	300	1 500	14	16	15	18	13	16	16	17	18	15
Étain (Sn)	mg/kg	5	50	300	1 500	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0	<1,0
Manganèse (Mn)	mg/kg	1000 /1210 ⁽⁵⁾	944 / 3 000 ⁽⁵⁾	2 200/3 000 ⁽⁵⁾	11 000	490	510	600	580	590	750	630	600	590	520
Molybdène (Mo)	mg/kg	2	10	40	200	<0,50	<0,50	<0,50	<0,50	<0,50	0,51	<0,50	<0,50	<0,50	<0,50
Nickel (Ni)	mg/kg	50	100	500	2 500	41	55	42	57	38	38	47	52	51	46
Plomb (Pb)	mg/kg	50	500	1 000	5 000	12	10	12	9,7	9,8	12	12	10	13	10
Sélénium (Se)	mg/kg	1	3	10	-	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50	<0,50
Zinc (Zn)	mg/kg	140	500	1 500	7 500	76	81	74	80	73	80	83	77	80	71

- Notes :
- ⁽¹⁾

: Résultats exprimés sur base sèche
- ⁽²⁾

: Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, mars 2019)
- ⁽³⁾

: Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.
- ⁽⁴⁾

: Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)
- ⁽⁵⁾

: Les valeurs inscrites correspondent aux critères applicables pour les teneurs d'origine anthropique (1 000, 1 000, 2 200 mg/kg respectivement) et les teneurs naturelles en manganèse (1 210, 3 000, 3 000 mg/kg respectivement) tel que stipulé dans le Cadre de gestion des teneurs naturelles en manganèse du MELCC du 17 novembre 2014.
- : Non analysé
- : Aucun critère ou norme
- 0,7

: Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC
- 5,9

: Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC
- 300

: Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC
- 300

: Concentration supérieure ou égale aux normes de l'annexe I du RESC

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSTRC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques							
		A ⁽³⁾	B	C	Annexe I	TF-01-19; CF-01A	TF-01-19; CF-01B	TF-01-19; CF-04	TF-02-19; CF-01B	TF-02-19; CF-03	TA-01-19; 1	TA-01-19; 3	TA-02-19; 2
Forage/ Échantillon						2019-07-29	2019-07-29	2019-07-29	2019-07-30	2019-07-30	2019-08-01	2019-08-01	2019-08-01
Date d'échantillonnage						0 - 0,25	0,25 - 0,61	1,83 - 2,44	0,20 - 0,61	1,22 - 1,83	0 - 0,15	0,40 - 0,60	0,20 - 0,35
Profondeur (m)						Remblai	Argile silt.	Argile silt.	Argile silt.	Argile silt.	Remblai	Argile silt.	Sols org.
Unité stratigraphique													
HAP													
Acénaphène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Acénaphthylène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Anthracène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(a)anthracène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(a)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(j)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(k)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b,j,k)fluoranthène	mg/kg	--	--	--	136	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(c)phénanthrène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(ghi)peryène	mg/kg	0,1	1	10	18	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Chrysène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenz(a,h)anthracène	mg/kg	0,1	1	10	82	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenzo(a,i)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,h)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,l)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
7,12-Diméthylbenzanthracène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluoranthène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluorène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Indéno(1,2,3-cd)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
3-Méthylcholanthrène	mg/kg	0,1	1	10	150	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Naphtalène	mg/kg	0,1	5	50	56	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phénanthrène	mg/kg	0,1	5	50	56	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040
Pyrène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Diméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Triméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10

Notes :

(1) : Résultats exprimés sur base sèche

(2) : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, Mars 2019)

(3) : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.

(4) : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)

- : Non analysé

-- : Aucun critère ou norme

0,7 : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC

5,9 : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC

(300) : Concentration supérieure ou égale aux normes de l'annexe I du RESC

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSTRC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques							
		A ⁽³⁾	B	C	Annexe I								
Forage/ Échantillon						TA-02-19; 3	TA-03-19; 2	TA-04-19; 3	TA-05-19; 2	TA-06-19; 2	TA-07-19; 1	TA-07-19; 3	TA-08-19; 1
Date d'échantillonnage		2019-08-01	2019-08-01	2019-08-01		2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-07-31	2019-07-31	2019-08-01
Profondeur (m)		0,35 - 0,60	0,20 - 0,40	0,40 - 0,60		0,30 - 0,50	0,25 - 0,40	0 - 0,15	0,40 - 0,60	0 - 0,25			
Unité stratigraphique		Argile silt.	Argile silt.	Argile silt.		Argile silt.	Argile silt.	Argile silt.	Argile silt.	Remblai	Argile silt.	Remblai	
HAP													
Acénaphène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Acénaphthylène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Anthracène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(a)anthracène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(a)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(j)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(k)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b,j,k)fluoranthène	mg/kg	--	--	--	136	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(c)phénanthrène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(ghi)peryène	mg/kg	0,1	1	10	18	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Chrysène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenz(a,h)anthracène	mg/kg	0,1	1	10	82	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenzo(a,i)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,h)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,l)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
7,12-Diméthylbenzanthracène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluoranthène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluorène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Indéno(1,2,3-cd)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
3-Méthylcholanthrène	mg/kg	0,1	1	10	150	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Naphtalène	mg/kg	0,1	5	50	56	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phénanthrène	mg/kg	0,1	5	50	56	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040
Pyrène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Diméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Triméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10

Notes :

(1) : Résultats exprimés sur base sèche

(2) : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, Mars 2019)

(3) : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.

(4) : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)

- : Non analysé

-- : Aucun critère ou norme

0,7 : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC

5,9 : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC

(300) : Concentration supérieure ou égale aux normes de l'annexe I du RESC

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSRTC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques						
		A ⁽³⁾	B	C	Annexe I							
Forage/ Échantillon						TA-08-19; 2	TA-09-19; 1	TA-09-19; 2	TA-10-19; 1	TA-10-19; 2	EMP1; E-1	EMP1; E-2
Date d'échantillonnage						2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-08-01	2019-07-31	2019-07-31
Profondeur (m)						0,25 - 0,40	0 - 0,20	0,20 - 0,40	0 - 0,25	0,25 - 0,40	-	-
Unité stratigraphique						Argile silt.	Remblai	Argile silt.	Remblai	Argile silt.	Remblai	Remblai
HAP												
Acénaphène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Acénaphthylène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Anthracène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(a)anthracène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(a)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(j)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(k)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b,j,k)fluoranthène	mg/kg	--	--	--	136	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(c)phénanthrène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(ghi)peryène	mg/kg	0,1	1	10	18	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Chrysène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenz(a,h)anthracène	mg/kg	0,1	1	10	82	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenzo(a,i)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,h)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,l)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
7,12-Diméthylbenzanthracène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluoranthène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluorène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Indéno(1,2,3-cd)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
3-Méthylcholanthrène	mg/kg	0,1	1	10	150	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Naphtalène	mg/kg	0,1	5	50	56	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phénanthrène	mg/kg	0,1	5	50	56	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040
Pyrène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Diméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Triméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10

Notes :

(1) : Résultats exprimés sur base sèche

(2) : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, Mars 2019)

(3) : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.

(4) : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)

- : Non analysé

-- : Aucun critère ou norme

0,7 : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC

5,9 : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC

(300) : Concentration supérieure ou égale aux normes de l'annexe I du RESC

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSTRC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques						
		A ⁽³⁾	B	C	Annexe I							
Forage/ Échantillon						EMP1; E-3	EMP1; E-4	EMP1; E-5	EMP1; E-6	EMP1; E-8	EMP1; E-9	EMP1; E-10
Date d'échantillonnage						2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-31
Profondeur (m)						-	-	-	-	-	-	-
Unité stratigraphique						Remblai	Remblai	Remblai	Remblai	Remblai	Remblai	Remblai
HAP												
Acénaphène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Acénaphthylène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Anthracène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(a)anthracène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(a)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(j)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(k)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b,j,k)fluoranthène	mg/kg	--	--	--	136	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(c)phénanthrène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(ghi)peryène	mg/kg	0,1	1	10	18	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Chrysène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenz(a,h)anthracène	mg/kg	0,1	1	10	82	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenzo(a,i)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,h)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,l)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
7,12-Diméthylbenzantracène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluoranthène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluorène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Indéno(1,2,3-cd)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
3-Méthylcholanthrène	mg/kg	0,1	1	10	150	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Naphtalène	mg/kg	0,1	5	50	56	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phénanthrène	mg/kg	0,1	5	50	56	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040
Pyrène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Diméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Triméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10

Notes :

(1) : Résultats exprimés sur base sèche

(2) : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, Mars 2019)

(3) : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.

(4) : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)

- : Non analysé

-- : Aucun critère ou norme

0,7 : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC

5,9 : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC

(300) : Concentration supérieure ou égale aux normes de l'annexe I du RESC

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSTRC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques					
		A ⁽³⁾	B	C	Annexe I						
Forage/ Échantillon						EMP1; E-11	EMP1; E-12	EMP1; E-13	EMP1; E-14	EMP1; E-15	EMP1; E-16
Date d'échantillonnage						2019-07-31	2019-07-31	2019-07-31	2019-07-31	2019-07-29	2019-07-31
Profondeur (m)						-	-	-	-	-	-
Unité stratigraphique						Remblai	Remblai	Remblai	Remblai	Remblai	Remblai
HAP											
Acénaphène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Acénaphthylène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Anthracène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(a)anthracène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(a)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(j)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(k)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(b,j,k)fluoranthène	mg/kg	--	--	--	136	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Benzo(c)phénanthrène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Benzo(ghi)pérylène	mg/kg	0,1	1	10	18	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Chrysène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenz(a,h)anthracène	mg/kg	0,1	1	10	82	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
Dibenzo(a,i)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,h)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,l)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
7,12-Diméthylbenzanthracène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluoranthène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Fluorène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Indéno(1,2,3-cd)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050	<0,050	<0,050
3-Méthylcholanthrène	mg/kg	0,1	1	10	150	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
Naphtalène	mg/kg	0,1	5	50	56	<0,010	<0,010	<0,010	<0,010	<0,010	<0,010
Phénanthrène	mg/kg	0,1	5	50	56	<0,040	<0,040	<0,040	<0,040	<0,040	<0,040
Pyrène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
1,3-Diméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10
2,3,5-Triméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10	<0,10	<0,10

Notes :

(1) : Résultats exprimés sur base sèche

(2) : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, Mars 2019)

(3) : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.

(4) : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)

- : Non analysé

-- : Aucun critère ou norme

0,7 : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC

5,9 : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC

300 : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC

(300) : Concentration supérieure ou égale aux normes de l'annexe I du RESC

Tableau D.3 : Sommaire des résultats analytiques pour les échantillons de sols Guide d'intervention - PSTRC du MELCC

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	Résultats analytiques			
		A ⁽³⁾	B	C	Annexe I				
Forage/ Échantillon						EMP1; E-17	EMP1; E-18	EMP1; E-19	EMP1; E-20
Date d'échantillonnage						2019-07-31	2019-07-31	2019-07-31	2019-07-31
Profondeur (m)						-	-	-	-
Unité stratigraphique						Remblai	Remblai	Remblai	Remblai
HAP									
Acénaphène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10
Acénaphthylène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10
Anthracène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10
Benzo(a)anthracène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050
Benzo(a)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050
Benzo(b)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050
Benzo(j)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050
Benzo(k)fluoranthène	mg/kg	0,1	1	10	--	<0,050	<0,050	<0,050	<0,050
Benzo(b,j,k)fluoranthène	mg/kg	--	--	--	136	<0,050	<0,050	<0,050	<0,050
Benzo(c)phénanthrène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10
Benzo(ghi)peryène	mg/kg	0,1	1	10	18	<0,050	<0,050	<0,050	<0,050
Chrysène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050
Dibenz(a,h)anthracène	mg/kg	0,1	1	10	82	<0,050	<0,050	<0,050	<0,050
Dibenzo(a,i)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,h)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10
Dibenzo(a,l)pyrène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10
7,12-Diméthylbenzanthracène	mg/kg	0,1	1	10	34	<0,10	<0,10	<0,10	<0,10
Fluoranthène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10
Fluorène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10
Indéno(1,2,3-cd)pyrène	mg/kg	0,1	1	10	34	<0,050	<0,050	<0,050	<0,050
3-Méthylcholanthrène	mg/kg	0,1	1	10	150	<0,10	<0,10	<0,10	<0,10
Naphtalène	mg/kg	0,1	5	50	56	<0,010	<0,010	<0,010	<0,010
Phénanthrène	mg/kg	0,1	5	50	56	<0,040	<0,040	<0,040	<0,040
Pyrène	mg/kg	0,1	10	100	100	<0,10	<0,10	<0,10	<0,10
2-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10
1-Méthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10
1,3-Diméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10
2,3,5-Triméthylnaphtalène	mg/kg	0,1	1	10	56	<0,10	<0,10	<0,10	<0,10

Notes :

- (1) : Résultats exprimés sur base sèche
- (2) : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, Mars 2019)
- (3) : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.
- (4) : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)
- : Non analysé
- : Aucun critère ou norme
- 0,7** : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC
- 5,9** : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC
- 300** : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC
- (300)** : Concentration supérieure ou égale aux normes de l'annexe I du RESC

Notes :

- (1) : Résultats exprimés sur base sèche
- (2) : Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, Mars 2019)
- (3) : Les critères A représentent les teneurs de fond pour les substances inorganiques et les limites de quantification pour les substances organiques. Dans le cas des métaux et métalloïdes, les teneurs de fond indiquées prévalent pour la province géologique des Basses-Terres du Saint-Laurent tel qu'indiqué au Guide d'intervention du MELCC.
- (4) : Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)
- (5) : Limite de détection rapportée du laboratoire
- (6) : Les valeurs inscrites correspondent aux critères applicables pour les teneurs d'origine anthropique (1 000, 1 000, 2 200 mg/kg respectivement) et les teneurs naturelles en manganèse (1 210, 3 000, 3 000 mg/kg respectivement) tel que stipulé dans le Cadre de gestion des teneurs naturelles en manganèse du MELCC du 17 novembre 2014.
- (7) : Conseil canadien des ministres de l'environnement
- (8) : Recommandation canadienne pour la qualité des sols - Environnement et santé humaine - Vocation résidentielle -RQSsh (6) - grains fins / grains grossiers
- (9) : Équivalence de Toxicité Totale relative au Benzo(a)pyrène - Un risque accru de cancer pour toute une vie (RACV) de 1 sur 100 000 (10⁻⁵) a été sélectionné
- : Non analysé
- n.a. : Différence relative non applicable. Résultats inférieurs à 10 fois la LDM ou concentration non détectée dans l'échantillon.
- 0,7** : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC
- 5,9** : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC
- 300** : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC
- 300** : Concentration supérieure ou égale aux normes de l'annexe I du RESC
- 50** : Concentration supérieure au critère RQS_E du CCME
- 50** : Concentration supérieure au critère ETT du CCME
- 0,96** : Concentration dans la plage A-B des critères du Guide d'intervention - PSRTC du MELCC et concentration supérieure au critère RQSE du CCME
- 8,60** : Concentration dans la plage B-C des critères du Guide d'intervention - PSRTC du MELCC et concentration supérieure au critère RQSE du CCME
- 12** : Concentration supérieure aux critères C du Guide d'intervention - PSRTC du MELCC et concentration supérieure au critère RQSE du CCME

Tableau D.4 : Résultats de contrôle qualité des sols

Paramètres	Unités ⁽¹⁾	Guide d'intervention - PSRTC ⁽²⁾			RESC ⁽⁴⁾	CCME ⁽⁷⁾ - RQS _{sh} ⁽⁸⁾ grains fins / grains grossiers	LDR ⁽⁵⁾	Résultats analytiques						Résultats analytiques					
		A ⁽³⁾	B	C	Annexe 1			Duplicata	Échantillon parent	Différence relative (%)	Duplicata	Échantillon parent	Différence relative (%)	Duplicata	Échantillon parent	Différence relative (%)	Duplicata	Échantillon parent	Différence relative (%)
Echantillon								DUP-2	TF-01-19; CF-01B		DUP-11	EMP-1; E-10		DUP-13	TA-10-19; 1		DUP-14	TA-10-19; 2	
Date d'échantillonnage								2019-07-29			2019-07-31			2019-08-01			2019-08-01		
Profondeur (m)								0,25 - 0,61		-		0 - 0,25		0,25 - 0,40					
BTEx et Hydrocarbures pétroliers F1																			
Benzene	ug/g	0,2	0,5	5	5	25	0,04	<0,020	<0,040	n.a.	<0,020	<0,020	n.a.	-	-	n.a.	-	<0,020	n.a.
Toluene	ug/g	0,2	3	30	30	330	0,04	<0,020	<0,040	n.a.	<0,020	<0,020	n.a.	-	-	n.a.	-	<0,020	n.a.
Ethylbenzene	ug/g	0,2	5	50	50	430	0,04	<0,020	<0,040	n.a.	<0,020	<0,020	n.a.	-	-	n.a.	-	<0,020	n.a.
o-Xylene	ug/g	--	--	--	50	--	0,04	<0,020	<0,040	n.a.	<0,020	<0,020	n.a.	-	-	n.a.	-	<0,020	n.a.
p+m-Xylene	ug/g	--	--	--	--	--	0,08	<0,040	<0,080	n.a.	<0,040	<0,040	n.a.	-	-	n.a.	-	<0,040	n.a.
Total Xylenes	ug/g	0,4	5	50	50	230	0,08	<0,040	<0,080	n.a.	<0,040	<0,040	n.a.	-	-	n.a.	-	<0,040	n.a.
F1 (C6-C10)	ug/g	--	--	--	--	320	20	<10	<20	n.a.	<10	<10	n.a.	-	-	n.a.	-	<10	n.a.
F1 (C6-C10) - BTEX	ug/g	--	--	--	--	320	20	<10	<20	n.a.	<10	<10	n.a.	-	-	n.a.	-	<10	n.a.
HYDROCARBURES PETROLIERS TOTAUX																			
Hydrocarbures pétroliers (C ₁₀ -C ₅₀)	mg/kg	100	700	3 500	10 000	--	100	<100	<100	n.a.	<100	<100	n.a.	<100	<100	n.a.	<100	<100	n.a.
F2 (C ₁₀ -C ₁₆)	ug/g	--	--	--	--	260	10	<10	<10	n.a.	<10	<10	n.a.	-	-	n.a.	-	<10	n.a.
F3 (C ₁₆ -C ₃₄)	ug/g	--	--	--	--	2500	50	<50	<50	n.a.	<50	<50	n.a.	-	-	n.a.	-	<50	n.a.
F4 (C ₃₄ -C ₅₀)	ug/g	--	--	--	--	6600	50	<50	<50	n.a.	<50	<50	n.a.	-	-	n.a.	-	<50	n.a.
Ligne de base atteinte à C ₅₀	ug/g	--	--	--	--	--	--	YES	YES	n.a.	YES	YES	n.a.	-	-	n.a.	-	YES	n.a.
MÉTAUX																			
Argent (Ag)	mg/kg	2	20	40	200	40	0,5	<0,50	<0,50	n.a.	<0,50	<0,50	n.a.	<0,50	<0,50	n.a.	<0,50	<0,50	n.a.
Arsenic (As)	mg/kg	6	30	50	250	12	2	<2,0	<2,0	n.a.	<2,0	<2,0	n.a.	<2,0	<2,0	n.a.	<2,0	<2,0	n.a.
Baryum (Ba)	mg/kg	340	500	2 000	10 000	2 000	4	150	160	6%	160	160	0%	100	110	10%	200	190	5%
Cadmium (Cd)	mg/kg	1,5	5	20	100	22	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	0,17	0,12	n.a.	0,12	<0,10	n.a.
Chrome total (Cr)	mg/kg	100	250	800	4 000	87	1	110	120	9%	81	94	15%	68	73	7%	130	120	8%
Cuivre (Cu)	mg/kg	50	100	500	2 500	91	1	50	54	8%	36	40	11%	20	21	5%	49	47	4%
Cobalt (Co)	mg/kg	25	50	300	1 500	300	1	22	23	4%	14	20	35%	13	14	7%	25	22	13%
Etain (Sn)	mg/kg	5	50	300	1 500	300	1	<1,0	<1,0	n.a.	<1,0	<1,0	n.a.	<1,0	<1,0	n.a.	<1,0	<1,0	n.a.
Manganèse (Mn)	mg/kg	1000 /1210 ⁽⁶⁾	1000 / 3000 ⁽⁶⁾	2 200/3 000 ⁽⁶⁾	11 000	--	2	690	710	3%	510	760	39%	420	460	9%	610	580	5%
Molybdène (Mo)	mg/kg	2	10	40	200	40	0,5	<0,50	<0,50	n.a.	<0,50	<0,50	n.a.	<0,50	<0,50	n.a.	<0,50	<0,50	n.a.
Nickel (Ni)	mg/kg	50	100	500	2 500	89	0,5	66	72	9%	47	54	14%	35	38	8%	64	61	5%
Plomb (Pb)	mg/kg	50	500	1 000	5 000	260	1	9,8	11	n.a.	11	12	9%	12	12	0%	11	10	10%
Selenium (Se)		1	3	10	--	2,9	0,5	<0,50	<0,50	n.a.	<0,50	<0,50	n.a.	<0,50	<0,50	n.a.	<0,50	<0,50	n.a.
Zinc (Zn)	mg/kg	140	500	1 500	7 500	410	5	86	93	8%	82	86	5%	70	73	4%	97	93	4%
HAP																			
Acénaphène	mg/kg	0,1	10	100	100	--	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Acénaphylène	mg/kg	0,1	10	100	100	--	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Anthracène	mg/kg	0,1	10	100	100	32	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Benzo(a)anthracène	mg/kg	0,1	1	10	34	10	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
Benzo(a)pyrène	mg/kg	0,1	1	10	34	72	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
Benzo(b)fluoranthène	mg/kg	0,1	1	10	--	10	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
Benzo(j)fluoranthène	mg/kg	0,1	1	10	--	--	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
Benzo(k)fluoranthène	mg/kg	0,1	1	10	--	10	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
Benzo(b,j,k)fluoranthène	mg/kg	--	--	--	136	--	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
Benzo(c)phénanthrène	mg/kg	0,1	1	10	56	--	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Benzo(ghi)pérylène	mg/kg	0,1	1	10	18	--	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
Chrysène	mg/kg	0,1	1	10	34	--	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
Dibenz(a,h)anthracène	mg/kg	0,1	1	10	82	10	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
Dibenzo(a,i)pyrène	mg/kg	0,1	1	10	34	--	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Dibenzo(a,h)pyrène	mg/kg	0,1	1	10	34	--	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Dibenzo(a,l)pyrène	mg/kg	0,1	1	10	34	--	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
7,12-Diméthylbenzanthracène	mg/kg	0,1	1	10	34	--	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Fluoranthène	mg/kg	0,1	10	100	100	180	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Fluorène	mg/kg	0,1	10	100	100	--	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Indéno(1,2,3-cd)pyrène	mg/kg	0,1	1	10	34	10	0,05	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.	<0,050	<0,050	n.a.
3-Méthylcholanthrène	mg/kg	0,1	1	10	150	--	0,1	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.	<0,10	<0,10	n.a.
Naphtalène	mg/kg	0,1	5	50	56	22	0,01	<0,010	<0,010	n.a.	<0,010	<0,010	n.a.	<0,010	<0,010	n.a.	<0,010	<0,010	n.a.
Phénanthrène	mg/kg	0,1	5	50	56	50	0,04	<0,040	<0,040	n.a.	<0,040	<0,040	n.a.	<0,040	<0,040				

Tableau D.5 : Sommaire des volumes de sols et matériaux non conforme présents sur le site

Sondage	Échantillon caractérisé	Paramètres excédant les valeurs des recommandations commerciales (RQSe) du CCME	Paramètres excédant les critères ⁽¹⁾ / Normes applicables ⁽²⁾ du MELCC	Profondeur de l'échantillon analysé (m)		Profondeur affectée estimée (m)		Épaisseur estimée (m)	Aire d'influence du sondage (m ²)	Volume estimé de sols affectés en fonction des critères du CCME ⁽³⁾	Volume estimé de sols affectés en fonction des critères du Guide d'intervention - PSRTC du MELCC ^{(1), (2)} (m ³ en place)				
				de	à	de	à			>CCME	< A	A-B	B-C	C-RESC	>RESC
TF-01-19	CF-01B	Métaux (Cr)	Métaux (Cr, Cu et Ni)	0,25	0,61	0,25	1,22	0,97	60	58		58			
	CF-04	Métaux (Cr)	Métaux (Cr et Ni)	1,83	2,44	1,22	1,80	0,58		35		35			
TF-02-19	CF-01B	Métaux (Cr)	Métaux (Cr, Cu et Ni)	0,20	0,61	0,20	0,91	0,71	30	21		21			
	CF-03	Métaux (Cr)	Métaux (Cr et Ni)	1,22	1,83	0,91	1,80	0,89		27		27			
TA-01-19	1	--	Métaux (Pb)	0,00	0,15	0,00	0,15	0,15	21	--		3			
	3	Métaux (Cr)	Métaux (Cr, Cu, Co et Ni)	0,40	0,60	0,15	1,80	1,65		35		35			
TA-02-19	3	Métaux (Cr)	Métaux (Cr et Ni)	0,35	0,60	0,35	1,80	1,45	75	109		109			
TA-03-19	2	Métaux (Cr)	Métaux (Cr, Cu et Ni)	0,20	0,40	0,00	0,80	0,80	363	290		290			
TA-04-19	3	Métaux (Cr)	Métaux (Cr et Ni)	0,40	0,60	0,20	0,80	0,60	376	226		226			
TA-05-19	2	Métaux (Cr)	Métaux (Cr, Cu et Ni)	0,30	0,50	0,30	0,80	0,50	328	164		164			

Sondage	Échantillon caractérisé	Paramètres excédant les valeurs des recommandations commerciales (RQSe) du CCME	Paramètres excédant les critères ⁽¹⁾ / Normes applicables ⁽²⁾ du MELCC	Profondeur de l'échantillon analysé (m)		Profondeur affectée estimée (m)		Épaisseur estimée (m)	Aire d'influence du sondage (m ²)	Volume estimé de sols affectés en fonction des critères du CCME ⁽³⁾	Volume estimé de sols affectés en fonction des critères du Guide d'intervention - PSRTC du MELCC ^{(1), (2)} (m ³ en place)				
				de	à	de	à			>CCME	< A	A-B	B-C	C-RESC	>RESC
TA-06-19	2	Métaux (Cr)	Métaux (Cr et Ni)	0,25	0,40	0,25	0,80	0,55	288	158		158			
TA-07-19	1	Métaux (Cr)	Métaux (Cr, Cu et Ni)	0,00	0,15	0,00	0,15	0,15	342	51		51			
	3	Métaux (Cr)	Métaux (Cr, Cu et Ni)	0,40	0,60	0,15	0,80	0,65		222		222			
TA-08-19	1	Métaux (Cr)	Métaux (Ni)	0,00	0,25	0,00	0,25	0,25	364	91		91			
	2	Métaux (Cr)	Métaux (Cr, Cu et Ni)	0,25	0,40	0,25	0,80	0,55		200		200			
TA-09-19	2	Métaux (Cr)	Métaux (Cr, Cu et Ni)	0,20	0,40	0,20	0,80	0,60	374	224		224			
TA-10-19	2	Métaux (Cr)	Métaux (Cr et Ni)	0,25	0,40	0,25	0,80	0,55	275	151		151			
TOTAL :										2 063	0	2 066	0	0	0

- Notes :**
- Aucun échantillon ou analyse
 - *** Base de la couche non atteinte
 - (1) Critères du Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (MELCC, Direction des lieux contaminés, Mars 2019)
 - (2) Normes de l'annexe I du Règlement sur l'enfouissement des sols contaminés (Gouvernement du Québec)
 - (3) Recommandation canadienne pour la qualité des sols - Environnement et santé humaine - Vocation commerciale -RQSe du CCME
 - (4) Règlement sur les matières dangereuses du Québec (Q-2, r.32)

Annexe E Note explicative et rapports de sondages

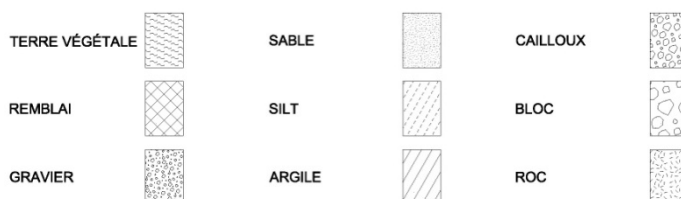
Les rapports de sondage qui font suite à cette note synthétisent les données de chantier et de laboratoire sur les propriétés géotechniques des sols, de la roche et de l'eau souterraine recueillies à chaque sondage. Cette note a pour but d'expliquer les différents symboles et abréviations utilisés dans les rapports de sondage.

STRATIGRAPHIE

Élévation/Profondeur : Dans cette colonne sont inscrites les élévations des contacts géologiques rattachées au niveau de référence mentionné à l'en-tête du rapport de sondage et établies à partir de la surface du terrain mesuré au moment de la réalisation du sondage. Les profondeurs sont également indiquées.

Description des sols et du roc : Chaque formation géologique est décrite selon la terminologie d'usage présentée ci-dessous.

SYMBOLES



NIVEAU D'EAU

Dans cette colonne est indiquée l'élévation du niveau de l'eau souterraine mesurée à la date indiquée. Un schéma présentant le type et la profondeur d'installation est aussi présenté dans cette colonne.

ÉCHANTILLONS

Type et numéro : Chaque échantillon est étiqueté conformément au numéro de cette colonne et la notation donnée réfère au type d'échantillon décrit à l'en-tête du rapport de sondage.

Sous-échantillon : Lorsqu'un échantillon inclut un changement de matière stratigraphique, il est parfois requis de le séparer et de créer des sous-échantillons. Cette colonne permet l'identification de ces derniers et permet l'association des mesures in situ et en laboratoire à ces sous-échantillons.

État : La position, la longueur et l'état de chaque échantillon sont montrés dans cette colonne. Le symbole illustre l'état de l'échantillon suivant la légende donnée à l'en-tête du rapport de sondage.

Calibre : Dans cette colonne est indiqué le calibre de l'échantillonneur.

N et Nb coups/150 mm : L'indice de pénétration standard « N » donné dans cette section est montré dans la colonne correspondante. Cet indice est obtenu de l'essai de pénétration standard et correspond au nombre de coups d'un marteau de 63,5 kilogrammes tombant en chute libre de 0,76 mètre nécessaire pour enfoncer les 300 derniers millimètres du carottier fendu normalisé (ASTM D-1586). Le résultat du nombre de coups obtenu par 150 mm est indiqué dans la colonne Nb coups/150 mm. Pour un carottier de 610 mm de longueur, l'indice N est obtenu en additionnant le nombre de coups nécessaire pour enfoncer les 2^e et 3^e courses de 150 mm d'enfoncement.

RQD : L'indice de qualité de la roche (RQD) est défini comme étant le rapport de la longueur totale de tous les fragments de carottes de 100 millimètres ou plus à la longueur totale de la course. L'indice RQD est présenté en pourcentage.

ESSAIS

Résultats : Dans cette section, les résultats d'essais effectués sur le chantier et au laboratoire sont indiqués à la profondeur correspondante. La définition des symboles rattachés à chaque essai est présentée à l'en-tête du rapport de sondage. Les résultats des essais qui n'apparaissent pas sur le rapport sont présentés en note à la fin du rapport de sondage. Par contre, une abréviation indiquant le type d'analyse réalisée est présentée vis-à-vis l'échantillon analysé.

Graphique : Ce graphique montre la résistance au cisaillement non drainé des sols cohérents mesurée en chantier ou en laboratoire (NQ 2501-200). Il est également utilisé pour les essais de pénétration dynamique (NQ 2501-145). De plus, ce graphique sert à la représentation des résultats de la teneur en eau et des limites d'Atterberg.

Classification

Argile
Silt et argile (non différenciés)
Sable
Gravier
Caillou
Bloc

Dimension des particules

Plus petite que 0,002 mm
plus petite que 0,08 mm
de 0,08 à 5 mm
de 5 à 80 mm
de 80 à 300 mm
plus grande que 300 mm

Terminologie descriptive

« Traces »
« Un peu »
Adjectif (ex. : sableux, silteux)
« Et » (ex. : sable et gravier)

Proportions

1 à 10 %
10 à 20 %
20 à 35 %
35 à 50 %

Compacité des sols granulaires

Très lâche
Lâche
Moyenne ou compacte
Dense
Très dense

Indice « N » de l'essai de pénétration standard, ASTM D-1586 (coups par 300 mm de pénétration)

0 à 4
4 à 10
10 à 30
30 à 50
plus de 50

Consistance des sols cohérents

Très molle
Molle
Moyenne ou ferme
Raide
Très raide
Dure

Résistance au cisaillement non drainé (kPa)

Moins de 12
12 à 25
25 à 50
50 à 100
100 à 200
plus de 200

Plasticité des sols cohérents

Faible
Moyenne
Élevée

Limite de liquidité

Inférieure à 30 %
entre 30 et 50 %
supérieure à 50 %

Sensibilité des sols cohérents

Faible
Moyenne
Forte
Très forte
Argile sensible

$S_t = (Cu/Cur)$

$S_t < 2$
2 à 4
4 à 8
8 à 16
 $S_t > 16$

Classification du roc

Très mauvaise qualité
Mauvaise qualité
Qualité moyenne
Bonne qualité
Excellente qualité

RQD (%)

< 25
25 à 50
50 à 75
75 à 90
90 à 100



Client :

TPSGC

RAPPORT DE FORAGE

Dossier n°: P-0019200-0-01-002

Sondage n°: TF-01-19

Date: 2019-07-29 à 2019-07-29

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037551,0 (Y)

MTM NAD 83 FUS 8 Est 242809,5 (X)

Élévation 47,21 (Z)

Prof. du roc: m Prof. de fin: 5,90 m

État des échantillons

Intact
 Remanié
 Perdu
 Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)

Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type d'échantillon

CF Carottier fendu
 TM Tube à paroi mince
 PS Tube à piston fixe
 CR Tube carottier
 TA À la tarière
 MA À la main
 TU Tube transparent
 PW Carottier Englobe
 SG Sol gelé

Abréviations

L Limites de consistance
 W_L Limite de liquidité (%)
 W_P Limite de plasticité (%)
 I_P Indice de plasticité (%)
 I_L Indice de liquidité
 W Teneur en eau (%)
 AG Analyse granulométrique
 S Sédimentométrie
 R Refus à l'enfoncement
 PDT Poids des tiges
 PDM Poids du marteau

M.O. Matière organique (%)
 K Perméabilité (cm/s)
 PV Poids volumique (kN/m³)
 A Absorption (l/min. m)
 U Compression uniaxiale (MPa)
 RQD Indice de qualité du roc (%)
 AC Analyse chimique
 P_L Pression limite, essai pressiométrique (kPa)
 E_M Module pressiométrique (MPa)
 E_r Module de réaction du roc (MPa)
 SP₀ Potentiel de ségrégation (mm²/H °C)

▼ Niveau d'eau
 N Pénétration standard (Nb coups/300mm)
 N_C Pénétration dyn. (Nb coups/300mm) ●
 σ'_p Pression de préconsolidation (kPa)
 TAS Taux d'agressivité des sols

Résistance au cisaillement

C_U Intact (kPa)
 C_{UR} Remanié (kPa)

Chenilier ▲
 Laboratoire ■

DDMM

PROFONDEUR - pi		PROFONDEUR - m		STRATIGRAPHIE			SYMBLES	NIVEAU D'EAU (m) / DATE	ÉCHANTILLONS							Examens organo.		RÉSULTATS	TENEUR EN EAU ET LIMITES (%)		RÉSISTANCE AU CISAILEMENT (kPa) OU PÉNÉTRATION DYNAMIQUE
ÉLÉVATION - m		PROF. - m		DESCRIPTION DES SOLS ET DU ROC					TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CALIBRE	RÉCUPÉRATION %	Nb coups/150mm	"N" ou RQD	Odeur	Visuel		Wp W WL		
																			20 40 60 80 100 120		
																					20 40 60 80 100120140160180
		47,21	0,00	Remblai : sol organique, brun.																	
1		46,96	0,25	Terrain naturel : argile et silt à argile silteuse, traces de sable et de gravier, brune, raide à très raide.					CF-01	A	X	N	90	6-6 8-10	14	I	I	AG AC (CF-01A): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : <A / <RQS AC (CF-01B): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS HP F1-F4 : <RQS BTEX : <A			
2									CF-02		X	B	100	2-4 8-10	12	I	I				
3	1								CF-03		X	B	100	4-5 8-10	13	I	I				
4									CF-04		X	B	100	3-5 5-8	10	I	I	AC (CF-04): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS HP F1-F4 : <RQS BTEX : <A			
5									CF-05		X	B	100	3-3 4-5	7	I	I	AG, S C _U = 184 kPa			▲
6	2								CF-06		X	B	100	2-2 3-3	5	I	I	L W = 43.9 W _L = 67 W _P = 30			△
7									CF-07		X	B	100	1-2 2-1	4	I	I	C _U = 122 kPa			▲
8																					
9																					
10	3	44,16	3,05	Argile silteuse, grise à brune, de consistance très raide.																	
11																					
12																					

Remarques: Un profil scissométrique a été effectué dans un forage effectué à toute proximité entre 2,9 m et 5,9 m de profondeur.

Type de forage: Tarière évidée

Équipement de forage: Chenilles

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 2

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037551,0 (Y)

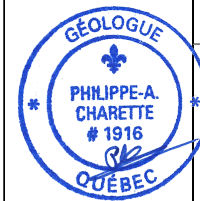
MTM NAD 83 FUS 8 Est 242809,5 (X)

Élévation 47,21 (Z)

Prof. du roc: m Prof. de fin: 5,90 m

PROFONDEUR - pi		PROFONDEUR - m		STRATIGRAPHIE			NIVEAU D'EAU (m) / DATE	ÉCHANTILLONS						ESSAIS			
ÉLÉVATION - m		PROF. - m		DESCRIPTION DES SOLS ET DU ROC		SYMBOLES	TYPE ET NUMERO	SOUS-ÉCH.	ÉTAT	CALIBRE	RÉCUPÉRATION %	Nb coups/150mm	"N" ou RQD	Examens organo.		RÉSULTATS	TENEUR EN EAU ET LIMITES (%)
														Odeur	Visuel		Wp W WL
																	20 40 60 80 100 120
																	RÉSISTANCE AU CISAILEMENT (kPa) OU PÉNÉTRATION DYNAMIQUE
																	20 40 60 80 100120140160180
14		42,94	4,27	Devenant grise et de consistance raide.			CF-07			B	100	1-2 2-1	4	I	I	C _{UR} = 24.0 kPa	
15							CF-08			B	100	1-1 1-1	2	I	I		
16	5															C _U = 55 kPa	▲
17							CF-09			B	100	1-1 1-1	2	I	I		
18																	
19	6	41,31	5,90	Fin de l'échantillonnage à une profondeur de 5,49m. Poursuite du forage pour l'utilisation d'un profil scissométrique jusqu'à 5,90m de profondeur.												C _U = 74 kPa C _{UR} = 10.9 kPa	△ ▲
20																	
21																	
22																	
23	7																
24																	
25																	
26	8																
27																	
28																	
29																	
30	9																
31																	
32																	

</



Remarques: Un profil scissométrique a été effectué dans un forage effectué à toute proximité entre 2,9 m et 5,9 m de profondeur.

Type de forage: Tarière évidée

Équipement de forage: Chenilles

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 2 de 2



Client :

TPSGC

RAPPORT DE FORAGE

Dossier n°: P-0019200-0-01-002

Sondage n°: TF-02-19

Date: 2019-07-30 à 2019-07-30

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037544,5 (Y)

MTM NAD 83 FUS 8 Est 242789,5 (X)

Élévation 47,42 (Z)

Prof. du roc: m Prof. de fin: 9,10 m

État des échantillons

Intact
 Remanié
 Perdu
 Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)

Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type d'échantillon

CF Carottier fendu
 TM Tube à paroi mince
 PS Tube à piston fixe
 CR Tube carottier
 TA À la tarière
 MA À la main
 TU Tube transparent
 PW Carottier Englobe
 SG Sol gelé

Abréviations

L Limites de consistance
 W_L Limite de liquidité (%)
 W_P Limite de plasticité (%)
 I_P Indice de plasticité (%)
 I_L Indice de liquidité
 W Teneur en eau (%)
 AG Analyse granulométrique
 S Sédimétrie
 R Refus à l'enfoncement
 PDT Poids des tiges
 PDM Poids du marteau

M.O. Matière organique (%)
 K Perméabilité (cm/s)
 PV Poids volumique (kN/m³)
 A Absorption (l/min. m)
 U Compression uniaxiale (MPa)
 RQD Indice de qualité du roc (%)
 AC Analyse chimique
 P_L Pression limite, essai pressiométrique (kPa)
 E_M Module pressiométrique (MPa)
 E_r Module de réaction du roc (MPa)
 SP₀ Potentiel de ségrégation (mm²/H °C)



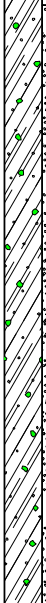




















▼ Niveau d'eau
 N Pénétration standard (Nb coups/300mm)
 N_C Pénétration dyn. (Nb coups/300mm) ●
 σ'_p Pression de préconsolidation (kPa)
 TAS Taux d'agressivité des sols

Résistance au cisaillement

C_U Intact (kPa)
 C_{UR} Remanié (kPa)

Chenilier ▲
 Laboratoire ■

DDMM

STRATIGRAPHIE						ÉCHANTILLONS								ESSAIS			
PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CALIBRE	RÉCUPÉRATION %	Nb coups/150mm	"N" ou RQD	Examens organo.		RÉSULTATS	TENEUR EN EAU ET LIMITES (%)	
													Odeur	Visuel		Wp	W
		47,42 0,00 47,22 0,20	Pierre concassée de calibre apparent 0-20 mm, grise. Terrain naturel : argile et silt à argile silteuse, traces de sable et traces de gravier, de consistance apparente raide. Présence de racelles.	  		CF-01	A B	                   	N 								

Remarques: Un profil scissométrique a été effectué dans un forage effectué à toute proximité entre 3,3 m et 5,9 m de profondeur.
 Installation d'un tube piézométrique de type casagrande de 19 mm de diamètre intérieur.

Type de forage: Tarière évidée

Équipement de forage: Chenilles

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 2

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037544,5 (Y)

MTM NAD 83 FUS 8 Est 242789,5 (X)

Élévation 47,42 (Z)

Prof. du roc: m Prof. de fin: 9,10 m

PROFONDEUR - pi		PROFONDEUR - m		STRATIGRAPHIE			ÉCHANTILLONS										ESSAIS												
		ÉLÉVATION - m PROF. - m		DESCRIPTION DES SOLS ET DU ROC		SYMBOLES		NIVEAU D'EAU (m) / DATE		TYPE ET NUMÉRO		SOUS-ÉCH.		ÉTAT		CALIBRE		RÉCUPÉRATION %		Nb coups/150mm		"N" ou RQD		Examens organo.		RÉSULTATS		TENEUR EN EAU ET LIMITES (%) Wp W WL	
																												20 40 60 80 100 120	
																												RÉSISTANCE AU CISAILEMENT (kPa) OU PÉNÉTRATION DYNAMIQUE	
																												20 40 60 80 100 120 140 160 180	
14				Argile silteuse, grise, de consistance raide à très raide.						CF-07			N	100	0-1 1-1	2	I	I											
15										CF-08			N	100	1-0 1-0	1	I	I											
16	5									CF-09			N	100	1-0 0-0	0	I	I											
17										CF-10			N	100	1-0 0-0	0	I	I											
18										CF-11			N	100	0-1 10-15	11	I	I											
19	6									CF-12					9-9 13-14	22	I	I											
20										CF-13			N	84	0-4 13-14	17	I	I											
21	41,09 6,33			Till composé d'un silt sableux, traces à un peu d'argile et de gravier, gris, compact à très dense.						CF-14			N	75	2-5 6-6	11	I	I											
22										CF-15			N	43	57-44 50-50 /100mm	94	I	I											
23	7																												
24																													
25																													
26	8																												
27																													
28																													
29	9																												
30	38,32 9,10			Fin du forage à une profondeur de 9,10m.																									
31																													
32																													

Remarques: Un profil scissométrique a été effectué dans un forage effectué à toute proximité entre 3,3 m et 5,9 m de profondeur. Installation d'un tube piézométrique de type casagrande de 19 mm de diamètre intérieur.

Type de forage: Tarière évidée

Équipement de forage: Chenilles

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 2 de 2



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002
 Sondage n°: PU-01-19
 Date: 2019-07-31

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037546,0 (Y)
 MTM NAD 83 FUS 8 Est 242816,5 (X)
 Élévation 47,45 (Z)
 Prof. du roc: m Prof. de fin: 0,75 m

État des échantillons

Intact Remanié Bloc Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)
 Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☒ Dim 2.0 m x 1.0 m

Tranchée ☐ Dim _____ X _____

Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance
 W_L Limite de liquidité (%)
 W_P Limite de plasticité (%)
 I_P Indice de plasticité (%)
 I_L Indice de liquidité
 W Teneur en eau (%)
 AG Analyse granulométrique
 S Sédimétrie
 R Refus à l'enfoncement
 AC Analyse chimique
 VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols
 M.O. Matière organique (%)
 K Perméabilité (cm/s)
 PV Poids volumique (kN/m³)
 A Absorption (l/min. m)
 U Compression uniaxiale (MPa)
 SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement
 C_U Intact (kPa)
 C_{UR} Remanié (kPa)

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Rétrocaveuse CAT 420E

STRATIGRAPHIE

ÉCHANTILLONS

ESSAIS

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBOLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Examens organo.	Odeur	Visuel	RÉSULTATS	TENEUR EN EAU ET LIMITES (%) W _p W WL	RÉSISTANCE AU CISAILEMENT NON DRAINÉ (kPa)
		47,45	0,00	Pierre décorative nette. Présence d'une membrane géotextile à 0,15 m de profondeur.													
		47,30	0,15	Pierre concassée de calibre apparent 0-20 mm, grise.													
		46,70	0,75	Fin du puits d'exploration à une profondeur de 0,75 m.													



Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002

Sondage n°: TA-01-19

Date: 2019-08-01

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037552,5 (Y)

MTM NAD 83 FUS 8 Est 242799,1 (X)

Élévation 47,23 (Z)

Prof. du roc: m Prof. de fin: 0,80 m

État des échantillons

☐ Intact ☐ Remanié ☐ Bloc ☐ Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)

Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____Tranchée ☐ Dim _____ X _____Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance

W_L Limite de liquidité (%)W_P Limite de plasticité (%)I_P Indice de plasticité (%)I_L Indice de liquidité

W Teneur en eau (%)

AG Analyse granulométrique

S Sédimentométrie

R Refus à l'enfoncement

AC Analyse chimique

VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols

M.O. Matière organique (%)

K Perméabilité (cm/s)

PV Poids volumique (kN/m³)

A Absorption (l/min. m)

U Compression uniaxiale (MPa)

SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement

C_u Intact (kPa)C_{ur} Remanié (kPa)
☐ Charrier ☐ Laboratoire

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBOLES	NIVEAU D'EAU (m) / DATE	ÉCHANTILLONS				Examens organo.	RÉSULTATS	ESSAIS	
							TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Odeur	Visuel	TENEUR EN EAU ET LIMITES (%)
		47,23	0,00	Remblai : sable silteux, un peu de gravier, brun. Présence de matières organiques.			1					I	I	W _p W WL 20 40 60 80 100 120 RÉSISTANCE AU CISAILLEMENT NON DRAINÉ (kPa) 20 40 60 80 100 120
		47,08	0,15	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			2					I	I	AC (1): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / <RQS
		46,88	0,35	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			3					I	I	AC (3): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS
		46,43	0,80	Fin du forage manuel à une profondeur de 0,80m.			4					I	I	



2019-10-29

Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002
 Sondage n°: TA-02-19
 Date: 2019-08-01

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037536,9 (Y)
 MTM NAD 83 FUS 8 Est 242802,9 (X)
 Élévation 47,39 (Z)
 Prof. du roc: m Prof. de fin: 0,80 m

État des échantillons

Intact Remanié Bloc Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)
 Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____

Tranchée ☐ Dim _____ X _____

Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance
 W_L Limite de liquidité (%)
 W_P Limite de plasticité (%)
 I_P Indice de plasticité (%)
 I_L Indice de liquidité
 W Teneur en eau (%)
 AG Analyse granulométrique
 S Sédimentométrie
 R Refus à l'enfoncement
 AC Analyse chimique
 VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols
 M.O. Matière organique (%)
 K Perméabilité (cm/s)
 PV Poids volumique (kN/m³)
 A Absorption (l/min. m)
 U Compression uniaxiale (MPa)
 SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement
 C_u Intact (kPa)
 C_{ur} Remanié (kPa)

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

STRATIGRAPHIE

ÉCHANTILLONS

ESSAIS

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBOLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Examens organo.	Odeur	Visuel	RÉSULTATS	TENEUR EN EAU ET LIMITES (%) W _p W WL	RÉSISTANCE AU CISAILLEMENT NON DRAINÉ (kPa)
		47,39	0,00	Remblai : sable silteux, un peu de gravier, brun. Présence de matières organiques.			1						I	I			
		47,04	0,35	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			2						I	I			
		46,59	0,80	Fin du forage manuel à une profondeur de 0,80m.			3						I	I			
							4						I	I			



2019-10-29

Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002
 Sondage n°: TA-03-19
 Date: 2019-08-01

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037496,4 (Y)
 MTM NAD 83 FUS 8 Est 242755,3 (X)
 Élévation 47,28 (Z)
 Prof. du roc: m Prof. de fin: 0,80 m

État des échantillons

Intact Remanié Bloc Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)
 Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____

Tranchée ☐ Dim _____ X _____

Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance
 W_L Limite de liquidité (%)
 W_p Limite de plasticité (%)
 I_p Indice de plasticité (%)
 I_L Indice de liquidité
 W Teneur en eau (%)
 AG Analyse granulométrique
 S Sédimentométrie
 R Refus à l'enfoncement
 AC Analyse chimique
 VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols
 M.O. Matière organique (%)
 K Perméabilité (cm/s)
 PV Poids volumique (kN/m³)
 A Absorption (l/min. m)
 U Compression uniaxiale (MPa)
 SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement
 C_u Intact (kPa)
 C_{ur} Remanié (kPa)

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

STRATIGRAPHIE

ÉCHANTILLONS

ESSAIS

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Examens organo.	Odeur	Visuel	RÉSULTATS	TENEUR EN EAU ET LIMITES (%) W _p W WL	RÉSISTANCE AU CISAILEMENT NON DRAINÉ (kPa)
		47,28	0,00	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			1						I	I			
							2						I	I			
							3						I	I			
							4						I	I			
		46,48	0,80	Fin du forage manuel à une profondeur de 0,80m.													



2019-10-29

Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002
 Sondage n°: TA-04-19
 Date: 2019-08-01

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037485,7 (Y)
 MTM NAD 83 FUS 8 Est 242774,1 (X)
 Élévation 47,17 (Z)
 Prof. du roc: m Prof. de fin: 0,80 m

État des échantillons

Intact Remanié Bloc Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)
 Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____

Tranchée ☐ Dim _____ X _____

Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance
 W_L Limite de liquidité (%)
 W_P Limite de plasticité (%)
 I_P Indice de plasticité (%)
 I_L Indice de liquidité
 W Teneur en eau (%)
 AG Analyse granulométrique
 S Sédimentométrie
 R Refus à l'enfoncement
 AC Analyse chimique
 VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols
 M.O. Matière organique (%)
 K Perméabilité (cm/s)
 PV Poids volumique (kN/m³)
 A Absorption (l/min. m)
 U Compression uniaxiale (MPa)
 SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement
 C_U Intact (kPa)
 C_{UR} Remanié (kPa)

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

STRATIGRAPHIE

ÉCHANTILLONS

ESSAIS

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Examens organo.	Odeur	Visuel	RÉSULTATS	TENEUR EN EAU ET LIMITES (%) W _p W WL	RÉSISTANCE AU CISAILLEMENT NON DRAINÉ (kPa)
		47,17	0,00	Pierre concassée de calibre apparent 0-20 mm, grise.			1						I	I		20 40 60 80 100 120	20 40 60 80 100 120
		46,97	0,20	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			2						I	I		20 40 60 80 100 120	20 40 60 80 100 120
		46,37	0,80	Fin du forage manuel à une profondeur de 0,80m.			3						I	I	AC (3): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS	20 40 60 80 100 120	20 40 60 80 100 120
							4						I	I		20 40 60 80 100 120	20 40 60 80 100 120



2019-10-29

Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002

Sondage n°: TA-05-19

Date: 2019-08-01

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037480,1 (Y)

MTM NAD 83 FUS 8 Est 242782,9 (X)

Élévation 47,06 (Z)

Prof. du roc: m Prof. de fin: 0,90 m

État des échantillons



Intact



Remanié



Bloc



Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)

Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____Tranchée ☐ Dim _____ X _____Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance

W_L Limite de liquidité (%)W_p Limite de plasticité (%)I_p Indice de plasticité (%)I_L Indice de liquidité

W Teneur en eau (%)

AG Analyse granulométrique

S Sédimentométrie

R Refus à l'enfoncement

AC Analyse chimique

VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols

M.O. Matière organique (%)

K Perméabilité (cm/s)

PV Poids volumique (kN/m³)

A Absorption (l/min. m)

U Compression uniaxiale (MPa)

SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement

C_u Intact (kPa)C_{ur} Remanié (kPa)

Charrier ▲

Laboratoire ■







Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

PROFONDEUR - pi		PROFONDEUR - m		STRATIGRAPHIE		SYMBOLES	NIVEAU D'EAU (m) / DATE	ÉCHANTILLONS					Examens organo.		RÉSULTATS	ESSAIS		
ÉLÉVATION - m		PROF. - m		DESCRIPTION DES SOLS ET DU ROC				TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Odeur	Visuel		TENEUR EN EAU ET LIMITES (%) Wp W WL 20 40 60 80 100 120		RÉSISTANCE AU CISAILEMENT NON DRAINÉ (kPa) 20 40 60 80 100 120
1		47,06	0,00	Pierre concassée de calibre apparent 0-20 mm, grise.				1					I	I	<p>AC (2): HP C₁₀C₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS HP F1-F4 : <RQS BTEx : <A</p>			
		46,76	0,30	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.				2					I	I				
									3					I		I		
									4					I		I		
3		46,16	0,90	Fin du forage manuel à une profondeur de 0,90m.									I	I				
2019-10-29																		



2019-10-29

Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002

Sondage n°: TA-06-19

Date: 2019-08-01

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037473,8 (Y)

MTM NAD 83 FUS 8 Est 242800,5 (X)

Élévation 46,88 (Z)

Prof. du roc: m Prof. de fin: 0,80 m

État des échantillons

☐ Intact ☐ Remanié ☐ Bloc ☐ Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)

Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____Tranchée ☐ Dim _____ X _____Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance

W_L Limite de liquidité (%)W_p Limite de plasticité (%)I_p Indice de plasticité (%)I_L Indice de liquidité

W Teneur en eau (%)

AG Analyse granulométrique

S Sédimentométrie

R Refus à l'enfoncement

AC Analyse chimique

VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols

M.O. Matière organique (%)

K Perméabilité (cm/s)

PV Poids volumique (kN/m³)

A Absorption (l/min. m)

U Compression uniaxiale (MPa)

SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement

C_u Intact (kPa)C_{ur} Remanié (kPa)
☐ Chantier ☐ Laboratoire

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

STRATIGRAPHIE

ÉCHANTILLONS

ESSAIS

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBOLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Examens organo.	Odeur	Visuel	RÉSULTATS	TENEUR EN EAU ET LIMITES (%)
		46,88	0,00	Pierre concassée de calibre apparent 0-20 mm, grise.			1						I	I		W _p W WL
		46,63	0,25	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			2						I	I	AC (2): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS	20 40 60 80 100 120
		46,08	0,80	Fin du forage manuel à une profondeur de 0,80m.			3						I	I		RÉSISTANCE AU CISAILEMENT NON DRAINÉ (kPa)
							4						I	I		20 40 60 80 100 120



Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002
 Sondage n°: TA-07-19
 Date: 2019-07-31

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037473,7 (Y)
 MTM NAD 83 FUS 8 Est 242746,9 (X)
 Élévation 47,40 (Z)
 Prof. du roc: m Prof. de fin: 0,80 m

État des échantillons

Intact Remanié Bloc Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)
 Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____

Tranchée ☐ Dim _____ X _____

Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance
 W_L Limite de liquidité (%)
 W_P Limite de plasticité (%)
 I_P Indice de plasticité (%)
 I_L Indice de liquidité
 W Teneur en eau (%)
 AG Analyse granulométrique
 S Sédimétrie
 R Refus à l'enfoncement
 AC Analyse chimique
 VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols
 M.O. Matière organique (%)
 K Perméabilité (cm/s)
 PV Poids volumique (kN/m³)
 A Absorption (l/min. m)
 U Compression uniaxiale (MPa)
 SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement
 C_u Intact (kPa)
 C_{ur} Remanié (kPa)

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

STRATIGRAPHIE

ÉCHANTILLONS

ESSAIS

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Examens organo.	Odeur	Visuel	RÉSULTATS	TENEUR EN EAU ET LIMITES (%) W _p W WL	RÉSISTANCE AU CISAILEMENT NON DRAINÉ (kPa)
		47,40	0,00	Remblai : sable silteux et argileux, un peu de gravier, brun. Présence de matières organiques.			1						I	I	AC (1): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS		
		47,25	0,15	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			2						I	I			
							3						I	I	AC (3): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS HP F1-F4 : <RQS BTEX : <A		
							4						I	I			
		46,60	0,80	Fin du forage manuel à une profondeur de 0,80m.													



2019-10-29

Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002
 Sondage n°: TA-08-19
 Date: 2019-08-01

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037466,9 (Y)
 MTM NAD 83 FUS 8 Est 242759,5 (X)
 Élévation 47,22 (Z)
 Prof. du roc: m Prof. de fin: 0,80 m

État des échantillons

Intact Remanié Bloc Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)
 Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____

Tranchée ☐ Dim _____ X _____

Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance
 W_L Limite de liquidité (%)
 W_p Limite de plasticité (%)
 I_p Indice de plasticité (%)
 I_L Indice de liquidité
 W Teneur en eau (%)
 AG Analyse granulométrique
 S Sédimentométrie
 R Refus à l'enfoncement
 AC Analyse chimique
 VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols
 M.O. Matière organique (%)
 K Perméabilité (cm/s)
 PV Poids volumique (kN/m³)
 A Absorption (l/min. m)
 U Compression uniaxiale (MPa)
 SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement
 C_u Intact (kPa)
 C_{ur} Remanié (kPa)

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

STRATIGRAPHIE

ÉCHANTILLONS

ESSAIS

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBOLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Examens organo.	Odeur	Visuel	RÉSULTATS	TENEUR EN EAU ET LIMITES (%) W _p W WL	RÉSISTANCE AU CISAILEMENT NON DRAINÉ (kPa)
		47,22	0,00	Remblai : sable silteux, un peu de gravier, brun. Présence de matières organiques.			1						I	I	AC (1): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS	20 40 60 80 100 120	
		46,97	0,25	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			2						I	I	AC (2): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS	20 40 60 80 100 120	
							3						I	I			
							4						I	I			
		46,42	0,80	Fin du forage manuel à une profondeur de 0,80m.													



2019-10-29

Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002

Sondage n°: TA-09-19

Date: 2019-08-01

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037459,4 (Y)

MTM NAD 83 FUS 8 Est 242774,9 (X)

Élévation 46,92 (Z)

Prof. du roc: m Prof. de fin: 0,80 m

État des échantillons

Intact
 Remanié
 Bloc
 Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)

Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____Tranchée ☐ Dim _____ X _____Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance

W_L Limite de liquidité (%)W_p Limite de plasticité (%)I_p Indice de plasticité (%)I_L Indice de liquidité

W Teneur en eau (%)

AG Analyse granulométrique

S Sédimentométrie

R Refus à l'enfoncement

AC Analyse chimique

VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols

M.O. Matière organique (%)

K Perméabilité (cm/s)

PV Poids volumique (kN/m³)

A Absorption (l/min. m)

U Compression uniaxiale (MPa)

SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement

C_u Intact (kPa) C_{ur} Remanié (kPa)

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

STRATIGRAPHIE

ÉCHANTILLONS

ESSAIS

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBOLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Examens organo.	Odeur	Visuel	RÉSULTATS	TENEUR EN EAU ET LIMITES (%)
		46,92	0,00	Remblai : sable silteux, un peu de gravier, brun. Présence de matières organiques.			1						I	I	AC (1): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : <A / <RQS	Wp W WL 20 40 60 80 100 120
		46,72	0,20	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			2						I	I	AC (2): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS HP F1-F4 : <RQS BTEX : <A	RÉSISTANCE AU CISAILEMENT NON DRAINÉ (kPa) 20 40 60 80 100 120
		46,12	0,80	Fin du forage manuel à une profondeur de 0,80m.			3						I	I		



2019-10-29

Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

2019-09-13

Page: 1 de 1



Client :

TPSGC

RAPPORT DE SONDAGE

Dossier n°: P-0019200-0-01-002
 Sondage n°: TA-10-19
 Date: 2019-08-01

Projet: Étude géotechnique et CES sommaire des sols - Implantation d'un nouveau hangar et agrandissement du chenil de l'ASFC

Endroit: Collège des Douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec)

Coordonnées (m): Nord 5037452,8 (Y)
 MTM NAD 83 FUS 8 Est 242788,5 (X)
 Élévation 46,53 (Z)
 Prof. du roc: m Prof. de fin: 0,80 m

État des échantillons

Intact Remanié Bloc Carotte

Examens organoleptiques sur les sols:

Aspect visuel: Inexistant(I); Disséminé(D); Imbibé(IM)
 Odeur: Inexistante(I); Légère(L); Moyenne(M); Persistante(P)

Type de sondage

Puits ☐ Dim _____ X _____

Tranchée ☐ Dim _____ X _____

Tarière ☐ Diamètre _____

Abréviations

L Limites de consistance
 W_L Limite de liquidité (%)
 W_p Limite de plasticité (%)
 I_p Indice de plasticité (%)
 I_L Indice de liquidité
 W Teneur en eau (%)
 AG Analyse granulométrique
 S Sédimentométrie
 R Refus à l'enfoncement
 AC Analyse chimique
 VBS Valeur au Bleu du sol

TAS Taux d'agressivité des sols
 M.O. Matière organique (%)
 K Perméabilité (cm/s)
 PV Poids volumique (kN/m³)
 A Absorption (l/min. m)
 U Compression uniaxiale (MPa)
 SP₀ Potentiel de ségrégation (mm²/H °C)

Résistance au cisaillement
 C_u Intact (kPa)
 C_{ur} Remanié (kPa)

Niveau d'eau

Profondeur: _____ m

Date: _____

Équipement d'excavation

Tarière manuelle

STRATIGRAPHIE

ÉCHANTILLONS

ESSAIS

PROFONDEUR - pi	PROFONDEUR - m	ÉLÉVATION - m	PROF. - m	DESCRIPTION DES SOLS ET DU ROC	SYMBOLES	NIVEAU D'EAU (m) / DATE	TYPE ET NUMÉRO	SOUS-ÉCH.	ÉTAT	CAILLOUX (%)	BLOCS (%)	Examens organo.	Odeur	Visuel	RÉSULTATS	TENEUR EN EAU ET LIMITES (%) W _p W WL	RÉSISTANCE AU CISAILEMENT NON DRAINÉ (kPa)
		46,53	0,00	Remblai : sable silteux, un peu de gravier, brun. Présence de matières organiques.			1						I	I	AC (1): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : <A / <RQS	20 40 60 80 100 120	
		46,28	0,25	Terrain naturel : dépôt cohérent composé d'argile silteuse, brune, très raide.			2						I	I	AC (2): HP C ₁₀ C ₅₀ : <A HAP: <A / <RQS Métaux : A-B / >RQS HP F1-F4 : <RQS BTEx : <A	20 40 60 80 100 120	
							3						I	I			
							4						I	I			
		45,73	0,80	Fin du forage manuel à une profondeur de 0,80m.													



2019-10-29

Remarques:

Préparé par: L. Bouchard, tech. sr

Vérifié par: P.-A. Charette, géo., EESA

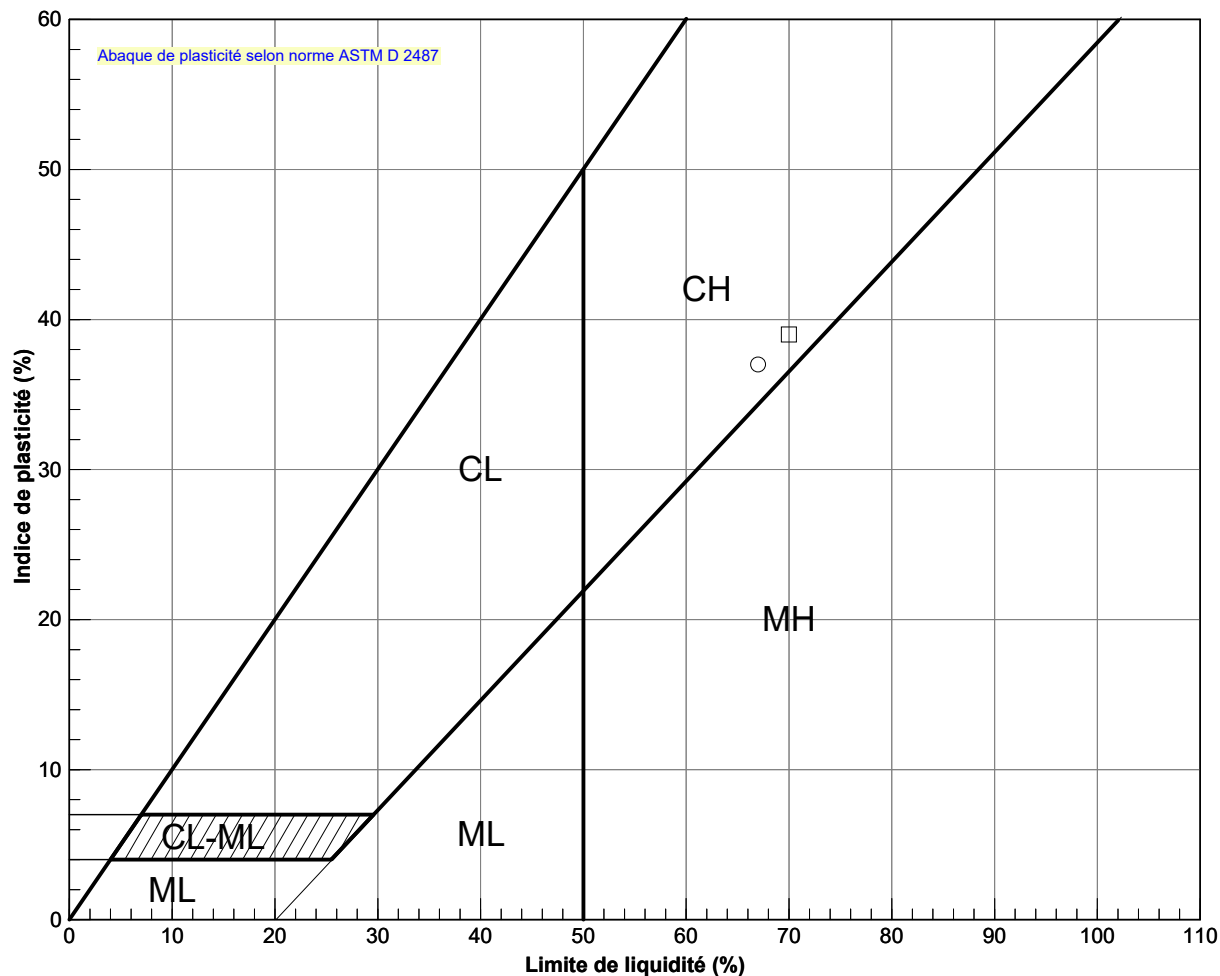
2019-09-13

Page: 1 de 1

Annexe F Résultats des essais en laboratoire

Projet : Étude géotechnique et CES sommaire des sols - Implantation du nouveau hangar et agrandissement du chenil de l'ASF Figure n° : 2

Endroit : Collège des douanes - 475, chemin de la Grande-Ligne, Rigaud (Québec) Dossier n° : P-0019200-0-01-002



Symbole	Sondage n°	Échantillon n°	Profondeur (m)	W_N	W_L	W_P	I_p	I_L	Class. USCS
○	TF-01-19	CF-06	3.05 - 3.66	43.9	67.0	30.0	37	0.4	CH
□	TF-02-19	CF-04	1.83 - 2.44	39.6	70.0	31.0	39	0.2	CH

Annexe G Procédures de prélèvement, de transport et de conservation des échantillons

PROCÉDURES DE PRÉLÈVEMENT, DE TRANSPORT ET DE CONSERVATION DES ÉCHANTILLONS

Toutes les opérations de prélèvement, de transport et de conservation des échantillons de sols, d'eau et de matières résiduelles récupérés par Englobe sont soumises à une politique de contrôle rigoureuse en regard des procédures utilisées. Ces procédures, qui respectent les exigences des différents guides du MELCC, sont résumées dans les paragraphes qui suivent.

PROCÉDURES D'ÉCHANTILLONNAGE

Sols

Les échantillons de sols sont prélevés à l'aide d'équipements d'échantillonnage appropriés (pelles, truelles, carottiers, tarières, etc.), lesquels sont lavés, entre chaque prélèvement, suivant la procédure indiquée à la section suivante.

Une fois prélevé, chacun des échantillons de sols est transféré dans un contenant d'une capacité variant de 50 à 500 ml selon les paramètres à analyser. Le guide « *Modes de conservation pour l'échantillonnage des sols* » du MELCC définit les quantités d'échantillons requises, le type de contenants à utiliser et les délais de conservation entre le prélèvement et l'analyse des échantillons de sol. Le préleveur utilise les contenants d'échantillon fournis par le laboratoire d'analyses qui a la responsabilité de fournir des contenants préparés de façon adéquate.

Divers types d'échantillons peuvent être prélevés lors de la caractérisation des sols. Les paragraphes suivants présentent ces principaux types d'échantillons et les particularités méthodologiques liées à leur échantillonnage.

Échantillon ponctuel

L'échantillon ponctuel est prélevé à un emplacement précis sur le terrain.

Les échantillons ponctuels sont prélevés sur des petites surfaces, de l'ordre de quelques dizaines de centimètres de côté (ex. : 10 cm × 10 cm ou 20 cm × 20 cm). Dans le cas d'un forage, l'échantillon est prélevé sur une épaisseur maximale de 0,6 m. Lorsque la quantité de sol le permet, les contenants sont complètement remplis (sans espace vapeur) et sont munis d'un couvercle garni d'une feuille d'aluminium ou de téflon.

Échantillon composé

Un échantillon composé est constitué d'un ensemble d'échantillons ponctuels, combinés en proportions égales ou de façon proportionnelle au poids ou au volume du secteur ou du lot que chaque échantillon représente. Un échantillon composé peut être préparé sur le terrain ou au laboratoire, en utilisant un récipient en matière inerte, propre et suffisamment grand. Il s'agit d'abord de prélever chacun des sous-échantillons selon la même méthode d'échantillonnage, de bien mélanger les sous-échantillons dans le récipient pour n'en former qu'un seul et de transférer ensuite l'échantillon composé dans un contenant approprié pour conservation et transport au

laboratoire. Dans le cas où les conditions de terrain (climatiques ou autres) ne permettent pas l'homogénéisation sur le terrain, une mention spéciale est faite au laboratoire, lui demandant spécifiquement une homogénéisation avant l'analyse. Lorsque la quantité de sol le permet, les contenants sont complètement remplis (sans espace vapeur) et sont munis d'un couvercle garni d'une feuille d'aluminium ou de téflon.

Échantillon en duplicata

La procédure pour obtenir des échantillons en duplicata consiste à effectuer le quartage de l'échantillon mélangé. Un quart complet est alors utilisé pour l'échantillon et le quart opposé sert à réaliser un duplicata.

Lorsque le sol provient d'un échantillonneur cylindrique, l'échantillon est coupé en deux dans le sens de la longueur et chaque segment est transféré dans un contenant distinct.

Échantillon pour composés volatils

Une attention spéciale est accordée aux échantillons prélevés pour l'analyse des composés volatils. Le prélèvement sur le terrain s'effectue de façon à minimiser le contact de l'échantillon avec l'atmosphère. Puisque le mélange d'un échantillon permet la libération de composés volatils, aucun échantillon composé ne doit être effectué.

Échantillons pour hydrocarbures

Lorsque la quantité de sol le permet et lorsque les paramètres recherchés sont des hydrocarbures, les échantillons de sols sont récupérés en double, le double de l'échantillon servant à la mesure des concentrations de vapeurs d'hydrocarbures.

Lorsque les volumes de sols disponibles le permettaient, les échantillons de sols ont été prélevés en duplicata afin d'y mesurer les concentrations en vapeurs organiques. Ces échantillons sont mis dans des pots remplis au 2/3 de leur capacité et scellés avec du papier d'aluminium, puis entreposés temporairement avant la prise des mesures de concentrations en vapeurs organiques. Les lectures de vapeurs organiques sur les échantillons ont été effectuées à l'aide d'un photoionisateur le jour même de leur prélèvement après que ces derniers aient été entreposés au moins une heure à la température de la pièce. Immédiatement avant la prise de mesures, chaque pot a été agité vigoureusement (avec son couvercle en place) afin de libérer les vapeurs et ensuite, la sonde a été introduite à travers le papier d'aluminium pour la mesure des vapeurs organiques dans l'espace d'air.

Eau souterraine

Préalablement à l'échantillonnage de l'eau souterraine, tous les puits ont été purgés à faible débit afin d'induire le plus faible rabattement du niveau de l'eau souterraine possible jusqu'à la stabilisation des conditions physico-chimiques (pH, température, conductivité, etc.) de l'eau. Par la suite, des échantillons d'eau souterraine sont prélevés avec les mêmes équipements que ceux utilisés lors de la purge.

Les échantillons d'eau sont recueillis dans un contenant d'une capacité variant de 40 à 1 000 ml selon les paramètres à analyser. Le guide « *Modes de conservation pour l'échantillonnage des*

eaux souterraines » du MELCC définit les quantités d'échantillons requises, le type de contenants à utiliser, les agents de conservation nécessaires et les délais de conservation entre le prélèvement et l'analyse des échantillons d'eau souterraine. Le préleveur utilise les contenants d'échantillon fournis par le laboratoire d'analyses qui a la responsabilité de fournir des contenants préparés de façon adéquate.

À moins d'avis contraire, aucun échantillon d'eau n'est prélevé lorsqu'il y a des hydrocarbures flottants à la surface de l'eau souterraine. Dans ce cas, cependant, l'épaisseur de la phase flottante d'hydrocarbures est mesurée à l'aide d'une sonde interface.

Produit en phase flottante

Le produit en phase flottante peut être échantillonné, si requis, et lorsqu'une quantité suffisante est présente dans le puits. Cet échantillonnage s'effectue à l'aide d'une écope à bille dédiée ou autre méthode jugée appropriée (ex. : pompe péristaltique). Les échantillons de produits en phase flottante sont recueillis dans un contenant de capacité variant de 40 à 1 000 ml selon les paramètres à analyser. Le guide « *Modes de conservation des échantillons relatifs à l'application du Règlement sur les matières dangereuses* » du MELCC définit les quantités d'échantillons requises, le type de contenants à utiliser et les délais de conservation entre le prélèvement et l'analyse des échantillons. Le préleveur utilise les contenants d'échantillon fournis par le laboratoire d'analyses qui a la responsabilité de fournir des contenants préparés de façon adéquate.

PROCÉDURES DE LAVAGE DES INSTRUMENTS D'ÉCHANTILLONNAGE

Lorsqu'ils ne sont pas dédiés à un point de prélèvement spécifique, tous les instruments d'échantillonnage sont lavés et rincés selon la procédure du MELCC décrite dans le *Guide d'échantillonnage à des fins d'analyses environnementales (Cahier 5 – Échantillonnage des sols, 2010)*.

Les outils servant au prélèvement et à la préparation des échantillons de sols sont nettoyés avant le prélèvement de chaque échantillon ponctuel ou composé. La première étape du nettoyage doit suivre la séquence suivante :

- ▶ rincer l'outil d'échantillonnage à l'eau de qualité compatible aux analyses envisagées pour enlever les résidus majeurs;
- ▶ nettoyer les surfaces avec une brosse, de l'eau et un détergent ne laissant pas de résidus (ex. : Alconox);
- ▶ rincer à l'eau pour enlever le détergent; si le matériel comporte encore des traces de souillure, reprendre le lavage;
- ▶ rincer à l'eau purifiée et égoutter le surplus. Le rinçage adéquat doit mettre en contact le liquide avec toutes les surfaces de l'équipement d'échantillonnage.

Dans le cas où les échantillons de sol sont soumis uniquement aux analyses de chimie inorganique, la première étape de nettoyage est généralement suffisante.

Dans le cas où les échantillons de sols sont soumis aux analyses de chimie organique, une deuxième étape de nettoyage doit être effectuée. Cette étape consiste à :

- ▶ rincer à l'acétone;
- ▶ rincer à l'hexane;
- ▶ rincer de nouveau à l'acétone et laisser égoutter.

Dans le cas où l'acétone ou l'hexane est un contaminant recherché, ou pourrait créer une interférence analytique (ex. : composés organiques volatils), il est remplacé par un produit équivalent (ex. : méthanol).

Lorsque l'échantillonneur est très souillé par des résidus huileux, il peut être nécessaire de le nettoyer à l'aide d'un chiffon imbibé de solvant avant d'entreprendre les étapes de rinçage.

IDENTIFICATION, TRANSPORT ET CONSERVATION DES ÉCHANTILLONS

Tous les échantillons de sols et d'eau recueillis au chantier sont dûment identifiés et placés au froid à l'intérieur de glacières appropriées, leur permettant de demeurer à une température voisine de 4°C depuis leur prélèvement jusqu'à leur livraison au laboratoire d'analyses. Dans la mesure du possible, les échantillons sont livrés au laboratoire d'analyses, accompagnés d'un bordereau de livraison dûment rempli, à l'intérieur d'un délai n'excédant pas 24 heures après la fin des travaux de terrain.

Les échantillons de sols et d'eau souterraine n'ayant pas servi aux analyses chimiques ou à un relevé de vapeur d'hydrocarbures sont conservés par le laboratoire d'analyses pour une période minimale d'un mois à compter de leur date de prélèvement. Après cette période, les échantillons sont éliminés à moins d'avoir reçu des directives précises à ce sujet de la part d'un représentant autorisé du client.

Les spécifications concernant le mode de conservation des différentes matrices sont fournies pour chaque paramètre à analyser dans les guides « Modes de conservation pour l'échantillonnage des sols », « Modes de conservation pour l'échantillonnage des eaux souterraines » et « Modes de conservation des échantillons relatifs à l'application du Règlement sur les matières dangereuses » du MELCC.

Annexe H Certificats analytiques

Votre # de commande: F04842
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD

Attention: Philippe-Alexandre Charette

Englobe Corp.
1200, BOUL. ST-MARTIN OUEST
Bureau 400
LAVAL, QC
CANADA H7S 2E4

Votre # Bordereau: 964627, 964628, 964629, 964630, 964631

Date du rapport: 2019/08/13
Rapport: R2480166
Version: 1 - Finale

CERTIFICAT D'ANALYSES

DE DOSSIER LAB BV: B935656

Reçu: 2019/08/06, 12:30

Matrice: Sol
Nombre d'échantillons reçus: 44

Analyses	Quantité	Date de l'	Date	Méthode de laboratoire	Référence Primaire
		extraction	Analysé		
Hydrocarbures pétroliers (C10-C50)	19	2019/08/09	2019/08/12	STL SOP-00172	MA.400-HYD. 1.1 R3 m
Hydrocarbures pétroliers (C10-C50)	1	2019/08/10	2019/08/12	STL SOP-00172	MA.400-HYD. 1.1 R3 m
Hydrocarbures pétroliers (C10-C50)	20	2019/08/11	2019/08/12	STL SOP-00172	MA.400-HYD. 1.1 R3 m
Hydrocarbures pétroliers (C10-C50)	4	2019/08/12	2019/08/12	STL SOP-00172	MA.400-HYD. 1.1 R3 m
CCME F1/BTEX-MeOH sur le terrain (1, 2)	20	N/A	N/A	STL SOP-00131	CCME PHC-CWS m
Hydrocarbures pétroliers (F2-F4) (1, 2)	20	2019/08/13	N/A	STL SOP-00170	CCME PHC-CWS m
Métaux extractibles totaux(basse limite)	44	2019/08/08	2019/08/10	STL SOP-000069	MA.200-Mét.1.2 R5 m
HAP (CCME)	19	2019/08/09	2019/08/12	STL SOP-00178	MA.400-HAP 1.1 R5 m
HAP (CCME)	1	2019/08/10	2019/08/12	STL SOP-00178	MA.400-HAP 1.1 R5 m
HAP (CCME)	4	2019/08/11	2019/08/12	STL SOP-00178	MA.400-HAP 1.1 R5 m
HAP (CCME)	16	2019/08/11	2019/08/13	STL SOP-00178	MA.400-HAP 1.1 R5 m
HAP (CCME)	4	2019/08/12	2019/08/12	STL SOP-00178	MA.400-HAP 1.1 R5 m

Remarques:

Laboratoires Bureau Veritas sont certifiés ISO/IEC 17025 pour certains paramètres précis des portées d'accréditation. Sauf indication contraire, les méthodes d'analyses utilisées par Labs BV s'inspirent des méthodes de référence d'organismes provinciaux, fédéraux et américains, tels que le CCME, le MELCC, l'EPA et l'APHA.

Toutes les analyses présentées ont été réalisées conformément aux procédures et aux pratiques relatives à la méthodologie, à l'assurance qualité et au contrôle de la qualité généralement appliqués par les employés de Labs BV (sauf s'il en a été convenu autrement par écrit entre le client et Labs BV). Toutes les données de laboratoire rencontrent les contrôles statistiques et respectent tous les critères de CQ et les critères de performance des méthodes, sauf s'il en a été signalé autrement. Tous les blancs de méthode sont rapportés, toutefois, les données des échantillons correspondants ne sont pas corrigées pour la valeur du blanc, sauf indication contraire. Le cas échéant, sauf indication contraire, l'incertitude de mesure n'a pas été prise en considération lors de la déclaration de la conformité à la norme de référence.

Les responsabilités de Labs BV sont restreintes au coût réel de l'analyse, sauf s'il en a été convenu autrement par écrit. Il n'existe aucune autre garantie, explicite ou implicite. Le client a fait appel à Labs BV pour l'analyse de ses échantillons conformément aux méthodes de référence mentionnées dans ce rapport. L'interprétation et l'utilisation des résultats sont sous l'entière responsabilité du client et ne font pas partie des services offerts par Labs BV, sauf si convenu autrement par écrit. Labs BV ne peut pas garantir l'exactitude des résultats qui dépendent des renseignements fournis par le client ou son

Votre # de commande: F04842
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD

Attention: Philippe-Alexandre Charette

Englobe Corp.
1200, BOUL. ST-MARTIN OUEST
Bureau 400
LAVAL, QC
CANADA H7S 2E4

Votre # Bordereau: 964627, 964628, 964629, 964630, 964631

Date du rapport: 2019/08/13
Rapport: R2480166
Version: 1 - Finale

CERTIFICAT D'ANALYSES

DE DOSSIER LAB BV: B935656

Reçu: 2019/08/06, 12:30
représentant.

Les résultats des échantillons solides, sauf les biotes, sont rapportés en fonction de la masse sèche, sauf indication contraire. Les analyses organiques ne sont pas corrigées en fonction de la récupération, sauf pour les méthodes de dilution isotopique.

Les résultats s'appliquent seulement aux échantillons analysés. Si l'échantillonnage n'est pas effectué par Labs BV, les résultats se rapportent aux échantillons fournis pour analyse.

Le présent rapport ne doit pas être reproduit, sinon dans son intégralité, sans le consentement écrit du laboratoire.

Lorsque la méthode de référence comprend un suffixe « m », cela signifie que la méthode d'analyse du laboratoire contient des modifications validées et appliquées afin d'améliorer la performance de la méthode de référence.

Notez: Les données brutes sont utilisées pour le calcul du RPD (% d'écart relatif). L'arrondissement des résultats finaux peut expliquer la variation apparente.

(1) Cette analyse a été effectuée par Lab BV - Mississauga

(2) Tous les résultats pour le CCME répondent aux critères exigés, sauf indication contraire dans le rapport. Les méthodes du SP-HCP utilisées par Lab BV respectent tous les éléments imposés par la méthode de référence et les éléments se rapportant à la performance ont été validés. Toutes les modifications ont été validées et jugées équivalentes d'après l'Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Validation of Performance-Based Alternative Methods, September 2003. La documentation est fournie sur demande. Différence par rapport à la Méthode de référence pour le standard pancanadien relatif aux hydrocarbures pétroliers dans le sol – méthode du 1er volet : les résultats pour les fractions F2/F3/F4 sont rapportés à l'aide d'une extraction à froid par solvant au lieu d'une extraction avec un appareil Soxhlet.

Note : Les paramètres inclus dans le présent certificat sont accrédités par le MELCC, à moins d'indication contraire.

clé de cryptage



**AUTHORIZED REPORT
RAPPORT AUTORISÉ**

Laboratoires Bureau Veritas
13 Aug 2019 16:59:58

Veuillez adresser toute question concernant ce certificat d'analyse à votre chargé(e) de projets
Rodrigo Caffarengo, Chargé de projets
Courriel: Rodrigo.CAFFARENGO@bvlabs.com
Téléphone (514)448-9001 Ext:7066336

=====
Ce rapport a été produit et distribué en utilisant une procédure automatisée sécuritaire.

Lab BV a mis en place des procédures qui protègent contre l'utilisation non autorisée de la signature électronique et emploie les «signataires» requis, conformément à l'ISO/CEI 17025. Veuillez vous référer à la page des signatures de validation pour obtenir les détails des validations pour chaque division.

HAP PAR GCMS (SOL)

ID Lab BV						GU4013	GU4014	GU4017	GU4018		
Date d'échantillonnage						2019/07/29	2019/07/29	2019/07/29	2019/07/30		
# Bordereau						964627	964627	964627	964627		
	Unités	A	B	C	D	TF-01-19; CF-01A	TF-01-19; CF-01B	TF-01-19; CF-04	TF-02-19; CF-01B	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	13	23	30	20	N/A	N/A
HAP											
Acénaphène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Acénaphthylène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Anthracène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Benzo(a)anthracène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(a)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	136	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(c)phénanthrène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Benzo(ghi)peryène	mg/kg	0.1	1	10	18	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Chrysène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	82	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	0.10	2017125
7,12-Diméthylbenzanthracène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Fluoranthène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Fluorène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	0.050	2017125
3-Méthylcholanthrène	mg/kg	0.1	1	10	150	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Naphtalène	mg/kg	0.1	5	50	56	<0.010	<0.010	<0.010	<0.010	0.010	2017125
Phénanthrène	mg/kg	0.1	5	50	56	<0.040	<0.040	<0.040	<0.040	0.040	2017125
Pyrène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	0.10	2017125
2-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	0.10	2017125
1-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	0.10	2017125
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	0.10	2017125
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	0.10	2017125
LDR = Limite de détection rapportée											
Lot CQ = Lot contrôle qualité											
N/A = Non Applicable											
† Accréditation non existante pour ce paramètre											



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4013	GU4014	GU4017	GU4018		
Date d'échantillonnage						2019/07/29	2019/07/29	2019/07/29	2019/07/30		
# Bordereau						964627	964627	964627	964627		
	Unités	A	B	C	D	TF-01-19; CF-01A	TF-01-19; CF-01B	TF-01-19; CF-04	TF-02-19; CF-01B	LDR	Lot CQ

Récupération des Surrogates (%)											
D10-Anthracène	%	-	-	-	-	82	86	86	82	N/A	2017125
D12-Benzo(a)pyrène	%	-	-	-	-	80	82	82	78	N/A	2017125
D14-Terphenyl	%	-	-	-	-	78	82	80	76	N/A	2017125
D8-Acenaphthylene	%	-	-	-	-	68	72	70	70	N/A	2017125
D8-Naphtalène	%	-	-	-	-	82	86	84	80	N/A	2017125

LDR = Limite de détection rapportée

Lot CQ = Lot contrôle qualité

N/A = Non Applicable

HAP PAR GCMS (SOL)

ID Lab BV						GU4020	GU4021	GU4022	GU4023	GU4024		
Date d'échantillonnage						2019/07/30	2019/08/01	2019/08/01	2019/08/01	2019/08/01		
# Bordereau						964627	964627	964627	964627	964627		
	Unités	A	B	C	D	TF-02-19; CF-03	TA-01-19; 1	TA-01-19; 3	TA-02-19; 2	TA-02-19; 3	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	26	12	26	8.6	21	N/A	N/A
HAP												
Acénaphthène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Acénaphthylène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Anthracène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Benzo(a)anthracène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(a)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	136	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(c)phénanthrène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Benzo(ghi)pérylène	mg/kg	0.1	1	10	18	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Chrysène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	82	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
7,12-Diméthylbenzanthracène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Fluoranthène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Fluorène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
3-Méthylcholanthrène	mg/kg	0.1	1	10	150	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Naphtalène	mg/kg	0.1	5	50	56	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	2017125
Phénanthrène	mg/kg	0.1	5	50	56	<0.040	<0.040	<0.040	<0.040	<0.040	0.040	2017125
Pyrène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
2-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
1-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												
† Accréditation non existante pour ce paramètre												



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4020	GU4021	GU4022	GU4023	GU4024		
Date d'échantillonnage						2019/07/30	2019/08/01	2019/08/01	2019/08/01	2019/08/01		
# Bordereau						964627	964627	964627	964627	964627		
	Unités	A	B	C	D	TF-02-19; CF-03	TA-01-19; 1	TA-01-19; 3	TA-02-19; 2	TA-02-19; 3	LDR	Lot CQ

Récupération des Surrogates (%)												
D10-Anthracène	%	-	-	-	-	84	86	88	84	82	N/A	2017125
D12-Benzo(a)pyrène	%	-	-	-	-	80	82	84	82	80	N/A	2017125
D14-Terphenyl	%	-	-	-	-	78	84	82	78	78	N/A	2017125
D8-Acenaphthylene	%	-	-	-	-	70	74	76	72	70	N/A	2017125
D8-Naphtalène	%	-	-	-	-	84	86	88	84	82	N/A	2017125

LDR = Limite de détection rapportée

Lot CQ = Lot contrôle qualité

N/A = Non Applicable

HAP PAR GCMS (SOL)

ID Lab BV						GU4026	GU4027	GU4039	GU4040	GU4041		
Date d'échantillonnage						2019/08/01	2019/08/01	2019/08/01	2019/08/01	2019/07/31		
# Bordereau						964627	964628	964628	964628	964628		
	Unités	A	B	C	D	TA-03-19; 2	TA-04-19;3	TA-05-19; 2	TA-06-19; 2	TA-07-19; 1	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	23	24	21	23	17	N/A	N/A
HAP												
Acénaphène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Acénaphthylène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Anthracène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Benzo(a)anthracène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(a)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	136	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(c)phénanthrène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Benzo(ghi)pérylène	mg/kg	0.1	1	10	18	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Chrysène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	82	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
7,12-Diméthylbenzanthracène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Fluoranthène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Fluorène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
3-Méthylcholanthrène	mg/kg	0.1	1	10	150	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Naphtalène	mg/kg	0.1	5	50	56	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	2017125
Phénanthrène	mg/kg	0.1	5	50	56	<0.040	<0.040	<0.040	<0.040	<0.040	0.040	2017125
Pyrène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
2-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
1-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												
† Accréditation non existante pour ce paramètre												



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4026	GU4027	GU4039	GU4040	GU4041		
Date d'échantillonnage						2019/08/01	2019/08/01	2019/08/01	2019/08/01	2019/07/31		
# Bordereau						964627	964628	964628	964628	964628		
	Unités	A	B	C	D	TA-03-19; 2	TA-04-19;3	TA-05-19; 2	TA-06-19; 2	TA-07-19; 1	LDR	Lot CQ
Récupération des Surrogates (%)												
D10-Anthracène	%	-	-	-	-	84	88	86	88	88	N/A	2017125
D12-Benzo(a)pyrène	%	-	-	-	-	80	84	82	82	84	N/A	2017125
D14-Terphenyl	%	-	-	-	-	80	82	80	76	78	N/A	2017125
D8-Acenaphthylene	%	-	-	-	-	72	74	74	78	80	N/A	2017125
D8-Naphtalène	%	-	-	-	-	82	88	86	78	80	N/A	2017125
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4042	GU4042	GU4043	GU4044	GU4045		
Date d'échantillonnage						2019/07/31	2019/07/31	2019/08/01	2019/08/01	2019/08/01		
# Bordereau						964628	964628	964628	964628	964628		
	Unités	A	B	C	D	TA-07-19; 3	TA-07-19; 3 Dup. de Lab.	TA-08-19; 1	TA-08-19; 2	TA-09-19; 1	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	28	28	14	21	16	N/A	N/A
HAP												
Acénaphthène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Acénaphthylène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Anthracène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Benzo(a)anthracène	mg/kg	0.1	1	10	<u>34</u>	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(a)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	<u>136</u>	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Benzo(c)phénanthrène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Benzo(ghi)peryène	mg/kg	0.1	1	10	<u>18</u>	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Chrysène	mg/kg	0.1	1	10	<u>34</u>	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	<u>82</u>	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
7,12-Diméthylbenzanthrène	mg/kg	0.1	1	10	<u>34</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Fluoranthène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Fluorène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017125
3-Méthylcholanthrène	mg/kg	0.1	1	10	<u>150</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
Naphtalène	mg/kg	0.1	5	50	<u>56</u>	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	2017125
Phénanthrène	mg/kg	0.1	5	50	<u>56</u>	<0.040	<0.040	<0.040	<0.040	<0.040	0.040	2017125
Pyrène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
2-Méthylnaphtalène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
1-Méthylnaphtalène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017125
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
Duplicata de laboratoire												
N/A = Non Applicable												
† Accréditation non existante pour ce paramètre												



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4042	GU4042	GU4043	GU4044	GU4045		
Date d'échantillonnage						2019/07/31	2019/07/31	2019/08/01	2019/08/01	2019/08/01		
# Bordereau						964628	964628	964628	964628	964628		
	Unités	A	B	C	D	TA-07-19; 3	TA-07-19; 3 Dup. de Lab.	TA-08-19; 1	TA-08-19; 2	TA-09-19; 1	LDR	Lot CQ

Récupération des Surrogates (%)												
D10-Anthracène	%	-	-	-	-	90	88	92	94	90	N/A	2017125
D12-Benzo(a)pyrène	%	-	-	-	-	84	84	88	86	84	N/A	2017125
D14-Terphenyl	%	-	-	-	-	78	78	84	80	78	N/A	2017125
D8-Acenaphthylene	%	-	-	-	-	80	78	84	82	80	N/A	2017125
D8-Naphtalène	%	-	-	-	-	80	76	84	80	78	N/A	2017125

LDR = Limite de détection rapportée

Lot CQ = Lot contrôle qualité

Duplicata de laboratoire

N/A = Non Applicable

HAP PAR GCMS (SOL)

ID Lab BV						GU4046	GU4047		GU4048	GU4049	GU4050		
Date d'échantillonnage						2019/08/01	2019/08/01		2019/08/01	2019/07/31	2019/07/31		
# Bordereau						964628	964629		964629	964629	964629		
	Unités	A	B	C	D	TA-09-19; 2	TA-10-19; 1	Lot CQ	TA-10-19; 2	EMP1; E-1	EMP1; E-2	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	22	15	N/A	23	11	12	N/A	N/A
HAP													
Acénaphène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Acénaphthylène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Anthracène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Benzo(a)anthracène	mg/kg	0.1	1	10	34	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
Benzo(a)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	136	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
Benzo(c)phénanthrène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Benzo(ghi)pérylène	mg/kg	0.1	1	10	18	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
Chrysène	mg/kg	0.1	1	10	34	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	82	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
7,12-Diméthylbenzantracène	mg/kg	0.1	1	10	34	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Fluoranthène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Fluorène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	2017125	<0.050	<0.050	<0.050	0.050	2017339
3-Méthylcholanthrène	mg/kg	0.1	1	10	150	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
Naphtalène	mg/kg	0.1	5	50	56	<0.010	<0.010	2017125	<0.010	<0.010	<0.010	0.010	2017339
Phénanthrène	mg/kg	0.1	5	50	56	<0.040	<0.040	2017125	<0.040	<0.040	<0.040	0.040	2017339
Pyrène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
2-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
1-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017125	<0.10	<0.10	<0.10	0.10	2017339
LDR = Limite de détection rapportée													
Lot CQ = Lot contrôle qualité													
N/A = Non Applicable													
† Accréditation non existante pour ce paramètre													

HAP PAR GCMS (SOL)

ID Lab BV						GU4046	GU4047		GU4048	GU4049	GU4050		
Date d'échantillonnage						2019/08/01	2019/08/01		2019/08/01	2019/07/31	2019/07/31		
# Bordereau						964628	964629		964629	964629	964629		
	Unités	A	B	C	D	TA-09-19; 2	TA-10-19; 1	Lot CQ	TA-10-19; 2	EMP1; E-1	EMP1; E-2	LDR	Lot CQ
Récupération des Surrogates (%)													
D10-Anthracène	%	-	-	-	-	90	84	2017125	92	94	92	N/A	2017339
D12-Benzo(a)pyrène	%	-	-	-	-	86	78	2017125	92	90	88	N/A	2017339
D14-Terphenyl	%	-	-	-	-	78	74	2017125	94	94	94	N/A	2017339
D8-Acenaphthylene	%	-	-	-	-	82	78	2017125	90	90	88	N/A	2017339
D8-Naphtalène	%	-	-	-	-	80	76	2017125	96	96	94	N/A	2017339
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité N/A = Non Applicable													

HAP PAR GCMS (SOL)

ID Lab BV						GU4051	GU4052		GU4053	GU4054	GU4056		
Date d'échantillonnage						2019/07/31	2019/07/31		2019/07/31	2019/07/31	2019/07/31		
# Bordereau						964629	964629		964629	964629	964629		
	Unités	A	B	C	D	EMP1; E-3	EMP1; E-4	Lot CQ	EMP1; E-5	EMP1; E-6	EMP1; E-8	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	20	8.1	N/A	19	18	13	N/A	N/A
HAP													
Acénaphthène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Acénaphthylène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Anthracène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Benzo(a)anthracène	mg/kg	0.1	1	10	34	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
Benzo(a)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	136	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
Benzo(c)phénanthrène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Benzo(ghi)pérylène	mg/kg	0.1	1	10	18	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
Chrysène	mg/kg	0.1	1	10	34	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	82	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
7,12-Diméthylbenzantracène	mg/kg	0.1	1	10	34	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Fluoranthène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Fluorène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	2017339	<0.050	<0.050	<0.050	0.050	2017347
3-Méthylcholanthrène	mg/kg	0.1	1	10	150	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
Naphtalène	mg/kg	0.1	5	50	56	<0.010	<0.010	2017339	<0.010	<0.010	<0.010	0.010	2017347
Phénanthrène	mg/kg	0.1	5	50	56	<0.040	<0.040	2017339	<0.040	<0.040	<0.040	0.040	2017347
Pyrène	mg/kg	0.1	10	100	100	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
2-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
1-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	2017339	<0.10	<0.10	<0.10	0.10	2017347
LDR = Limite de détection rapportée													
Lot CQ = Lot contrôle qualité													
N/A = Non Applicable													
† Accréditation non existante pour ce paramètre													



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4051	GU4052		GU4053	GU4054	GU4056		
Date d'échantillonnage						2019/07/31	2019/07/31		2019/07/31	2019/07/31	2019/07/31		
# Bordereau						964629	964629		964629	964629	964629		
	Unités	A	B	C	D	EMP1; E-3	EMP1; E-4	Lot CQ	EMP1; E-5	EMP1; E-6	EMP1; E-8	LDR	Lot CQ
Récupération des Surrogates (%)													
D10-Anthracène	%	-	-	-	-	94	90	2017339	92	92	92	N/A	2017347
D12-Benzo(a)pyrène	%	-	-	-	-	90	88	2017339	86	88	88	N/A	2017347
D14-Terphenyl	%	-	-	-	-	96	90	2017339	80	80	82	N/A	2017347
D8-Acenaphthylene	%	-	-	-	-	90	88	2017339	82	82	82	N/A	2017347
D8-Naphtalène	%	-	-	-	-	96	94	2017339	82	82	82	N/A	2017347
LDR = Limite de détection rapportée													
Lot CQ = Lot contrôle qualité													
N/A = Non Applicable													

HAP PAR GCMS (SOL)

ID Lab BV						GU4057		GU4058	GU4059	GU4060		
Date d'échantillonnage						2019/07/31		2019/07/31	2019/07/31	2019/07/31		
# Bordereau						964630		964630	964630	964630		
	Unités	A	B	C	D	EMP1; E-9	Lot CQ	EMP1; E-10	EMP1; E-11	EMP1; E-12	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	14	N/A	16	13	18	N/A	N/A
HAP												
Acénaphthène	mg/kg	0.1	10	100	100	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Acénaphthylène	mg/kg	0.1	10	100	100	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Anthracène	mg/kg	0.1	10	100	100	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Benzo(a)anthracène	mg/kg	0.1	1	10	34	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
Benzo(a)pyrène	mg/kg	0.1	1	10	34	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	136	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
Benzo(c)phénanthrène	mg/kg	0.1	1	10	56	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Benzo(ghi)pérylène	mg/kg	0.1	1	10	18	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
Chrysène	mg/kg	0.1	1	10	34	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	82	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	34	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	34	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	34	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
7,12-Diméthylbenzanthracène	mg/kg	0.1	1	10	34	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Fluoranthène	mg/kg	0.1	10	100	100	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Fluorène	mg/kg	0.1	10	100	100	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	34	<0.050	2017347	<0.050	<0.050	<0.050	0.050	2017339
3-Méthylcholanthrène	mg/kg	0.1	1	10	150	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
Naphtalène	mg/kg	0.1	5	50	56	<0.010	2017347	<0.010	<0.010	<0.010	0.010	2017339
Phénanthrène	mg/kg	0.1	5	50	56	<0.040	2017347	<0.040	<0.040	<0.040	0.040	2017339
Pyrène	mg/kg	0.1	10	100	100	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
2-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
1-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	2017347	<0.10	<0.10	<0.10	0.10	2017339
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												
† Accréditation non existante pour ce paramètre												



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4057		GU4058	GU4059	GU4060		
Date d'échantillonnage						2019/07/31		2019/07/31	2019/07/31	2019/07/31		
# Bordereau						964630		964630	964630	964630		
	Unités	A	B	C	D	EMP1; E-9	Lot CQ	EMP1; E-10	EMP1; E-11	EMP1; E-12	LDR	Lot CQ

Récupération des Surrogates (%)

D10-Anthracène	%	-	-	-	-	90	2017347	90	90	90	N/A	2017339
D12-Benzo(a)pyrène	%	-	-	-	-	86	2017347	86	86	88	N/A	2017339
D14-Terphenyl	%	-	-	-	-	78	2017347	92	90	92	N/A	2017339
D8-Acenaphthylene	%	-	-	-	-	80	2017347	88	88	86	N/A	2017339
D8-Naphtalène	%	-	-	-	-	80	2017347	94	94	94	N/A	2017339

LDR = Limite de détection rapportée

Lot CQ = Lot contrôle qualité

N/A = Non Applicable

HAP PAR GCMS (SOL)

ID Lab BV						GU4061	GU4062	GU4063	GU4064	GU4065		
Date d'échantillonnage						2019/07/31	2019/07/31	2019/07/29	2019/07/31	2019/07/31		
# Bordereau						964630	964630	964630	964630	964630		
	Unités	A	B	C	D	EMP1; E-13	EMP1; E-14	EMP1; E-15	EMP1; E-16	EMP1; E-17	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	19	15	15	12	16	N/A	N/A
HAP												
Acénaphène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Acénaphthylène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Anthracène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Benzo(a)anthracène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(a)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	136	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(c)phénanthrène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Benzo(ghi)peryène	mg/kg	0.1	1	10	18	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Chrysène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	82	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
7,12-Diméthylbenzanthrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Fluoranthène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Fluorène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
3-Méthylcholanthrène	mg/kg	0.1	1	10	150	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Naphtalène	mg/kg	0.1	5	50	56	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	2017339
Phénanthrène	mg/kg	0.1	5	50	56	<0.040	<0.040	<0.040	<0.040	<0.040	0.040	2017339
Pyrene	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
2-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
1-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												
† Accréditation non existante pour ce paramètre												



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4061	GU4062	GU4063	GU4064	GU4065		
Date d'échantillonnage						2019/07/31	2019/07/31	2019/07/29	2019/07/31	2019/07/31		
# Bordereau						964630	964630	964630	964630	964630		
	Unités	A	B	C	D	EMP1; E-13	EMP1; E-14	EMP1; E-15	EMP1; E-16	EMP1; E-17	LDR	Lot CQ

Récupération des Surrogates (%)												
D10-Anthracène	%	-	-	-	-	92	92	92	92	84	N/A	2017339
D12-Benzo(a)pyrène	%	-	-	-	-	92	88	90	90	82	N/A	2017339
D14-Terphenyl	%	-	-	-	-	94	92	94	94	86	N/A	2017339
D8-Acenaphthylene	%	-	-	-	-	90	88	88	88	82	N/A	2017339
D8-Naphtalène	%	-	-	-	-	94	94	94	94	86	N/A	2017339

LDR = Limite de détection rapportée

Lot CQ = Lot contrôle qualité

N/A = Non Applicable



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4066	GU4067	GU4068	GU4069	GU4070		
Date d'échantillonnage						2019/07/31	2019/07/31	2019/07/31	2019/07/29	2019/07/31		
# Bordereau						964630	964631	964631	964631	964631		
	Unités	A	B	C	D	EMP1; E-18	EMP1; E-19	EMP1; E-20	DUP-2	DUP-11	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	19	15	22	23	15	N/A	N/A
HAP												
Acénaphène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Acénaphthylène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Anthracène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Benzo(a)anthracène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(a)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	136	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Benzo(c)phénanthrène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Benzo(ghi)peryène	mg/kg	0.1	1	10	18	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Chrysène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	82	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
7,12-Diméthylbenzanthrène	mg/kg	0.1	1	10	34	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Fluoranthène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Fluorène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	34	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	2017339
3-Méthylcholanthrène	mg/kg	0.1	1	10	150	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
Naphtalène	mg/kg	0.1	5	50	56	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	2017339
Phénanthrène	mg/kg	0.1	5	50	56	<0.040	<0.040	<0.040	<0.040	<0.040	0.040	2017339
Pyrène	mg/kg	0.1	10	100	100	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
2-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
1-Méthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	56	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	2017339
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												
† Accréditation non existante pour ce paramètre												



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

HAP PAR GCMS (SOL)

ID Lab BV						GU4066	GU4067	GU4068	GU4069	GU4070		
Date d'échantillonnage						2019/07/31	2019/07/31	2019/07/31	2019/07/29	2019/07/31		
# Bordereau						964630	964631	964631	964631	964631		
	Unités	A	B	C	D	EMP1; E-18	EMP1; E-19	EMP1; E-20	DUP-2	DUP-11	LDR	Lot CQ
Récupération des Surrogates (%)												
D10-Anthracène	%	-	-	-	-	94	90	94	92	92	N/A	2017339
D12-Benzo(a)pyrène	%	-	-	-	-	90	88	90	86	90	N/A	2017339
D14-Terphenyl	%	-	-	-	-	96	92	96	92	94	N/A	2017339
D8-Acenaphthylene	%	-	-	-	-	90	88	90	88	90	N/A	2017339
D8-Naphtalène	%	-	-	-	-	96	94	96	94	94	N/A	2017339
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												

HAP PAR GCMS (SOL)

ID Lab BV						GU4070	GU4071	GU4072		
Date d'échantillonnage						2019/07/31	2019/08/01	2019/08/01		
# Bordereau						964631	964631	964631		
	Unités	A	B	C	D	DUP-11 Dup. de Lab.	DUP-13	DUP-14	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	15	15	22	N/A	N/A
HAP										
Acénaphène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	0.10	2017339
Acénaphylène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	0.10	2017339
Anthracène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	0.10	2017339
Benzo(a)anthracène	mg/kg	0.1	1	10	<u>34</u>	<0.050	<0.050	<0.050	0.050	2017339
Benzo(a)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	0.050	2017339
Benzo(j)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	0.050	2017339
Benzo(k)fluoranthène †	mg/kg	0.1	1	10	-	<0.050	<0.050	<0.050	0.050	2017339
Benzo(b+j+k)fluoranthène	mg/kg	-	-	-	<u>136</u>	<0.050	<0.050	<0.050	0.050	2017339
Benzo(c)phénanthrène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	0.10	2017339
Benzo(ghi)pérylène	mg/kg	0.1	1	10	<u>18</u>	<0.050	<0.050	<0.050	0.050	2017339
Chrysène	mg/kg	0.1	1	10	<u>34</u>	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,h)anthracène	mg/kg	0.1	1	10	<u>82</u>	<0.050	<0.050	<0.050	0.050	2017339
Dibenzo(a,i)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,h)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.10	<0.10	<0.10	0.10	2017339
Dibenzo(a,l)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.10	<0.10	<0.10	0.10	2017339
7,12-Diméthylbenzanthrène	mg/kg	0.1	1	10	<u>34</u>	<0.10	<0.10	<0.10	0.10	2017339
Fluoranthène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	0.10	2017339
Fluorène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	0.10	2017339
Indéno(1,2,3-cd)pyrène	mg/kg	0.1	1	10	<u>34</u>	<0.050	<0.050	<0.050	0.050	2017339
3-Méthylcholanthrène	mg/kg	0.1	1	10	<u>150</u>	<0.10	<0.10	<0.10	0.10	2017339
Naphtalène	mg/kg	0.1	5	50	<u>56</u>	<0.010	<0.010	<0.010	0.010	2017339
Phénanthrène	mg/kg	0.1	5	50	<u>56</u>	<0.040	<0.040	<0.040	0.040	2017339
Pyrène	mg/kg	0.1	10	100	<u>100</u>	<0.10	<0.10	<0.10	0.10	2017339
2-Méthylnaphtalène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	0.10	2017339
1-Méthylnaphtalène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	0.10	2017339
1,3-Diméthylnaphtalène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	0.10	2017339
2,3,5-Triméthylnaphtalène	mg/kg	0.1	1	10	<u>56</u>	<0.10	<0.10	<0.10	0.10	2017339
LDR = Limite de détection rapportée										
Lot CQ = Lot contrôle qualité										
Duplicata de laboratoire										
N/A = Non Applicable										
† Accréditation non existante pour ce paramètre										

HAP PAR GCMS (SOL)

ID Lab BV						GU4070	GU4071	GU4072		
Date d'échantillonnage						2019/07/31	2019/08/01	2019/08/01		
# Bordereau						964631	964631	964631		
	Unités	A	B	C	D	DUP-11 Dup. de Lab.	DUP-13	DUP-14	LDR	Lot CQ
Récupération des Surrogates (%)										
D10-Anthracène	%	-	-	-	-	92	92	94	N/A	2017339
D12-Benzo(a)pyrène	%	-	-	-	-	90	90	92	N/A	2017339
D14-Terphenyl	%	-	-	-	-	94	94	96	N/A	2017339
D8-Acenaphthylene	%	-	-	-	-	88	88	90	N/A	2017339
D8-Naphtalène	%	-	-	-	-	94	94	96	N/A	2017339
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité Duplicata de laboratoire N/A = Non Applicable										



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

HYDROCARBURES PAR GC/FID (SOL)

ID Lab BV						GU4013	GU4014	GU4017		
Date d'échantillonnage						2019/07/29	2019/07/29	2019/07/29		
# Bordereau						964627	964627	964627		
	Unités	A	B	C	D	TF-01-19; CF-01A	TF-01-19; CF-01B	TF-01-19; CF-04	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	13	23	30	N/A	N/A
HYDROCARBURES PÉTROLIERS										
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	100	2017100
Récupération des Surrogates (%)										
1-Chlorooctadécane	%	-	-	-	-	89	91	91	N/A	2017100
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité N/A = Non Applicable										

ID Lab BV						GU4018	GU4020	GU4021	GU4022		
Date d'échantillonnage						2019/07/30	2019/07/30	2019/08/01	2019/08/01		
# Bordereau						964627	964627	964627	964627		
	Unités	A	B	C	D	TF-02-19; CF-01B	TF-02-19; CF-03	TA-01-19; 1	TA-01-19; 3	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	20	26	12	26	N/A	N/A
HYDROCARBURES PÉTROLIERS											
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	<100	100	2017100
Récupération des Surrogates (%)											
1-Chlorooctadécane	%	-	-	-	-	84	89	89	92	N/A	2017100
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité N/A = Non Applicable											



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

HYDROCARBURES PAR GCFID (SOL)

ID Lab BV						GU4023	GU4024	GU4026	GU4027	GU4039		
Date d'échantillonnage						2019/08/01	2019/08/01	2019/08/01	2019/08/01	2019/08/01		
# Bordereau						964627	964627	964627	964628	964628		
	Unités	A	B	C	D	TA-02-19; 2	TA-02-19; 3	TA-03-19; 2	TA-04-19; 3	TA-05-19; 2	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	8.6	21	23	24	21	N/A	N/A
HYDROCARBURES PÉTROLIERS												
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	<100	<100	100	2017100
Récupération des Surrogates (%)												
1-Chlorooctadécane	%	-	-	-	-	91	90	91	92	89	N/A	2017100
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité N/A = Non Applicable												

ID Lab BV						GU4040	GU4041	GU4042	GU4042	GU4043		
Date d'échantillonnage						2019/08/01	2019/07/31	2019/07/31	2019/07/31	2019/08/01		
# Bordereau						964628	964628	964628	964628	964628		
	Unités	A	B	C	D	TA-06-19; 2	TA-07-19; 1	TA-07-19; 3	TA-07-19; 3 Dup. de Lab.	TA-08-19; 1	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	23	17	28	28	14	N/A	N/A
HYDROCARBURES PÉTROLIERS												
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	<100	<100	100	2017100
Récupération des Surrogates (%)												
1-Chlorooctadécane	%	-	-	-	-	88	91	91	93	95	N/A	2017100
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité Duplicata de laboratoire N/A = Non Applicable												



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

HYDROCARBURES PAR GC/FID (SOL)

ID Lab BV						GU4044	GU4045	GU4046	GU4047		
Date d'échantillonnage						2019/08/01	2019/08/01	2019/08/01	2019/08/01		
# Bordereau						964628	964628	964628	964629		
	Unités	A	B	C	D	TA-08-19; 2	TA-09-19; 1	TA-09-19; 2	TA-10-19; 1	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	21	16	22	15	N/A	N/A
HYDROCARBURES PÉTROLIERS											
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	<100	100	2017100
Récupération des Surrogates (%)											
1-Chlorooctadécane	%	-	-	-	-	93	91	91	88	N/A	2017100
LDR = Limite de détection rapportée											
Lot CQ = Lot contrôle qualité											
N/A = Non Applicable											

ID Lab BV						GU4048	GU4049	GU4050	GU4051	GU4052		
Date d'échantillonnage						2019/08/01	2019/07/31	2019/07/31	2019/07/31	2019/07/31		
# Bordereau						964629	964629	964629	964629	964629		
	Unités	A	B	C	D	TA-10-19; 2	EMP1; E-1	EMP1; E-2	EMP1; E-3	EMP1; E-4	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	23	11	12	20	8.1	N/A	N/A
HYDROCARBURES PÉTROLIERS												
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	<100	<100	100	2017338
Récupération des Surrogates (%)												
1-Chlorooctadécane	%	-	-	-	-	93	91	94	93	91	N/A	2017338
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

HYDROCARBURES PAR GC/FID (SOL)

ID Lab BV						GU4053	GU4053	GU4054	GU4056	GU4057		
Date d'échantillonnage						2019/07/31	2019/07/31	2019/07/31	2019/07/31	2019/07/31		
# Bordereau						964629	964629	964629	964629	964630		
	Unités	A	B	C	D	EMP1; E-5	EMP1; E-5 Dup. de Lab.	EMP1; E-6	EMP1; E-8	EMP1; E-9	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	19	19	18	13	14	N/A	N/A
HYDROCARBURES PÉTROLIERS												
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	<100	<100	100	2017346
Récupération des Surrogates (%)												
1-Chlorooctadécane	%	-	-	-	-	89	90	91	90	92	N/A	2017346
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité Duplicata de laboratoire N/A = Non Applicable												

ID Lab BV						GU4058	GU4059	GU4060	GU4061	GU4062		
Date d'échantillonnage						2019/07/31	2019/07/31	2019/07/31	2019/07/31	2019/07/31		
# Bordereau						964630	964630	964630	964630	964630		
	Unités	A	B	C	D	EMP1; E-10	EMP1; E-11	EMP1; E-12	EMP1; E-13	EMP1; E-14	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	16	13	18	19	15	N/A	N/A
HYDROCARBURES PÉTROLIERS												
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	<100	<100	100	2017338
Récupération des Surrogates (%)												
1-Chlorooctadécane	%	-	-	-	-	93	90	91	90	94	N/A	2017338
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité N/A = Non Applicable												



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

HYDROCARBURES PAR GC/FID (SOL)

ID Lab BV						GU4063	GU4064	GU4065	GU4066	GU4067		
Date d'échantillonnage						2019/07/29	2019/07/31	2019/07/31	2019/07/31	2019/07/31		
# Bordereau						964630	964630	964630	964630	964631		
	Unités	A	B	C	D	EMP1; E-15	EMP1; E-16	EMP1; E-17	EMP1; E-18	EMP1; E-19	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	15	12	16	19	15	N/A	N/A
HYDROCARBURES PÉTROLIERS												
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	<100	<100	100	2017338
Récupération des Surrogates (%)												
1-Chlorooctadécane	%	-	-	-	-	97	89	92	92	96	N/A	2017338
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité N/A = Non Applicable												

ID Lab BV						GU4068	GU4069	GU4070	GU4070	GU4071		
Date d'échantillonnage						2019/07/31	2019/07/29	2019/07/31	2019/07/31	2019/08/01		
# Bordereau						964631	964631	964631	964631	964631		
	Unités	A	B	C	D	EMP1; E-20	DUP-2	DUP-11	DUP-11 Dup. de Lab.	DUP-13	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	22	23	15	15	15	N/A	N/A
HYDROCARBURES PÉTROLIERS												
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	<100	<100	<100	<100	100	2017338
Récupération des Surrogates (%)												
1-Chlorooctadécane	%	-	-	-	-	93	95	96	93	91	N/A	2017338
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité Duplicata de laboratoire N/A = Non Applicable												

HYDROCARBURES PAR GCFID (SOL)

ID Lab BV						GU4072		
Date d'échantillonnage						2019/08/01		
# Bordereau						964631		
	Unités	A	B	C	D	DUP-14	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	22	N/A	N/A
HYDROCARBURES PÉTROLIERS								
Hydrocarbures pétroliers (C10-C50)	mg/kg	100	700	3500	10000	<100	100	2017338
Récupération des Surrogates (%)								
1-Chlorooctadécane	%	-	-	-	-	96	N/A	2017338
LDR = Limite de détection rapportée Lot CQ = Lot contrôle qualité N/A = Non Applicable								



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4013	GU4014	GU4017		
Date d'échantillonnage						2019/07/29	2019/07/29	2019/07/29		
# Bordereau						964627	964627	964627		
	Unités	A	B	C	D	TF-01-19; CF-01A	TF-01-19; CF-01B	TF-01-19; CF-04	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	13	23	30	N/A	N/A
MÉTAUX										
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	<0.50	<0.50	0.50	2016451
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	2.0	<2.0	2.0	2.0	2016451
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	210	160	140	4.0	2016451
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	<0.10	<0.10	0.10	2016451
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	86	120	100	1.0	2016451
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	37	54	51	1.0	2016451
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	19	23	20	1.0	2016451
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	<1.0	<1.0	1.0	2016451
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	690	710	620	2.0	2016451
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	<0.50	<0.50	0.50	2016451
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	48	72	63	0.50	2016451
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	11	11	9.7	1.0	2016451
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	<0.50	<0.50	0.50	2016451
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	78	93	86	5.0	2016451
LDR = Limite de détection rapportée										
Lot CQ = Lot contrôle qualité										
N/A = Non Applicable										



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4018	GU4020	GU4021	GU4022		
Date d'échantillonnage						2019/07/30	2019/07/30	2019/08/01	2019/08/01		
# Bordereau						964627	964627	964627	964627		
	Unités	A	B	C	D	TF-02-19; CF-01B	TF-02-19; CF-03	TA-01-19; 1	TA-01-19; 3	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	20	26	12	26	N/A	N/A
MÉTAUX											
Argent (Ag)	mg/kg	2	20	40	200	<0.50	<0.50	<0.50	<0.50	0.50	2016483
Arsenic (As)	mg/kg	6	30	50	250	<2.0	<2.0	2.1	<2.0	2.0	2016483
Baryum (Ba)	mg/kg	340	500	2000	10000	200	160	230	190	4.0	2016483
Cadmium (Cd)	mg/kg	1.5	5	20	100	<0.10	<0.10	<0.10	<0.10	0.10	2016483
Chrome (Cr)	mg/kg	100	250	800	4000	110	110	53	120	1.0	2016483
Cuivre (Cu)	mg/kg	50	100	500	2500	52	48	24	52	1.0	2016483
Cobalt (Co)	mg/kg	25	50	300	1500	20	19	13	27	1.0	2016483
Etain (Sn)	mg/kg	5	50	300	1500	<1.0	<1.0	<1.0	<1.0	1.0	2016483
Manganèse (Mn)	mg/kg	1000	1000	2200	11000	620	540	810	860	2.0	2016483
Molybdène (Mo)	mg/kg	2	10	40	200	<0.50	<0.50	1.1	<0.50	0.50	2016483
Nickel (Ni)	mg/kg	50	100	500	2500	62	63	32	71	0.50	2016483
Plomb (Pb)	mg/kg	50	500	1000	5000	11	8.4	97	11	1.0	2016483
Sélénium (Se)	mg/kg	1	3	10	50	<0.50	<0.50	<0.50	<0.50	0.50	2016483
Zinc (Zn)	mg/kg	140	500	1500	7500	92	87	98	91	5.0	2016483
LDR = Limite de détection rapportée											
Lot CQ = Lot contrôle qualité											
N/A = Non Applicable											



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4023		GU4024		GU4026		
Date d'échantillonnage						2019/08/01		2019/08/01		2019/08/01		
# Bordereau						964627		964627		964627		
	Unités	A	B	C	D	TA-02-19; 2	Lot CQ	TA-02-19; 3	Lot CQ	TA-03-19; 2	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	8.6	N/A	21	N/A	23	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016451	<0.50	2016483	<0.50	0.50	2016451
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016451	<2.0	2016483	<2.0	2.0	2016451
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	110	2016451	180	2016483	160	4.0	2016451
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	2016451	<0.10	2016483	<0.10	0.10	2016451
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	29	2016451	110	2016483	120	1.0	2016451
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	14	2016451	50	2016483	52	1.0	2016451
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	6.7	2016451	21	2016483	23	1.0	2016451
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016451	<1.0	2016483	<1.0	1.0	2016451
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	330	2016451	650	2016483	730	2.0	2016451
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016451	<0.50	2016483	<0.50	0.50	2016451
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	18	2016451	64	2016483	70	0.50	2016451
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	7.1	2016451	10	2016483	9.4	1.0	2016451
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016451	<0.50	2016483	<0.50	0.50	2016451
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	48	2016451	89	2016483	88	5.0	2016451
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4027		GU4039		GU4040		
Date d'échantillonnage						2019/08/01		2019/08/01		2019/08/01		
# Bordereau						964628		964628		964628		
	Unités	A	B	C	D	TA-04-19;3	Lot CQ	TA-05-19; 2	Lot CQ	TA-06-19; 2	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	24	N/A	21	N/A	23	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016483	<2.0	2016451	<2.0	2.0	2016483
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	160	2016483	180	2016451	190	4.0	2016483
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	2016483	<0.10	2016451	<0.10	0.10	2016483
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	110	2016483	130	2016451	110	1.0	2016483
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	50	2016483	53	2016451	44	1.0	2016483
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	20	2016483	21	2016451	18	1.0	2016483
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016483	<1.0	2016451	<1.0	1.0	2016483
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	510	2016483	600	2016451	610	2.0	2016483
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	65	2016483	70	2016451	56	0.50	2016483
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	8.7	2016483	11	2016451	9.5	1.0	2016483
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	86	2016483	99	2016451	88	5.0	2016483
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4041		GU4042		GU4043		
Date d'échantillonnage						2019/07/31		2019/07/31		2019/08/01		
# Bordereau						964628		964628		964628		
	Unités	A	B	C	D	TA-07-19; 1	Lot CQ	TA-07-19; 3	Lot CQ	TA-08-19; 1	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	17	N/A	28	N/A	14	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016483	<2.0	2016451	<2.0	2.0	2016483
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	180	2016483	160	2016451	160	4.0	2016483
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	2016483	<0.10	2016451	<0.10	0.10	2016483
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	110	2016483	120	2016451	93	1.0	2016483
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	51	2016483	52	2016451	40	1.0	2016483
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	22	2016483	21	2016451	19	1.0	2016483
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016483	<1.0	2016451	<1.0	1.0	2016483
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	680	2016483	630	2016451	630	2.0	2016483
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	66	2016483	67	2016451	52	0.50	2016483
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	14	2016483	10	2016451	12	1.0	2016483
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	97	2016483	90	2016451	84	5.0	2016483
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4044	GU4045		GU4046		
Date d'échantillonnage						2019/08/01	2019/08/01		2019/08/01		
# Bordereau						964628	964628		964628		
	Unités	A	B	C	D	TA-08-19; 2	TA-09-19; 1	Lot CQ	TA-09-19; 2	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	21	16	N/A	22	N/A	N/A
MÉTAUX											
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	<0.50	2016483	<0.50	0.50	2016451
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	<2.0	2016483	2.1	2.0	2016451
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	170	140	2016483	190	4.0	2016451
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	<0.10	2016483	<0.10	0.10	2016451
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	120	81	2016483	120	1.0	2016451
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	52	28	2016483	52	1.0	2016451
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	19	16	2016483	21	1.0	2016451
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	<1.0	2016483	<1.0	1.0	2016451
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	520	460	2016483	550	2.0	2016451
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	<0.50	2016483	<0.50	0.50	2016451
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	64	44	2016483	66	0.50	2016451
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	11	14	2016483	11	1.0	2016451
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	<0.50	2016483	<0.50	0.50	2016451
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	91	76	2016483	96	5.0	2016451
LDR = Limite de détection rapportée											
Lot CQ = Lot contrôle qualité											
N/A = Non Applicable											



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4047		GU4048		GU4049		
Date d'échantillonnage						2019/08/01		2019/08/01		2019/07/31		
# Bordereau						964629		964629		964629		
	Unités	A	B	C	D	TA-10-19; 1	Lot CQ	TA-10-19; 2	Lot CQ	EMP1; E-1	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	15	N/A	23	N/A	11	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016483	<2.0	2016451	<2.0	2.0	2016483
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	110	2016483	190	2016451	82	4.0	2016483
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	0.12	2016483	<0.10	2016451	<0.10	0.10	2016483
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	73	2016483	120	2016451	39	1.0	2016483
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	21	2016483	47	2016451	17	1.0	2016483
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	14	2016483	22	2016451	8.7	1.0	2016483
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016483	<1.0	2016451	<1.0	1.0	2016483
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	460	2016483	580	2016451	330	2.0	2016483
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	38	2016483	61	2016451	23	0.50	2016483
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	12	2016483	10	2016451	8.5	1.0	2016483
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	73	2016483	93	2016451	48	5.0	2016483
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4050		GU4051		GU4052		
Date d'échantillonnage						2019/07/31		2019/07/31		2019/07/31		
# Bordereau						964629		964629		964629		
	Unités	A	B	C	D	EMP1; E-2	Lot CQ	EMP1; E-3	Lot CQ	EMP1; E-4	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	12	N/A	20	N/A	8.1	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016451	<0.50	2016483	<0.50	0.50	2016451
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016451	<2.0	2016483	<2.0	2.0	2016451
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	120	2016451	110	2016483	100	4.0	2016451
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	2016451	<0.10	2016483	<0.10	0.10	2016451
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	61	2016451	63	2016483	36	1.0	2016451
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	27	2016451	29	2016483	16	1.0	2016451
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	13	2016451	13	2016483	8.6	1.0	2016451
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016451	<1.0	2016483	<1.0	1.0	2016451
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	490	2016451	470	2016483	530	2.0	2016451
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016451	<0.50	2016483	0.56	0.50	2016451
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	36	2016451	37	2016483	22	0.50	2016451
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	9.8	2016451	9.2	2016483	11	1.0	2016451
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016451	<0.50	2016483	<0.50	0.50	2016451
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	65	2016451	68	2016483	57	5.0	2016451
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4053		GU4054	GU4056		
Date d'échantillonnage						2019/07/31		2019/07/31	2019/07/31		
# Bordereau						964629		964629	964629		
	Unités	A	B	C	D	EMP1; E-5	Lot CQ	EMP1; E-6	EMP1; E-8	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	19	N/A	18	13	N/A	N/A
MÉTAUX											
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016483	<0.50	<0.50	0.50	2016451
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016483	<2.0	<2.0	2.0	2016451
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	190	2016483	150	130	4.0	2016451
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	2016483	<0.10	<0.10	0.10	2016451
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	100	2016483	82	74	1.0	2016451
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	47	2016483	38	34	1.0	2016451
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	20	2016483	18	14	1.0	2016451
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016483	<1.0	<1.0	1.0	2016451
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	680	2016483	810	530	2.0	2016451
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016483	<0.50	<0.50	0.50	2016451
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	60	2016483	49	43	0.50	2016451
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	10	2016483	10	10	1.0	2016451
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016483	<0.50	<0.50	0.50	2016451
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	85	2016483	83	80	5.0	2016451
LDR = Limite de détection rapportée											
Lot CQ = Lot contrôle qualité											
N/A = Non Applicable											



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4057		GU4058		GU4059		
Date d'échantillonnage						2019/07/31		2019/07/31		2019/07/31		
# Bordereau						964630		964630		964630		
	Unités	A	B	C	D	EMP1; E-9	Lot CQ	EMP1; E-10	Lot CQ	EMP1; E-11	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	14	N/A	16	N/A	13	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016483	<2.0	2016451	2.2	2.0	2016483
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	120	2016483	160	2016451	130	4.0	2016483
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	2016483	<0.10	2016451	<0.10	0.10	2016483
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	58	2016483	94	2016451	72	1.0	2016483
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	27	2016483	40	2016451	32	1.0	2016483
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	12	2016483	20	2016451	14	1.0	2016483
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016483	<1.0	2016451	<1.0	1.0	2016483
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	510	2016483	760	2016451	490	2.0	2016483
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	34	2016483	54	2016451	41	0.50	2016483
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	11	2016483	12	2016451	12	1.0	2016483
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	74	2016483	86	2016451	76	5.0	2016483
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4060		GU4061		GU4062		
Date d'échantillonnage						2019/07/31		2019/07/31		2019/07/31		
# Bordereau						964630		964630		964630		
	Unités	A	B	C	D	EMP1; E-12	Lot CQ	EMP1; E-13	Lot CQ	EMP1; E-14	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	18	N/A	19	N/A	15	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016451	<0.50	2016483	<0.50	0.50	2016451
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016451	<2.0	2016483	<2.0	2.0	2016451
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	150	2016451	140	2016483	140	4.0	2016451
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	2016451	<0.10	2016483	<0.10	0.10	2016451
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	98	2016451	69	2016483	95	1.0	2016451
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	44	2016451	32	2016483	43	1.0	2016451
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	16	2016451	15	2016483	18	1.0	2016451
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016451	<1.0	2016483	<1.0	1.0	2016451
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	510	2016451	600	2016483	580	2.0	2016451
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016451	<0.50	2016483	<0.50	0.50	2016451
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	55	2016451	42	2016483	57	0.50	2016451
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	10	2016451	12	2016483	9.7	1.0	2016451
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016451	<0.50	2016483	<0.50	0.50	2016451
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	81	2016451	74	2016483	80	5.0	2016451
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4063		GU4064		GU4065		
Date d'échantillonnage						2019/07/29		2019/07/31		2019/07/31		
# Bordereau						964630		964630		964630		
	Unités	A	B	C	D	EMP1; E-15	Lot CQ	EMP1; E-16	Lot CQ	EMP1; E-17	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	15	N/A	12	N/A	16	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016483	<2.0	2016451	<2.0	2.0	2016483
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	130	2016483	130	2016451	150	4.0	2016483
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	2016483	<0.10	2016451	<0.10	0.10	2016483
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	65	2016483	68	2016451	81	1.0	2016483
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	29	2016483	28	2016451	36	1.0	2016483
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	13	2016483	16	2016451	16	1.0	2016483
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016483	<1.0	2016451	<1.0	1.0	2016483
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	590	2016483	750	2016451	630	2.0	2016483
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016483	0.51	2016451	<0.50	0.50	2016483
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	38	2016483	38	2016451	47	0.50	2016483
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	9.8	2016483	12	2016451	12	1.0	2016483
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016483
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	73	2016483	80	2016451	83	5.0	2016483
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
N/A = Non Applicable												



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4065		GU4066		GU4067		
Date d'échantillonnage						2019/07/31		2019/07/31		2019/07/31		
# Bordereau						964630		964630		964631		
	Unités	A	B	C	D	EMP1; E-17 Dup. de Lab.	Lot CQ	EMP1; E-18	Lot CQ	EMP1; E-19	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	16	N/A	19	N/A	15	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016494
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	2016483	<2.0	2016451	<2.0	2.0	2016494
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	150	2016483	150	2016451	150	4.0	2016494
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	2016483	<0.10	2016451	<0.10	0.10	2016494
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	83	2016483	85	2016451	88	1.0	2016494
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	36	2016483	40	2016451	41	1.0	2016494
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	16	2016483	17	2016451	18	1.0	2016494
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	2016483	<1.0	2016451	<1.0	1.0	2016494
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	610	2016483	600	2016451	590	2.0	2016494
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016494
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	48	2016483	52	2016451	51	0.50	2016494
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	12	2016483	10	2016451	13	1.0	2016494
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	2016483	<0.50	2016451	<0.50	0.50	2016494
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	82	2016483	77	2016451	80	5.0	2016494
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
Duplicata de laboratoire												
N/A = Non Applicable												



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4068	GU4069	GU4069		GU4070		
Date d'échantillonnage						2019/07/31	2019/07/29	2019/07/29		2019/07/31		
# Bordereau						964631	964631	964631		964631		
	Unités	A	B	C	D	EMP1; E-20	DUP-2	DUP-2 Dup. de Lab.	Lot CQ	DUP-11	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	22	23	23	N/A	15	N/A	N/A
MÉTAUX												
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	<0.50	<0.50	2016451	<0.50	0.50	2016494
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	<2.0	<2.0	2016451	<2.0	2.0	2016494
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	130	150	150	2016451	160	4.0	2016494
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	<0.10	<0.10	<0.10	2016451	<0.10	0.10	2016494
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	78	110	100	2016451	81	1.0	2016494
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	35	50	47	2016451	36	1.0	2016494
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	15	22	19	2016451	14	1.0	2016494
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	<1.0	<1.0	2016451	<1.0	1.0	2016494
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	520	690	600	2016451	510	2.0	2016494
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	<0.50	<0.50	2016451	<0.50	0.50	2016494
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	46	66	62	2016451	47	0.50	2016494
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	10	9.8	9.1	2016451	11	1.0	2016494
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	<0.50	<0.50	2016451	<0.50	0.50	2016494
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	71	86	82	2016451	82	5.0	2016494
LDR = Limite de détection rapportée												
Lot CQ = Lot contrôle qualité												
Duplicata de laboratoire												
N/A = Non Applicable												

MÉTAUX EXTRACTIBLES TOTAUX (SOL)

ID Lab BV						GU4071	GU4072		
Date d'échantillonnage						2019/08/01	2019/08/01		
# Bordereau						964631	964631		
	Unités	A	B	C	D	DUP-13	DUP-14	LDR	Lot CQ
% HUMIDITÉ	%	-	-	-	-	15	22	N/A	N/A
MÉTAUX									
Argent (Ag)	mg/kg	2	20	40	<u>200</u>	<0.50	<0.50	0.50	2016494
Arsenic (As)	mg/kg	6	30	50	<u>250</u>	<2.0	<2.0	2.0	2016494
Baryum (Ba)	mg/kg	340	500	2000	<u>10000</u>	100	200	4.0	2016494
Cadmium (Cd)	mg/kg	1.5	5	20	<u>100</u>	0.17	0.12	0.10	2016494
Chrome (Cr)	mg/kg	100	250	800	<u>4000</u>	68	130	1.0	2016494
Cuivre (Cu)	mg/kg	50	100	500	<u>2500</u>	20	49	1.0	2016494
Cobalt (Co)	mg/kg	25	50	300	<u>1500</u>	13	25	1.0	2016494
Etain (Sn)	mg/kg	5	50	300	<u>1500</u>	<1.0	<1.0	1.0	2016494
Manganèse (Mn)	mg/kg	1000	1000	2200	<u>11000</u>	420	610	2.0	2016494
Molybdène (Mo)	mg/kg	2	10	40	<u>200</u>	<0.50	<0.50	0.50	2016494
Nickel (Ni)	mg/kg	50	100	500	<u>2500</u>	35	64	0.50	2016494
Plomb (Pb)	mg/kg	50	500	1000	<u>5000</u>	12	11	1.0	2016494
Sélénium (Se)	mg/kg	1	3	10	<u>50</u>	<0.50	<0.50	0.50	2016494
Zinc (Zn)	mg/kg	140	500	1500	<u>7500</u>	70	97	5.0	2016494
LDR = Limite de détection rapportée									
Lot CQ = Lot contrôle qualité									
N/A = Non Applicable									



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01

Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

REMARQUES GÉNÉRALES

A,B,C,D: Les critères des sols proviennent de l'Annexe 2 du « Guide d'intervention-Protection des sols et réhabilitation des terrains contaminés. MELCC, 2019. » et intitulé « Grille des critères génériques pour les sols ». Les critères des sols sont ceux de la province géologique des Basses-Terres du Saint-Laurent. Le critère D provient de l'Annexe I du « Règlement sur l'enfouissement des sols contaminés, c. Q-2, r.18 ».

Les critères A et B pour l'eau souterraine proviennent de l'annexe 7 intitulé « Grille des critères de qualité des eaux souterraines » du guide d'intervention mentionné plus haut. A=Eau de consommation; B=Résurgence dans l'eau de surface

Ces références ne sont rapportées qu'à titre indicatif et ne doivent être interprétées dans aucun autre contexte.

- = Ce composé ne fait pas partie de la réglementation.

HAP PAR GCMS (SOL)

Les résultats bruts non-arrondis sont utilisés dans le calcul du benzo(b+j+k)fluoranthène. Ce résultat total est alors arrondi à deux chiffres significatifs.

Les résultats ne se rapportent qu'aux échantillons soumis pour analyse

RAPPORT ASSURANCE QUALITÉ

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
2016451	KK	Blanc fortifié	Argent (Ag)	2019/08/10		97	%
			Arsenic (As)	2019/08/10		96	%
			Baryum (Ba)	2019/08/10		97	%
			Cadmium (Cd)	2019/08/10		101	%
			Chrome (Cr)	2019/08/10		104	%
			Cuivre (Cu)	2019/08/10		105	%
			Cobalt (Co)	2019/08/10		103	%
			Etain (Sn)	2019/08/10		98	%
			Manganèse (Mn)	2019/08/10		104	%
			Molybdène (Mo)	2019/08/10		102	%
			Nickel (Ni)	2019/08/10		105	%
			Plomb (Pb)	2019/08/10		108	%
			Sélénium (Se)	2019/08/10		104	%
			Zinc (Zn)	2019/08/10		100	%
2016451	KK	Blanc de méthode	Argent (Ag)	2019/08/10	<0.50		mg/kg
			Arsenic (As)	2019/08/10	<2.0		mg/kg
			Baryum (Ba)	2019/08/10	<4.0		mg/kg
			Cadmium (Cd)	2019/08/10	<0.10		mg/kg
			Chrome (Cr)	2019/08/10	<1.0		mg/kg
			Cuivre (Cu)	2019/08/10	<1.0		mg/kg
			Cobalt (Co)	2019/08/10	<1.0		mg/kg
			Etain (Sn)	2019/08/10	<1.0		mg/kg
			Manganèse (Mn)	2019/08/10	<2.0		mg/kg
			Molybdène (Mo)	2019/08/10	<0.50		mg/kg
			Nickel (Ni)	2019/08/10	<0.50		mg/kg
			Plomb (Pb)	2019/08/10	<1.0		mg/kg
			Sélénium (Se)	2019/08/10	<0.50		mg/kg
			Zinc (Zn)	2019/08/10	<5.0		mg/kg
2016483	KK	Blanc fortifié	Argent (Ag)	2019/08/10		88	%
			Arsenic (As)	2019/08/10		91	%
			Baryum (Ba)	2019/08/10		90	%
			Cadmium (Cd)	2019/08/10		94	%
			Chrome (Cr)	2019/08/10		96	%
			Cuivre (Cu)	2019/08/10		98	%
			Cobalt (Co)	2019/08/10		96	%
			Etain (Sn)	2019/08/10		91	%
			Manganèse (Mn)	2019/08/10		95	%
			Molybdène (Mo)	2019/08/10		94	%
			Nickel (Ni)	2019/08/10		97	%
			Plomb (Pb)	2019/08/10		99	%
			Sélénium (Se)	2019/08/10		94	%
			Zinc (Zn)	2019/08/10		95	%
2016483	KK	Blanc de méthode	Argent (Ag)	2019/08/10	<0.50		mg/kg
			Arsenic (As)	2019/08/10	<2.0		mg/kg
			Baryum (Ba)	2019/08/10	<4.0		mg/kg
			Cadmium (Cd)	2019/08/10	<0.10		mg/kg
			Chrome (Cr)	2019/08/10	<1.0		mg/kg
			Cuivre (Cu)	2019/08/10	<1.0		mg/kg
			Cobalt (Co)	2019/08/10	<1.0		mg/kg
			Etain (Sn)	2019/08/10	<1.0		mg/kg

RAPPORT ASSURANCE QUALITÉ (SUITE)

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
2016494	KK	Blanc fortifié	Manganèse (Mn)	2019/08/10	<2.0		mg/kg
			Molybdène (Mo)	2019/08/10	<0.50		mg/kg
			Nickel (Ni)	2019/08/10	<0.50		mg/kg
			Plomb (Pb)	2019/08/10	<1.0		mg/kg
			Sélénium (Se)	2019/08/10	<0.50		mg/kg
			Zinc (Zn)	2019/08/10	<5.0		mg/kg
			Argent (Ag)	2019/08/10		96	%
			Arsenic (As)	2019/08/10		98	%
			Baryum (Ba)	2019/08/10		95	%
			Cadmium (Cd)	2019/08/10		102	%
			Chrome (Cr)	2019/08/10		105	%
			Cuivre (Cu)	2019/08/10		105	%
			Cobalt (Co)	2019/08/10		104	%
			Etain (Sn)	2019/08/10		97	%
			Manganèse (Mn)	2019/08/10		102	%
			Molybdène (Mo)	2019/08/10		102	%
			Nickel (Ni)	2019/08/10		105	%
			Plomb (Pb)	2019/08/10		106	%
			Sélénium (Se)	2019/08/10		101	%
			Zinc (Zn)	2019/08/10		101	%
2016494	KK	Blanc de méthode	Argent (Ag)	2019/08/10	<0.50		mg/kg
			Arsenic (As)	2019/08/10	<2.0		mg/kg
			Baryum (Ba)	2019/08/10	<4.0		mg/kg
			Cadmium (Cd)	2019/08/10	<0.10		mg/kg
			Chrome (Cr)	2019/08/10	<1.0		mg/kg
			Cuivre (Cu)	2019/08/10	<1.0		mg/kg
			Cobalt (Co)	2019/08/10	<1.0		mg/kg
			Etain (Sn)	2019/08/10	<1.0		mg/kg
			Manganèse (Mn)	2019/08/10	<2.0		mg/kg
			Molybdène (Mo)	2019/08/10	<0.50		mg/kg
			Nickel (Ni)	2019/08/10	<0.50		mg/kg
			Plomb (Pb)	2019/08/10	<1.0		mg/kg
			Sélénium (Se)	2019/08/10	<0.50		mg/kg
			Zinc (Zn)	2019/08/10	<5.0		mg/kg
2017100	MG4	Blanc fortifié	1-Chlorooctadécane	2019/08/12		88	%
			Hydrocarbures pétroliers (C10-C50)	2019/08/12		85	%
2017100	MG4	Blanc de méthode	1-Chlorooctadécane	2019/08/12		89	%
			Hydrocarbures pétroliers (C10-C50)	2019/08/12	<100		mg/kg
2017125	JPT	Blanc fortifié	D10-Anthracène	2019/08/12		84	%
			D12-Benzo(a)pyrène	2019/08/12		82	%
			D14-Terphenyl	2019/08/12		78	%
			D8-Acenaphthylene	2019/08/12		72	%
			D8-Naphtalène	2019/08/12		84	%
			Acénaphène	2019/08/12		100	%
			Acénaphthylène	2019/08/12		94	%
			Anthracène	2019/08/12		99	%
			Benzo(a)anthracène	2019/08/12		101	%
			Benzo(a)pyrène	2019/08/12		96	%
			Benzo(b)fluoranthène	2019/08/12		105	%
			Benzo(j)fluoranthène	2019/08/12		95	%

RAPPORT ASSURANCE QUALITÉ (SUITE)

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
2017125	JPT	Blanc de méthode	Benzo(k)fluoranthène	2019/08/12		95	%
			Benzo(b+j+k)fluoranthène	2019/08/12		98	%
			Benzo(c)phénanthrène	2019/08/12		97	%
			Benzo(ghi)pérylène	2019/08/12		99	%
			Chrysène	2019/08/12		98	%
			Dibenzo(a,h)anthracène	2019/08/12		101	%
			Dibenzo(a,i)pyrène	2019/08/12		95	%
			Dibenzo(a,h)pyrène	2019/08/12		82	%
			Dibenzo(a,l)pyrène	2019/08/12		95	%
			7,12-Diméthylbenzanthracène	2019/08/12		84	%
			Fluoranthène	2019/08/12		99	%
			Fluorène	2019/08/12		98	%
			Indéno(1,2,3-cd)pyrène	2019/08/12		95	%
			3-Méthylcholanthrène	2019/08/12		94	%
			Naphtalène	2019/08/12		99	%
			Phénanthrène	2019/08/12		100	%
			Pyrène	2019/08/12		98	%
			2-Méthylnaphtalène	2019/08/12		73	%
			1-Méthylnaphtalène	2019/08/12		91	%
			1,3-Diméthylnaphtalène	2019/08/12		90	%
			2,3,5-Triméthylnaphtalène	2019/08/12		94	%
			D10-Anthracène	2019/08/12		84	%
			D12-Benzo(a)pyrène	2019/08/12		80	%
			D14-Terphenyl	2019/08/12		76	%
			D8-Acenaphthylene	2019/08/12		70	%
			D8-Naphtalène	2019/08/12		82	%
			Acénaphène	2019/08/12	<0.10		mg/kg
			Acénaphthylène	2019/08/12	<0.10		mg/kg
			Anthracène	2019/08/12	<0.10		mg/kg
			Benzo(a)anthracène	2019/08/12	<0.050		mg/kg
			Benzo(a)pyrène	2019/08/12	<0.050		mg/kg
			Benzo(b)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(j)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(k)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(b+j+k)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(c)phénanthrène	2019/08/12	<0.10		mg/kg
			Benzo(ghi)pérylène	2019/08/12	<0.050		mg/kg
			Chrysène	2019/08/12	<0.050		mg/kg
			Dibenzo(a,h)anthracène	2019/08/12	<0.050		mg/kg
			Dibenzo(a,i)pyrène	2019/08/12	<0.10		mg/kg
			Dibenzo(a,h)pyrène	2019/08/12	<0.10		mg/kg
			Dibenzo(a,l)pyrène	2019/08/12	<0.10		mg/kg
			7,12-Diméthylbenzanthracène	2019/08/12	<0.10		mg/kg
			Fluoranthène	2019/08/12	<0.10		mg/kg
			Fluorène	2019/08/12	<0.10		mg/kg
			Indéno(1,2,3-cd)pyrène	2019/08/12	<0.050		mg/kg
			3-Méthylcholanthrène	2019/08/12	<0.10		mg/kg
			Naphtalène	2019/08/12	<0.010		mg/kg
			Phénanthrène	2019/08/12	<0.040		mg/kg
			Pyrène	2019/08/12	<0.10		mg/kg



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

RAPPORT ASSURANCE QUALITÉ (SUITE)

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
2017338	MG4	Blanc fortifié	2-MéthylNaphtalène	2019/08/12	<0.10		mg/kg
			1-MéthylNaphtalène	2019/08/12	<0.10		mg/kg
			1,3-DiméthylNaphtalène	2019/08/12	<0.10		mg/kg
			2,3,5-TriméthylNaphtalène	2019/08/12	<0.10		mg/kg
			1-Chlorooctadécane	2019/08/12		97	%
2017338	MG4	Blanc de méthode	Hydrocarbures pétroliers (C10-C50)	2019/08/12		84	%
			1-Chlorooctadécane	2019/08/12		95	%
2017339	FFE	Blanc fortifié	Hydrocarbures pétroliers (C10-C50)	2019/08/12	<100		mg/kg
			D10-Anthracène	2019/08/12		94	%
			D12-Benzo(a)pyrène	2019/08/12		94	%
			D14-Terphenyl	2019/08/12		96	%
			D8-Acenaphthylene	2019/08/12		90	%
			D8-Naphtalène	2019/08/12		96	%
			Acénaphène	2019/08/12		84	%
			Acénaphthylène	2019/08/12		106	%
			Anthracène	2019/08/12		103	%
			Benzo(a)anthracène	2019/08/12		96	%
			Benzo(a)pyrène	2019/08/12		93	%
			Benzo(b)fluoranthène	2019/08/12		78	%
			Benzo(j)fluoranthène	2019/08/12		100	%
			Benzo(k)fluoranthène	2019/08/12		91	%
			Benzo(b+j+k)fluoranthène	2019/08/12		90	%
			Benzo(c)phénanthrène	2019/08/12		93	%
			Benzo(ghi)pérylène	2019/08/12		91	%
			Chrysène	2019/08/12		92	%
			Dibenzo(a,h)anthracène	2019/08/12		93	%
			Dibenzo(a,i)pyrène	2019/08/12		92	%
			Dibenzo(a,h)pyrène	2019/08/12		96	%
			Dibenzo(a,l)pyrène	2019/08/12		109	%
			7,12-Diméthylbenzanthracène	2019/08/12		72	%
			Fluoranthène	2019/08/12		94	%
			Fluorène	2019/08/12		96	%
			Indéno(1,2,3-cd)pyrène	2019/08/12		99	%
			3-Méthylcholanthrène	2019/08/12		81	%
			Naphtalène	2019/08/12		95	%
			Phénanthrène	2019/08/12		78	%
			Pyrène	2019/08/12		94	%
			2-MéthylNaphtalène	2019/08/12		74	%
			1-MéthylNaphtalène	2019/08/12		97	%
			1,3-DiméthylNaphtalène	2019/08/12		87	%
			2,3,5-TriméthylNaphtalène	2019/08/12		92	%
			D10-Anthracène	2019/08/12		94	%
			D12-Benzo(a)pyrène	2019/08/12		92	%
			D14-Terphenyl	2019/08/12		96	%
			D8-Acenaphthylene	2019/08/12		90	%
			D8-Naphtalène	2019/08/12		96	%
			Acénaphène	2019/08/12	<0.10		mg/kg
			Acénaphthylène	2019/08/12	<0.10		mg/kg
			Anthracène	2019/08/12	<0.10		mg/kg
			Benzo(a)anthracène	2019/08/12	<0.050		mg/kg

RAPPORT ASSURANCE QUALITÉ (SUITE)

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
			Benzo(a)pyrène	2019/08/12	<0.050		mg/kg
			Benzo(b)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(j)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(k)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(b+j+k)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(c)phénanthrène	2019/08/12	<0.10		mg/kg
			Benzo(ghi)pérylène	2019/08/12	<0.050		mg/kg
			Chrysène	2019/08/12	<0.050		mg/kg
			Dibenzo(a,h)anthracène	2019/08/12	<0.050		mg/kg
			Dibenzo(a,i)pyrène	2019/08/12	<0.10		mg/kg
			Dibenzo(a,h)pyrène	2019/08/12	<0.10		mg/kg
			Dibenzo(a,l)pyrène	2019/08/12	<0.10		mg/kg
			7,12-Diméthylbenzanthrène	2019/08/12	<0.10		mg/kg
			Fluoranthène	2019/08/12	<0.10		mg/kg
			Fluorène	2019/08/12	<0.10		mg/kg
			Indéno(1,2,3-cd)pyrène	2019/08/12	<0.050		mg/kg
			3-Méthylcholanthrène	2019/08/12	<0.10		mg/kg
			Naphtalène	2019/08/12	<0.010		mg/kg
			Phénanthrène	2019/08/12	<0.040		mg/kg
			Pyrène	2019/08/12	<0.10		mg/kg
			2-Méthylnaphtalène	2019/08/12	<0.10		mg/kg
			1-Méthylnaphtalène	2019/08/12	<0.10		mg/kg
			1,3-Diméthylnaphtalène	2019/08/12	<0.10		mg/kg
			2,3,5-Triméthylnaphtalène	2019/08/12	<0.10		mg/kg
2017346	MG4	Blanc fortifié	1-Chlorooctadécane	2019/08/12		93	%
			Hydrocarbures pétroliers (C10-C50)	2019/08/12		85	%
2017346	MG4	Blanc de méthode	1-Chlorooctadécane	2019/08/12		92	%
			Hydrocarbures pétroliers (C10-C50)	2019/08/12	<100		mg/kg
2017347	FFE	Blanc fortifié	D10-Anthrène	2019/08/12		90	%
			D12-Benzo(a)pyrène	2019/08/12		88	%
			D14-Terphenyl	2019/08/12		76	%
			D8-Acenaphthylene	2019/08/12		82	%
			D8-Naphtalène	2019/08/12		82	%
			Acénaphène	2019/08/12		109	%
			Acénaphthylène	2019/08/12		109	%
			Anthracène	2019/08/12		113	%
			Benzo(a)anthracène	2019/08/12		106	%
			Benzo(a)pyrène	2019/08/12		95	%
			Benzo(b)fluoranthène	2019/08/12		97	%
			Benzo(j)fluoranthène	2019/08/12		98	%
			Benzo(k)fluoranthène	2019/08/12		107	%
			Benzo(b+j+k)fluoranthène	2019/08/12		100	%
			Benzo(c)phénanthrène	2019/08/12		100	%
			Benzo(ghi)pérylène	2019/08/12		97	%
			Chrysène	2019/08/12		103	%
			Dibenzo(a,h)anthracène	2019/08/12		102	%
			Dibenzo(a,i)pyrène	2019/08/12		97	%
			Dibenzo(a,h)pyrène	2019/08/12		87	%
			Dibenzo(a,l)pyrène	2019/08/12		94	%
			7,12-Diméthylbenzanthrène	2019/08/12		75	%



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

RAPPORT ASSURANCE QUALITÉ (SUITE)

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
2017347	FFE	Blanc de méthode	Fluoranthène	2019/08/12		106	%
			Fluorène	2019/08/12		111	%
			Indéno(1,2,3-cd)pyrène	2019/08/12		105	%
			3-Méthylcholanthrène	2019/08/12		92	%
			Naphtalène	2019/08/12		99	%
			Phénanthrène	2019/08/12		108	%
			Pyrène	2019/08/12		104	%
			2-Méthylnaphtalène	2019/08/12		76	%
			1-Méthylnaphtalène	2019/08/12		96	%
			1,3-Diméthylnaphtalène	2019/08/12		101	%
			2,3,5-Triméthylnaphtalène	2019/08/12		100	%
			D10-Anthracène	2019/08/12		94	%
			D12-Benzo(a)pyrène	2019/08/12		90	%
			D14-Terphenyl	2019/08/12		80	%
			D8-Acenaphthylene	2019/08/12		82	%
			D8-Naphtalène	2019/08/12		82	%
			Acénaphène	2019/08/12	<0.10		mg/kg
			Acénaphthylène	2019/08/12	<0.10		mg/kg
			Anthracène	2019/08/12	<0.10		mg/kg
			Benzo(a)anthracène	2019/08/12	<0.050		mg/kg
			Benzo(a)pyrène	2019/08/12	<0.050		mg/kg
			Benzo(b)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(j)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(k)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(b+j+k)fluoranthène	2019/08/12	<0.050		mg/kg
			Benzo(c)phénanthrène	2019/08/12	<0.10		mg/kg
			Benzo(ghi)pérylène	2019/08/12	<0.050		mg/kg
			Chrysène	2019/08/12	<0.050		mg/kg
			Dibenzo(a,h)anthracène	2019/08/12	<0.050		mg/kg
			Dibenzo(a,i)pyrène	2019/08/12	<0.10		mg/kg
			Dibenzo(a,h)pyrène	2019/08/12	<0.10		mg/kg
			Dibenzo(a,l)pyrène	2019/08/12	<0.10		mg/kg
			7,12-Diméthylbenzanthracène	2019/08/12	<0.10		mg/kg
			Fluoranthène	2019/08/12	<0.10		mg/kg
			Fluorène	2019/08/12	<0.10		mg/kg
			Indéno(1,2,3-cd)pyrène	2019/08/12	<0.050		mg/kg
			3-Méthylcholanthrène	2019/08/12	<0.10		mg/kg
			Naphtalène	2019/08/12	<0.010		mg/kg
			Phénanthrène	2019/08/12	<0.040		mg/kg
			Pyrène	2019/08/12	<0.10		mg/kg
			2-Méthylnaphtalène	2019/08/12	<0.10		mg/kg
			1-Méthylnaphtalène	2019/08/12	<0.10		mg/kg
			1,3-Diméthylnaphtalène	2019/08/12	<0.10		mg/kg



Dossier Lab BV: B935656
Date du rapport: 2019/08/13

Englobe Corp.
Votre # du projet: P-0019200-0-01
Adresse du site: RIGAUD
Votre # de commande: F04842
Initiales du préleveur: LB

RAPPORT ASSURANCE QUALITÉ (SUITE)

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
			2,3,5-Triméthylnaphtalène	2019/08/12	<0.10		mg/kg
<p>Blanc fortifié: Un blanc, d'une matrice exempte de contaminants, auquel a été ajouté une quantité connue d'analyte provenant généralement d'une deuxième source. Utilisé pour évaluer la précision de la méthode.</p> <p>Blanc de méthode: Une partie aliquote de matrice pure soumise au même processus analytique que les échantillons, du prétraitement au dosage. Sert à évaluer toutes contaminations du laboratoire.</p> <p>Surrogate: Composé se comportant de façon similaire aux composés analysés et ajouté à l'échantillon avant l'analyse. Sert à évaluer la qualité de l'extraction.</p> <p>Réc = Récupération</p>							



BUREAU
VERITAS

Dossier Lab BV: B935656

Date du rapport: 2019/08/13

Englobe Corp.

Votre # du projet: P-0019200-0-01


Adresse du site: RIGAUD

Votre # de commande: F04842

Initiales du préleveur: LB

PAGE DES SIGNATURES DE VALIDATION

Les résultats analytiques ainsi que les données de contrôle-qualité contenus dans ce rapport furent vérifiés et validés par les personnes suivantes:



Abdeslam Siaida, B.Sc. Chimiste, Analyste II



Frédéric Arnau, B.Sc., Chimiste, Spécialiste Scientifique



Jean-Frédéric Lamy, B.Sc., Chimiste, Spécialiste Scientifique



Ramona Dascal, Chargée de projet

Lab BV a mis en place des procédures qui protègent contre l'utilisation non autorisée de la signature électronique et emploie les «signataires» requis, conformément à l'ISO/CEI 17025. Veuillez vous référer à la page des signatures de validation pour obtenir les détails des validations pour chaque division.



Your P.O. #: F04842
Your Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your C.O.C. #: B935656-NONT-01-01

Attention: Rodrigo Caffarengo

Bureau Veritas Laboratories
889 Montée de Liesse
Ville St-Laurent, QC
CANADA H4T 1P5

Report Date: 2019/08/12
Report #: R5835569
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9L8936

Received: 2019/08/08, 08:39

Sample Matrix: Soil
Samples Received: 20

Analyses	Date		Date Analyzed	Laboratory Method	Reference
	Quantity	Extracted			
Petroleum Hydro. CCME F1 & BTEX in Soil (1)	20	N/A	2019/08/09	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Soil (2)	20	2019/08/09	2019/08/12	CAM SOP-00316	CCME CWS m
Moisture	20	N/A	2019/08/09	CAM SOP-00445	Carter 2nd ed 51.2 m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) No lab extraction date is given for F1BTEX & VOC samples that are field preserved with methanol. Extraction date is the date sampled unless otherwise stated.

(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following "Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003". Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.



Your P.O. #: F04842
Your Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your C.O.C. #: B935656-NONT-01-01

Attention: Rodrigo Caffarengo

Bureau Veritas Laboratories
889 Montée de Liesse
Ville St-Laurent, QC
CANADA H4T 1P5

Report Date: 2019/08/12
Report #: R5835569
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9L8936

Received: 2019/08/08, 08:39

Encryption Key



**AUTHORIZED REPORT
RAPPORT AUTORISÉ**

Bureau Veritas Laboratories

12 Aug 2019 16:07:45

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Sara Singh, B.Sc, Senior Project Manager

Email: Sara.Singh@bvlabs.com

Phone# (905)817-5827

=====

This report has been generated and distributed using a secure automated process.

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV194		
Sampling Date		2019/07/29		
COC Number		B935656-NONT-01-01		
	UNITS	GU4014-TF-01-19; CF-01B	RDL	QC Batch
Inorganics				
Moisture	%	23	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.040	0.040	6271764
Toluene	ug/g	<0.040	0.040	6271764
Ethylbenzene	ug/g	<0.040	0.040	6271764
o-Xylene	ug/g	<0.040	0.040	6271764
p+m-Xylene	ug/g	<0.080	0.080	6271764
Total Xylenes	ug/g	<0.080	0.080	6271764
F1 (C6-C10)	ug/g	<20	20	6271764
F1 (C6-C10) - BTEX	ug/g	<20	20	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	99	N/A	6271764
4-Bromofluorobenzene	%	99	N/A	6271764
D10-Ethylbenzene	%	112	N/A	6271764
D4-1,2-Dichloroethane	%	100	N/A	6271764
o-Terphenyl	%	89	N/A	6271981
RDL = Reportable Detection Limit				
QC Batch = Quality Control Batch				
N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV194		
Sampling Date		2019/07/29		
COC Number		B935656-NONT-01-01		
	UNITS	GU4014-TF-01-19; CF-01B Lab-Dup	RDL	QC Batch
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
o-Terphenyl	%	96	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV195		
Sampling Date		2019/07/29		
COC Number		B935656-NONT-01-01		
	UNITS	GU4017-TF-01-19; CF-04	RDL	QC Batch
Inorganics				
Moisture	%	28	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	100	N/A	6271764
4-Bromofluorobenzene	%	99	N/A	6271764
D10-Ethylbenzene	%	107	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
o-Terphenyl	%	95	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV195		
Sampling Date		2019/07/29		
COC Number		B935656-NONT-01-01		
	UNITS	GU4017-TF-01-19; CF-04 Lab-Dup	RDL	QC Batch
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	100	N/A	6271764
4-Bromofluorobenzene	%	99	N/A	6271764
D10-Ethylbenzene	%	108	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV196		
Sampling Date		2019/08/01		
COC Number		B935656-NONT-01-01		
	UNITS	GU4023-TA-02-19;2	RDL	QC Batch
Inorganics				
Moisture	%	11	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	99	N/A	6271764
4-Bromofluorobenzene	%	98	N/A	6271764
D10-Ethylbenzene	%	98	N/A	6271764
D4-1,2-Dichloroethane	%	98	N/A	6271764
o-Terphenyl	%	96	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV197		
Sampling Date		2019/08/01		
COC Number		B935656-NONT-01-01		
	UNITS	GU4026-TA-03-19;2	RDL	QC Batch
Inorganics				
Moisture	%	22	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.040	0.040	6271764
Toluene	ug/g	<0.040	0.040	6271764
Ethylbenzene	ug/g	<0.040	0.040	6271764
o-Xylene	ug/g	<0.040	0.040	6271764
p+m-Xylene	ug/g	<0.080	0.080	6271764
Total Xylenes	ug/g	<0.080	0.080	6271764
F1 (C6-C10)	ug/g	<20	20	6271764
F1 (C6-C10) - BTEX	ug/g	<20	20	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	100	N/A	6271764
4-Bromofluorobenzene	%	98	N/A	6271764
D10-Ethylbenzene	%	108	N/A	6271764
D4-1,2-Dichloroethane	%	99	N/A	6271764
o-Terphenyl	%	109	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV198		
Sampling Date		2019/08/01		
COC Number		B935656-NONT-01-01		
	UNITS	GU4039-TA-05-19;2	RDL	QC Batch
Inorganics				
Moisture	%	21	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	101	N/A	6271764
4-Bromofluorobenzene	%	97	N/A	6271764
D10-Ethylbenzene	%	112	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
o-Terphenyl	%	96	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV199		
Sampling Date		2019/08/01		
COC Number		B935656-NONT-01-01		
	UNITS	GU4042-TA-07-19;3	RDL	QC Batch
Inorganics				
Moisture	%	29	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.040	0.040	6271764
Toluene	ug/g	<0.040	0.040	6271764
Ethylbenzene	ug/g	<0.040	0.040	6271764
o-Xylene	ug/g	<0.040	0.040	6271764
p+m-Xylene	ug/g	<0.080	0.080	6271764
Total Xylenes	ug/g	<0.080	0.080	6271764
F1 (C6-C10)	ug/g	<20	20	6271764
F1 (C6-C10) - BTEX	ug/g	<20	20	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	101	N/A	6271764
4-Bromofluorobenzene	%	99	N/A	6271764
D10-Ethylbenzene	%	102	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
o-Terphenyl	%	94	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV200		
Sampling Date		2019/08/01		
COC Number		B935656-NONT-01-01		
	UNITS	GU4046-TA-09-19;2	RDL	QC Batch
Inorganics				
Moisture	%	22	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	98	N/A	6271764
4-Bromofluorobenzene	%	99	N/A	6271764
D10-Ethylbenzene	%	105	N/A	6271764
D4-1,2-Dichloroethane	%	100	N/A	6271764
o-Terphenyl	%	96	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV201		
Sampling Date		2019/08/01		
COC Number		B935656-NONT-01-01		
	UNITS	GU4048-TA-10-19;2	RDL	QC Batch
Inorganics				
Moisture	%	23	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	99	N/A	6271764
4-Bromofluorobenzene	%	98	N/A	6271764
D10-Ethylbenzene	%	108	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
o-Terphenyl	%	101	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV202		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4050-EMP1;E-2	RDL	QC Batch
Inorganics				
Moisture	%	14	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	100	N/A	6271764
4-Bromofluorobenzene	%	98	N/A	6271764
D10-Ethylbenzene	%	111	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
o-Terphenyl	%	95	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV203		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4052-EMP1; E-4	RDL	QC Batch
Inorganics				
Moisture	%	8.0	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	101	N/A	6271764
4-Bromofluorobenzene	%	99	N/A	6271764
D10-Ethylbenzene	%	108	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
o-Terphenyl	%	106	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV204		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4054-EMP1;E-6	RDL	QC Batch
Inorganics				
Moisture	%	19	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	101	N/A	6271764
4-Bromofluorobenzene	%	97	N/A	6271764
D10-Ethylbenzene	%	115	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
o-Terphenyl	%	96	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV205		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4056-EMP1;E-8	RDL	QC Batch
Inorganics				
Moisture	%	15	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	100	N/A	6271764
4-Bromofluorobenzene	%	96	N/A	6271764
D10-Ethylbenzene	%	108	N/A	6271764
D4-1,2-Dichloroethane	%	100	N/A	6271764
o-Terphenyl	%	94	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV206		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4058-EMP1;E-10	RDL	QC Batch
Inorganics				
Moisture	%	17	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	98	N/A	6271764
4-Bromofluorobenzene	%	98	N/A	6271764
D10-Ethylbenzene	%	116	N/A	6271764
D4-1,2-Dichloroethane	%	99	N/A	6271764
o-Terphenyl	%	103	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV207		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4060-EMP1;E-12	RDL	QC Batch
Inorganics				
Moisture	%	19	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	99	N/A	6271764
4-Bromofluorobenzene	%	97	N/A	6271764
D10-Ethylbenzene	%	106	N/A	6271764
D4-1,2-Dichloroethane	%	99	N/A	6271764
o-Terphenyl	%	95	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV208		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4062-EMP1;E-14	RDL	QC Batch
Inorganics				
Moisture	%	17	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	99	N/A	6271764
4-Bromofluorobenzene	%	98	N/A	6271764
D10-Ethylbenzene	%	106	N/A	6271764
D4-1,2-Dichloroethane	%	100	N/A	6271764
o-Terphenyl	%	99	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV209		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4064-EMP1;E-16	RDL	QC Batch
Inorganics				
Moisture	%	13	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	101	N/A	6271764
4-Bromofluorobenzene	%	100	N/A	6271764
D10-Ethylbenzene	%	105	N/A	6271764
D4-1,2-Dichloroethane	%	102	N/A	6271764
o-Terphenyl	%	98	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV210		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4066-EMP1;E-18	RDL	QC Batch
Inorganics				
Moisture	%	22	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	100	N/A	6271764
4-Bromofluorobenzene	%	99	N/A	6271764
D10-Ethylbenzene	%	112	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
o-Terphenyl	%	99	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV211		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4068-EMP1;E-20	RDL	QC Batch
Inorganics				
Moisture	%	22	1.0	6272117
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	100	N/A	6271764
4-Bromofluorobenzene	%	97	N/A	6271764
D10-Ethylbenzene	%	111	N/A	6271764
D4-1,2-Dichloroethane	%	100	N/A	6271764
o-Terphenyl	%	98	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV212		
Sampling Date		2019/07/29		
COC Number		B935656-NONT-01-01		
	UNITS	GU4069-DUP-2	RDL	QC Batch
Inorganics				
Moisture	%	23	1.0	6272348
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	100	N/A	6271764
4-Bromofluorobenzene	%	97	N/A	6271764
D10-Ethylbenzene	%	102	N/A	6271764
D4-1,2-Dichloroethane	%	101	N/A	6271764
o-Terphenyl	%	97	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KLV213		
Sampling Date		2019/07/31		
COC Number		B935656-NONT-01-01		
	UNITS	GU4070-DUP-11	RDL	QC Batch
Inorganics				
Moisture	%	18	1.0	6272348
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.020	0.020	6271764
Toluene	ug/g	<0.020	0.020	6271764
Ethylbenzene	ug/g	<0.020	0.020	6271764
o-Xylene	ug/g	<0.020	0.020	6271764
p+m-Xylene	ug/g	<0.040	0.040	6271764
Total Xylenes	ug/g	<0.040	0.040	6271764
F1 (C6-C10)	ug/g	<10	10	6271764
F1 (C6-C10) - BTEX	ug/g	<10	10	6271764
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6271981
F3 (C16-C34 Hydrocarbons)	ug/g	<50	50	6271981
F4 (C34-C50 Hydrocarbons)	ug/g	<50	50	6271981
Reached Baseline at C50	ug/g	Yes	N/A	6271981
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	98	N/A	6271764
4-Bromofluorobenzene	%	97	N/A	6271764
D10-Ethylbenzene	%	114	N/A	6271764
D4-1,2-Dichloroethane	%	99	N/A	6271764
o-Terphenyl	%	94	N/A	6271981
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

TEST SUMMARY

BV Labs ID: KLV194
Sample ID: GU4014-TF-01-19; CF-01B
Matrix: Soil

Collected: 2019/07/29
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV194 Dup
Sample ID: GU4014-TF-01-19; CF-01B
Matrix: Soil

Collected: 2019/07/29
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati

BV Labs ID: KLV195
Sample ID: GU4017-TF-01-19; CF-04
Matrix: Soil

Collected: 2019/07/29
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV195 Dup
Sample ID: GU4017-TF-01-19; CF-04
Matrix: Soil

Collected: 2019/07/29
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu

BV Labs ID: KLV196
Sample ID: GU4023-TA-02-19;2
Matrix: Soil

Collected: 2019/08/01
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV197
Sample ID: GU4026-TA-03-19;2
Matrix: Soil

Collected: 2019/08/01
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

TEST SUMMARY

BV Labs ID: KLV198
Sample ID: GU4039-TA-05-19;2
Matrix: Soil

Collected: 2019/08/01
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV199
Sample ID: GU4042-TA-07-19;3
Matrix: Soil

Collected: 2019/08/01
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV200
Sample ID: GU4046-TA-09-19;2
Matrix: Soil

Collected: 2019/08/01
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV201
Sample ID: GU4048-TA-10-19;2
Matrix: Soil

Collected: 2019/08/01
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV202
Sample ID: GU4050-EMP1;E-2
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

TEST SUMMARY

BV Labs ID: KLV203
Sample ID: GU4052-EMP1; E-4
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV204
Sample ID: GU4054-EMP1;E-6
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV205
Sample ID: GU4056-EMP1;E-8
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV206
Sample ID: GU4058-EMP1;E-10
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV207
Sample ID: GU4060-EMP1;E-12
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

TEST SUMMARY

BV Labs ID: KLV208
Sample ID: GU4062-EMP1;E-14
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV209
Sample ID: GU4064-EMP1;E-16
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV210
Sample ID: GU4066-EMP1;E-18
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV211
Sample ID: GU4068-EMP1;E-20
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272117	N/A	2019/08/09	Amitoj Singh Uppal

BV Labs ID: KLV212
Sample ID: GU4069-DUP-2
Matrix: Soil

Collected: 2019/07/29
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272348	N/A	2019/08/09	Amitoj Singh Uppal



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

TEST SUMMARY

BV Labs ID: KLV213
Sample ID: GU4070-DUP-11
Matrix: Soil

Collected: 2019/07/31
Shipped:
Received: 2019/08/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	6271764	N/A	2019/08/09	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	6271981	2019/08/09	2019/08/12	Prabhjot Gulati
Moisture	BAL	6272348	N/A	2019/08/09	Amitoj Singh Uppal



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	15.0°C
-----------	--------

Sample KLV194 [GU4014-TF-01-19; CF-01B] : F1/ BTEX analysis : Detection limits were adjusted for sample weight .

Sample KLV197 [GU4026-TA-03-19;2] : F1/ BTEX analysis : Detection limits were adjusted for sample weight .

Sample KLV199 [GU4042-TA-07-19;3] : F1/ BTEX analysis : Detection limits were adjusted for high moisture content and sample weight. .

Sample KLV209 [GU4064-EMP1;E-16] : F1/BTEX Analysis: Greater than 10g of soil was submitted in the field preserved vial. This significantly exceeds the protocol specification of approximately 5g. Additional methanol was added to the vial to ensure extraction efficiency.

Results relate only to the items tested.

BUREAU
VERITAS

BV Labs Job #: B9L8936

Report Date: 2019/08/12

QUALITY ASSURANCE REPORT

Bureau Veritas Laboratories

Client Project #: P-0019200-0-01 [B935656]

Site Location: RIGAUD

Your P.O. #: F04842

Sampler Initials: LB

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6271764	1,4-Difluorobenzene	2019/08/09	100	60 - 140	100	60 - 140	100	%		
6271764	4-Bromofluorobenzene	2019/08/09	100	60 - 140	98	60 - 140	98	%		
6271764	D10-Ethylbenzene	2019/08/09	106	60 - 140	101	60 - 140	101	%		
6271764	D4-1,2-Dichloroethane	2019/08/09	100	60 - 140	100	60 - 140	100	%		
6271981	o-Terphenyl	2019/08/12	102	60 - 130	92	60 - 130	101	%		
6271764	Benzene	2019/08/09	87	60 - 140	96	60 - 140	<0.020	ug/g	NC	50
6271764	Ethylbenzene	2019/08/09	87	60 - 140	96	60 - 140	<0.020	ug/g	NC	50
6271764	F1 (C6-C10) - BTEX	2019/08/09					<10	ug/g	NC	30
6271764	F1 (C6-C10)	2019/08/09	78	60 - 140	94	80 - 120	<10	ug/g	NC	30
6271764	o-Xylene	2019/08/09	86	60 - 140	95	60 - 140	<0.020	ug/g	NC	50
6271764	p+m-Xylene	2019/08/09	89	60 - 140	98	60 - 140	<0.040	ug/g	NC	50
6271764	Toluene	2019/08/09	86	60 - 140	94	60 - 140	<0.020	ug/g	NC	50
6271764	Total Xylenes	2019/08/09					<0.040	ug/g	NC	50
6271981	F2 (C10-C16 Hydrocarbons)	2019/08/12	100	50 - 130	91	80 - 120	<10	ug/g	NC	30
6271981	F3 (C16-C34 Hydrocarbons)	2019/08/12	104	50 - 130	92	80 - 120	<50	ug/g	NC	30
6271981	F4 (C34-C50 Hydrocarbons)	2019/08/12	101	50 - 130	92	80 - 120	<50	ug/g	NC	30
6272117	Moisture	2019/08/09							1.3	20
6272348	Moisture	2019/08/09							2.5	20

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference $\leq 2 \times$ RDL).



BV Labs Job #: B9L8936
Report Date: 2019/08/12

Bureau Veritas Laboratories
Client Project #: P-0019200-0-01 [B935656]
Site Location: RIGAUD
Your P.O. #: F04842
Sampler Initials: LB

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

A handwritten signature in black ink, appearing to read "Anastassia Hamanov", written over a horizontal line.

Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



SUBCONTRACTING REQUEST FORM

To: Lab BV - Mississauga

Job# B935656

☐ Yes ☐ No International Sample/BioHazard (if yes, add copy of Movement Cert., heat treat is required prior to disposal)

☐ Yes ☐ No Special Protocol (if yes, Protocol _____)

Sample ID	Matrix	Test(s) Required	Container	Date Sampled	Date Required
GU4014-01R\TF-01-19; CF-01B	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/29	2019/08/13
GU4014-02R\TF-01-19; CF-01B	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/29	2019/08/13
GU4017-01R\TF-01-19; CF-04	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/29	2019/08/13
GU4017-02R\TF-01-19; CF-04	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/29	2019/08/13
GU4023-01R\TA-02-19; 2	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/08/01	2019/08/13
GU4023-02R\TA-02-19; 2	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/08/01	2019/08/13
GU4026-01R\TA-03-19; 2	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/08/01	2019/08/13
GU4026-02R\TA-03-19; 2	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/08/01	2019/08/13
GU4039-01R\TA-05-19; 2	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/08/01	2019/08/13
GU4039-02R\TA-05-19; 2	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/08/01	2019/08/13
GU4042-01R\TA-07-19; 3	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4042-02R\TA-07-19; 3	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4046-01R\TA-09-19; 2	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/08/01	2019/08/13
GU4046-02R\TA-09-19; 2	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/08/01	2019/08/13
GU4048-01R\TA-10-19; 2	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/08/01	2019/08/13
GU4048-02R\TA-10-19; 2	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/08/01	2019/08/13
GU4050-01R\EMP1; E-2	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4050-02R\EMP1; E-2	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4052-01R\EMP1; E-4	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4052-02R\EMP1; E-4	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4054-01R\EMP1; E-6	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4054-02R\EMP1; E-6	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4056-01R\EMP1; E-8	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4056-02R\EMP1; E-8	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4058-01R\EMP1; E-10	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4058-02R\EMP1; E-10	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4060-01R\EMP1; E-12	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4060-02R\EMP1; E-12	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4062-01R\EMP1; E-14	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4062-02R\EMP1; E-14	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4064-01R\EMP1; E-16	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4064-02R\EMP1; E-16	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4066-01R\EMP1; E-18	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4066-02R\EMP1; E-18	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4068-01R\EMP1; E-20	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/31	2019/08/13
GU4068-02R\EMP1; E-20	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/31	2019/08/13
GU4069-01R\DUP-2	SOIL	Petroleum Hydrocarbons (F2-F4)	1-120J	2019/07/29	2019/08/13
GU4069-02R\DUP-2	SOIL	CCME F1/BTEX-Methanol Field Preserved	2-40ME	2019/07/29	2019/08/13

Laboratoires Bureau Veritas
889, Montée de Liesse
Saint-Laurent, Québec, H4T 1P5
(418) 543-3788
(418) 543-8994



Englobe Corp. - LAVAL
Lab BV PM : Rodrigo Caffarengo

SUBCONTRACTING REQUEST FORM

Sample ID	Material	Analysis	Request Date	Due Date
GU4070-01R\DUPLICATE	SOIL	Petroleum Hydrocarbons (F2-F4)	2019/07/31	2019/08/13
GU4070-02R\DUPLICATE	SOIL	CCME F1/BTEX-Methanol Field Preserved	2019/07/31	2019/08/13

	Temp. 1	Temp. 2	Temp. 3			
Cooler #1	15	15	15	Custody Seal Present	YES	NO
				Custody Seal Intact	YES	NO
				Ice Present Upon Receipt	YES	NO
Cooler #2				Custody Seal Present	YES	NO
				Custody Seal Intact	YES	NO
				Ice Present Upon Receipt	YES	NO
Cooler #3				Custody Seal Present	YES	NO
				Custody Seal Intact	YES	NO
				Ice Present Upon Receipt	YES	NO

Receiving Location:

Lab BV - Mississauga

Job #

Relinquished by (Sign)

(print)

Date and Time

Received by (Sign)

(print)

Date and Time

NOTES:

- 1) Please call us if due date cannot be met. Please reference Sample ID on your report.
- 2) Please advise us if your laboratory cannot perform the requested analysis or must subcontract to a 3rd party lab
- 3) Include copy of this completed form, Client COC & signed final report to soustraitanceque@bvlabs.com and to Rodrigo.CAFFARENGO@bvlabs.com

Reporting Requirements:

National:

Regional:

Please Report in French

08-Aug-19 08:39

Nazeema Rahaman



B9L8936

WVL ENV-1178

Shipping Instructions

- | | |
|--|---|
| <input type="checkbox"/> Ship Immediately (highlight Yellow) | <input type="checkbox"/> Ship Cold |
| <input type="checkbox"/> Requires 9am | <input type="checkbox"/> Ship Room Temp |
| <input type="checkbox"/> Requires Sat. Delivery | <input type="checkbox"/> Ship Frozen |
| <input type="checkbox"/> Regular Ship next available day | <input type="checkbox"/> COC Must be Attached |
- Sender (Print) _____ Initial _____

Shipping Department Checklist

- | | |
|--|--|
| <input type="checkbox"/> Correct Shipping location | <input type="checkbox"/> Correct Sample Ids (Paperwork vs Bottles) |
| <input type="checkbox"/> Yes <input type="checkbox"/> No Special-Cooler, Ice, Tape-custody seal, Date&Sign | |
| Date Shipped _____ | Number of coolers _____ |
| Shipper (Print) _____ | Initial _____ |

Laboratoires Bureau Veritas
889, Montée de Liesse
Saint-Laurent, Quebec, H4T 1P5
(418) 543-3788
(418) 543-8994



1/1

Englobe Corp. - LAVAL
Lab BV PM : Rodrigo Caffarengo

SUBCONTRACTING REQUEST FORM

Test Code	Parameter
Petroleum Hydrocarbons (F2-F4)	F2 (C10-C16) F3 (C16-C34) F4 (C34-C50) Reached Baseline at C50
CCME F1/BTEX-Methanol Field Preserved	Benzene Ethylbenzene F1 (C6-C10) F1 (C6-C10) - BTEX o-Xylene p+m-Xylene Toluene Total_Xylenes



Sent to: Lab BV - Mississauga
6740 Campobello Rd
Mississauga, ON, L5N 2L8
Tel: (800) 563-6266

BV LABS INTERLAB CHAIN OF CUSTODY RECORD

Page 01 of 02

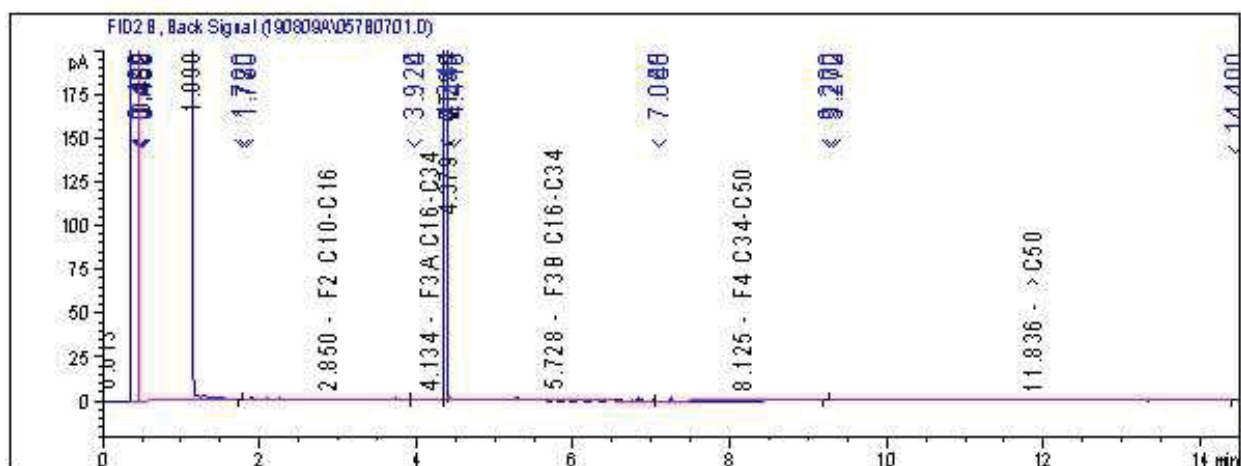
COC # B935656-NONT-01-01

REPORT INFORMATION							ANALYSIS REQUESTED										Job Barcode Label																																																	
Company: Bureau Veritas Laboratories							<div>CCME F1/BTEX-Methanol Field Preserved</div> <div>Petroleum Hydrocarbons (F2-F4)</div>																																																											
Address: 889, Montée de Liesse, Saint-Laurent, Quebec, H4T 1P5																																																																		
Contact Name: Rodrigo Caffarengo																																																																		
Email: Rodrigo.CAFFARENGO@bvlab.com, soustraitanceque@bvlab.com																																																																		
Phone: (514) 448-9001 ext. 7066336																																																																		
BV Labs Project #: B935656																																																																		
Client Invoice To: Englobe Corp. (3155)																																																																		
Client Report To: Englobe Corp. (3155)							Incl. on Report? Yes / No																																																											
#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.											ADDITIONAL SAMPLE INFORMATION																																																	
1	GU4014-TF-01-19; CF-01B	SOIL	2019/07/29		LB	3	X	X									(P: 01, 02)																																																	
2	GU4017-TF-01-19; CF-04	SOIL	2019/07/29		LB	3	X	X									(P: 01, 02)																																																	
3	GU4023-TA-02-19; 2	SOIL	2019/08/01		LB	3	X	X									(P: 01, 02)																																																	
4	GU4026-TA-03-19; 2	SOIL	2019/08/01		LB	3	X	X									(P: 01, 02)																																																	
5	GU4039-TA-05-19; 2	SOIL	2019/08/01		LB	3	X	X									(P: 01, 02)																																																	
6	GU4042-TA-07-19; 3	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																	
7	GU4046-TA-09-19; 2	SOIL	2019/08/01		LB	3	X	X									(P: 01, 02)																																																	
8	GU4048-TA-10-19; 2	SOIL	2019/08/01		LB	3	X	X									(P: 01, 02)																																																	
9	GU4050-EMP1; E-2	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																	
10	GU4052-EMP1; E-4	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																	
SITE LOCATION: RIGAUD							REGULATORY CRITERIA				SPECIAL INSTRUCTIONS				REQUIRED EDDs		TURNAROUND TIME																																																	
SITE #:							Guide Basse-Terres+ RESC				Please inform Lab BV immediately if you are not accredited for the requested test(s). **Please return a copy of this form with the report.**				Dessau Soprin Excel (Q004) National Excel (N001)		<input type="checkbox"/> Rush Required 2019/08/12 Date Required Please inform us if rush charges will be incurred.																																																	
PROJECT #:																																																																		
P-0019200-0-01																																																																		
PO/A/E, TASK ORDER/SERVICE ORDER, LINE ITEM:																																																																		
F04842																																																																		
COOLER ID: 1							COOLER ID:				COOLER ID:				RECEIVING LAB USE ONLY																																																			
<table><tr><td></td><td>YES</td><td>NO</td><td rowspan="4">Temp: (°C)</td><td rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">3</td></tr><tr><td>Custody Seal Present</td><td></td><td>✓</td></tr><tr><td>Custody Seal Intact</td><td></td><td>✓</td></tr><tr><td>Cooling Media Present</td><td>✓</td><td></td></tr></table>								YES	NO	Temp: (°C)	1	2	3	Custody Seal Present		✓	Custody Seal Intact		✓	Cooling Media Present	✓		<table><tr><td></td><td>YES</td><td>NO</td><td rowspan="4">Temp: (°C)</td><td rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">3</td></tr><tr><td>Custody Seal Present</td><td></td><td></td></tr><tr><td>Custody Seal Intact</td><td></td><td></td></tr><tr><td>Cooling Media Present</td><td></td><td></td></tr></table>					YES	NO	Temp: (°C)	1	2	3	Custody Seal Present			Custody Seal Intact			Cooling Media Present			<table><tr><td></td><td>YES</td><td>NO</td><td rowspan="4">Temp: (°C)</td><td rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">3</td></tr><tr><td>Custody Seal Present</td><td></td><td></td></tr><tr><td>Custody Seal Intact</td><td></td><td></td></tr><tr><td>Cooling Media Present</td><td></td><td></td></tr></table>					YES	NO	Temp: (°C)	1	2	3	Custody Seal Present			Custody Seal Intact			Cooling Media Present						
	YES	NO	Temp: (°C)	1	2	3																																																												
Custody Seal Present		✓																																																																
Custody Seal Intact		✓																																																																
Cooling Media Present	✓																																																																	
	YES	NO	Temp: (°C)	1	2	3																																																												
Custody Seal Present																																																																		
Custody Seal Intact																																																																		
Cooling Media Present																																																																		
	YES	NO	Temp: (°C)	1	2	3																																																												
Custody Seal Present																																																																		
Custody Seal Intact																																																																		
Cooling Media Present																																																																		
RELINQUISHED BY: (SIGN & PRINT)							DATE: (YYYY/MM/DD)		TIME: (HH:MM)		RECEIVED BY: (SIGN & PRINT)		DATE: (YYYY/MM/DD)		TIME: (HH:MM)		Samples Labelled By: Labels Verified By:																																																	
1. FLORENTINE SIMON							2019.08.08				1. GUY G. GUYEN		2019 08 08 08:39																																																					
2.											2.																																																							

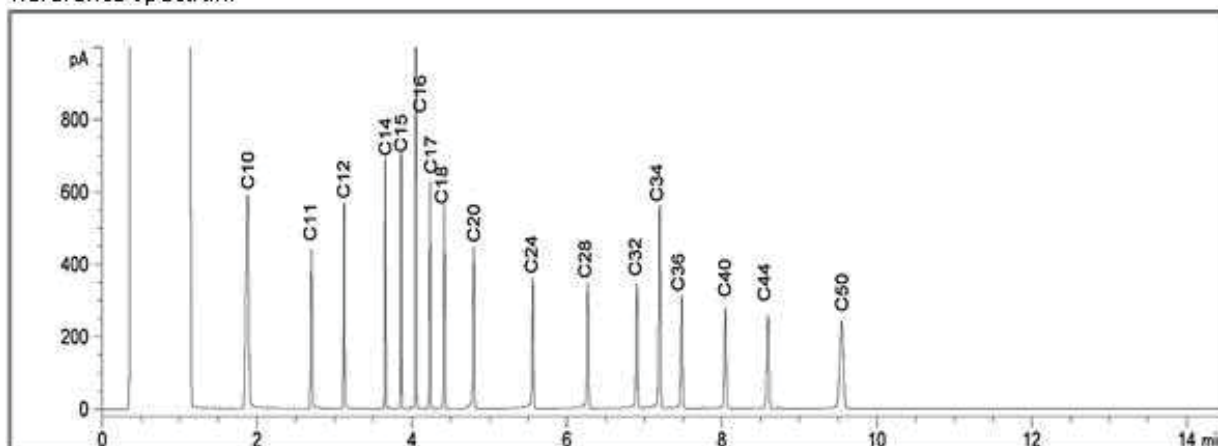
COC # B935656-NONT-02-01

REPORT INFORMATION										ANALYSIS REQUESTED										Job Barcode Label																																																																																				
Company: Bureau Veritas Laboratories																																																																																																								
Address: 889, Montée de Liesse, Saint-Laurent, Quebec, H4T 1P5																																																																																																								
Contact Name: Rodrigo Caffarengo																																																																																																								
Email: Rodrigo.CAFFARENGO@bvlab.com, soustraitanceque@bvlab.com																																																																																																								
Phone: (514) 448-9001 ext. 7066336																																																																																																								
BV Labs Project #: B935656																																																																																																								
Client Invoice To: Englobe Corp. (3155)																																																																																																								
Client Report To: Englobe Corp. (3155)										Incl. on Report? Yes / No																																																																																														
#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.	CCME F1/BTEX-Methanol Field Preserved		Petroleum Hydrocarbons (F2-F4)								ADDITIONAL SAMPLE INFORMATION																																																																																							
1	GU4054-EMP1; E-6	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																																																							
2	GU4056-EMP1; E-8	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																																																							
3	GU4058-EMP1; E-10	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																																																							
4	GU4060-EMP1; E-12	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																																																							
5	GU4062-EMP1; E-14	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																																																							
6	GU4064-EMP1; E-16	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																																																							
7	GU4066-EMP1; E-18	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																																																							
8	GU4068-EMP1; E-20	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																																																							
9	GU4069-DUP-2	SOIL	2019/07/29		LB	3	X	X									(P: 01, 02)																																																																																							
10	GU4070-DUP-11	SOIL	2019/07/31		LB	3	X	X									(P: 01, 02)																																																																																							
SITE LOCATION:					REGULATORY CRITERIA					SPECIAL INSTRUCTIONS					REQUIRED EDDs		TURNAROUND TIME																																																																																							
RIGAUD					Guide Basse-Terre+ RESC					Please inform Lab BV immediately if you are not accredited for the requested test(s). **Please return a copy of this form with the report.**					Dessau Soprin Excel (Q004)		National Excel (N001)																																																																																							
SITE #:																	<input type="checkbox"/> Rush Required 2019/08/12 Date Required Please inform us if rush charge will be incurred.																																																																																							
PROJECT #:																																																																																																								
P-0019200-0-01																																																																																																								
PO/AFE, TASK ORDER/SERVICE ORDER, LINE ITEM:																																																																																																								
F04842																																																																																																								
COOLER ID:										COOLER ID:										COOLER ID:																																																																																				
<table border="1"> <tr> <td></td> <td>YES</td> <td>NO</td> <td rowspan="4">Temp: (°C)</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>Custody Seal Present</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Custody Seal Intact</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Cooling Media Present</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>											YES	NO	Temp: (°C)	1	2	3	Custody Seal Present						Custody Seal Intact						Cooling Media Present						<table border="1"> <tr> <td></td> <td>YES</td> <td>NO</td> <td rowspan="4">Temp: (°C)</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>Custody Seal Present</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Custody Seal Intact</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Cooling Media Present</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>											YES	NO	Temp: (°C)	1	2	3	Custody Seal Present						Custody Seal Intact						Cooling Media Present						<table border="1"> <tr> <td></td> <td>YES</td> <td>NO</td> <td rowspan="4">Temp: (°C)</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>Custody Seal Present</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Custody Seal Intact</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Cooling Media Present</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>											YES	NO	Temp: (°C)	1	2	3	Custody Seal Present						Custody Seal Intact						Cooling Media Present					
	YES	NO	Temp: (°C)	1	2	3																																																																																																		
Custody Seal Present																																																																																																								
Custody Seal Intact																																																																																																								
Cooling Media Present																																																																																																								
	YES	NO	Temp: (°C)	1	2	3																																																																																																		
Custody Seal Present																																																																																																								
Custody Seal Intact																																																																																																								
Cooling Media Present																																																																																																								
	YES	NO	Temp: (°C)	1	2	3																																																																																																		
Custody Seal Present																																																																																																								
Custody Seal Intact																																																																																																								
Cooling Media Present																																																																																																								
RECEIVING LAB USE ONLY										RECEIVING LAB USE ONLY										RECEIVING LAB USE ONLY																																																																																				
BV Labs Job #										BV Labs Job #										BV Labs Job #																																																																																				
RELINQUISHED BY: (SIGN & PRINT)										DATE: (YYYY/MM/DD)										TIME: (HH:MM)										RECEIVED BY: (SIGN & PRINT)										DATE: (YYYY/MM/DD)										TIME: (HH:MM)																																																						
1. FLORENCE Gervin										2019.08.07																				1. SEC page 1																																																																										
2.																														2.																																																																										

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

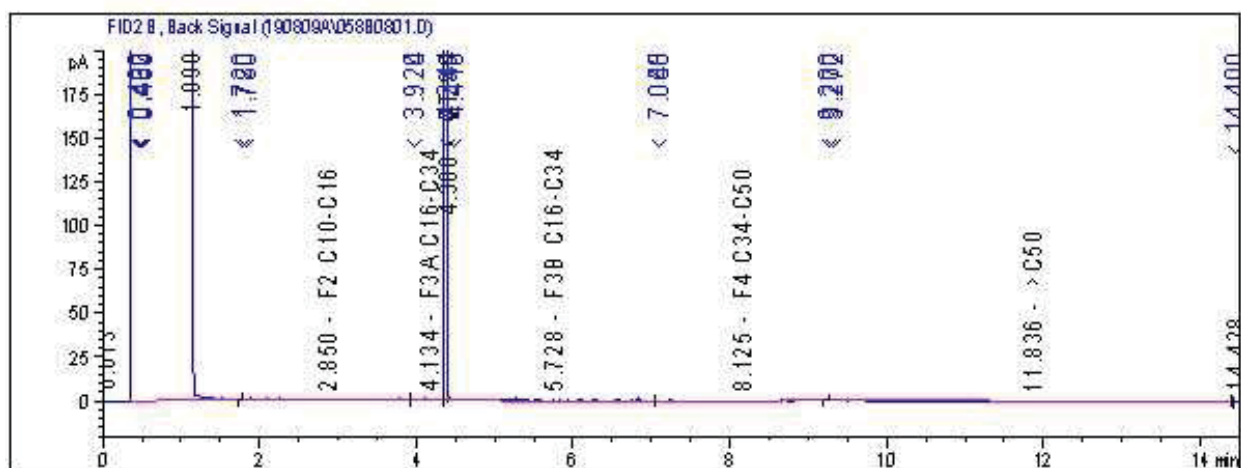
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

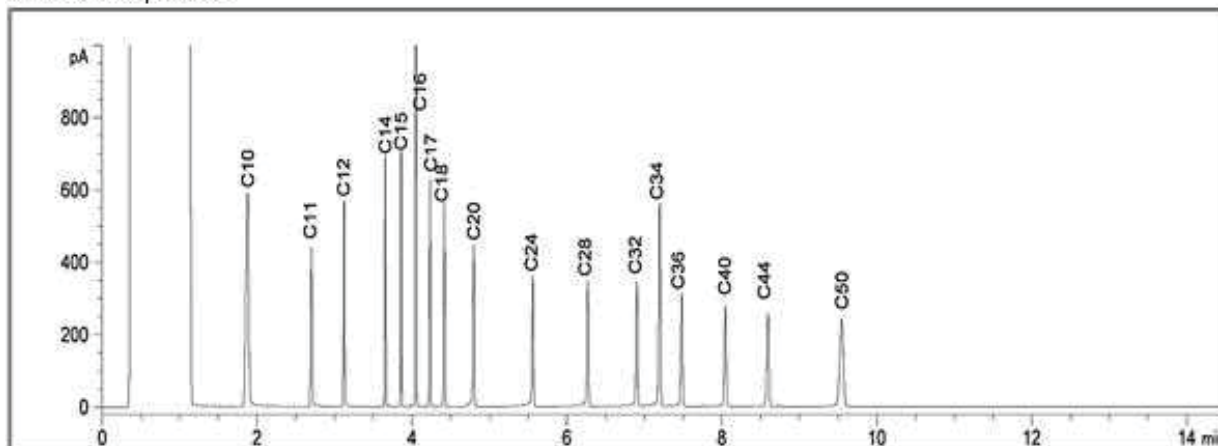
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

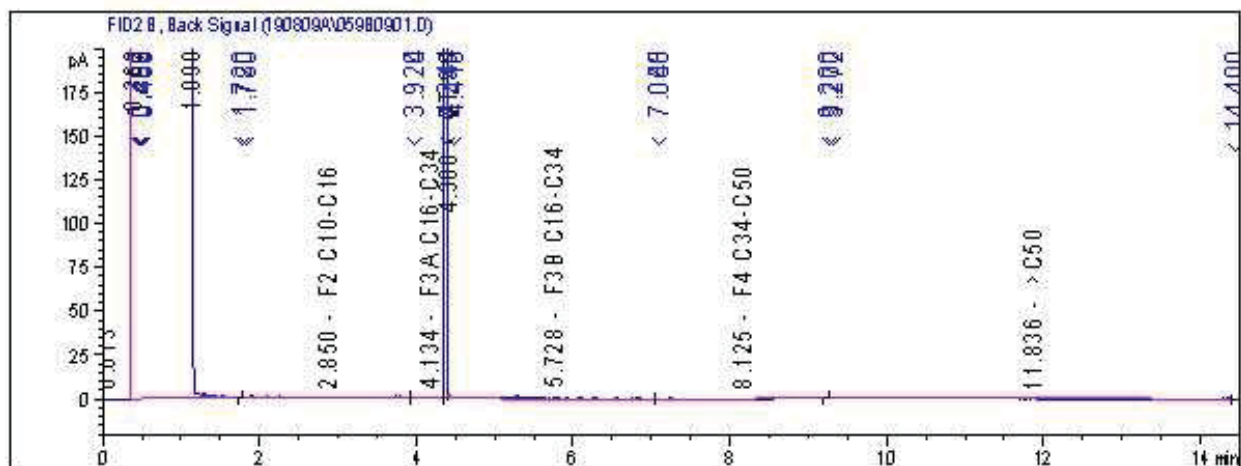
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

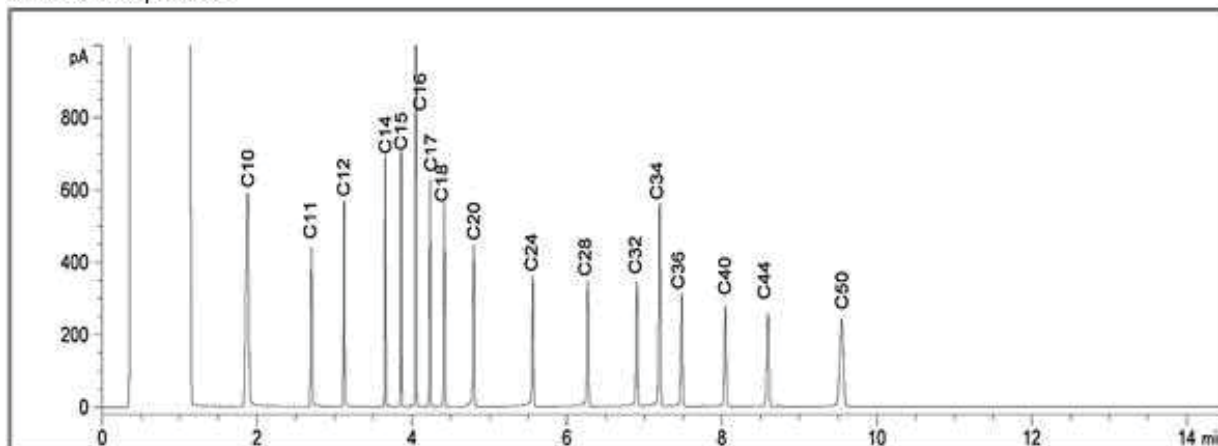
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

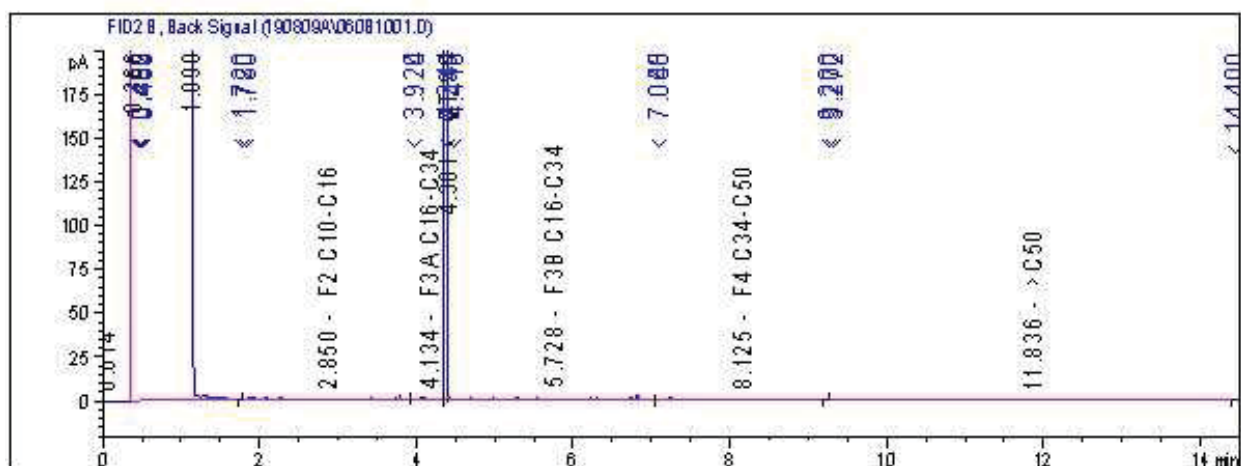
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

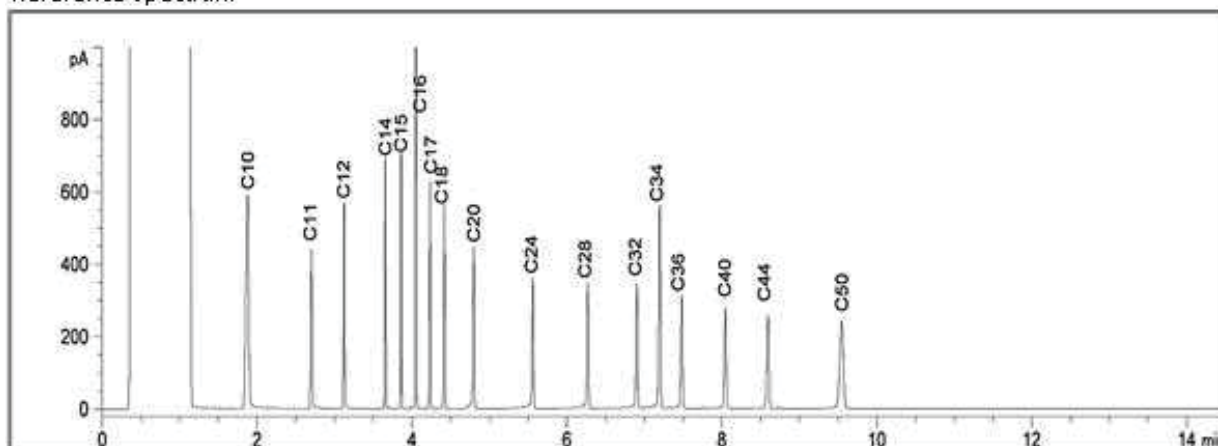
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

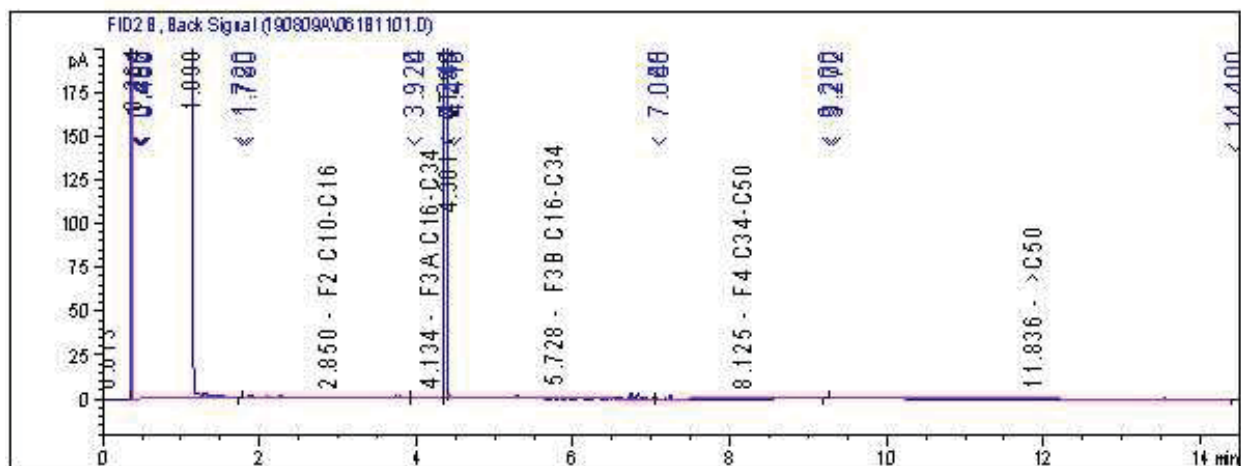
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

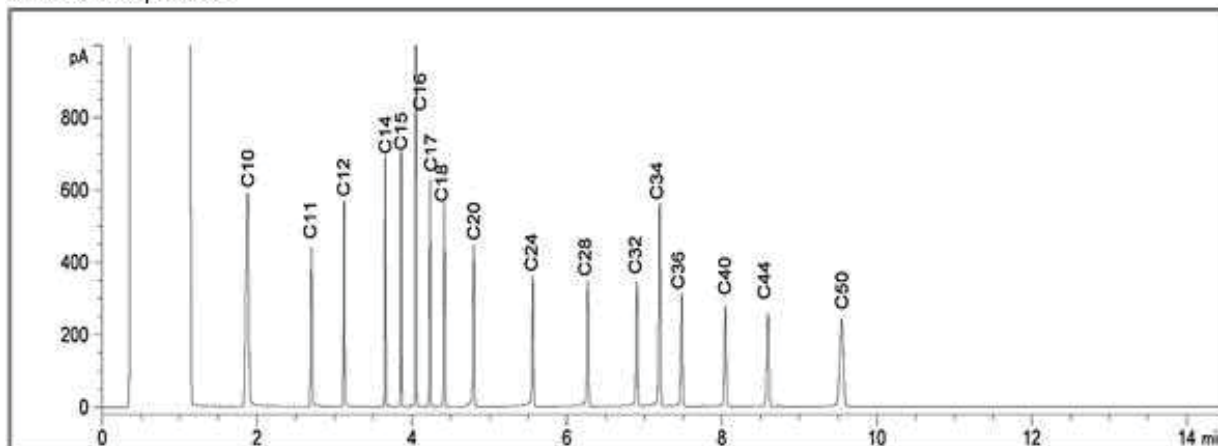
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

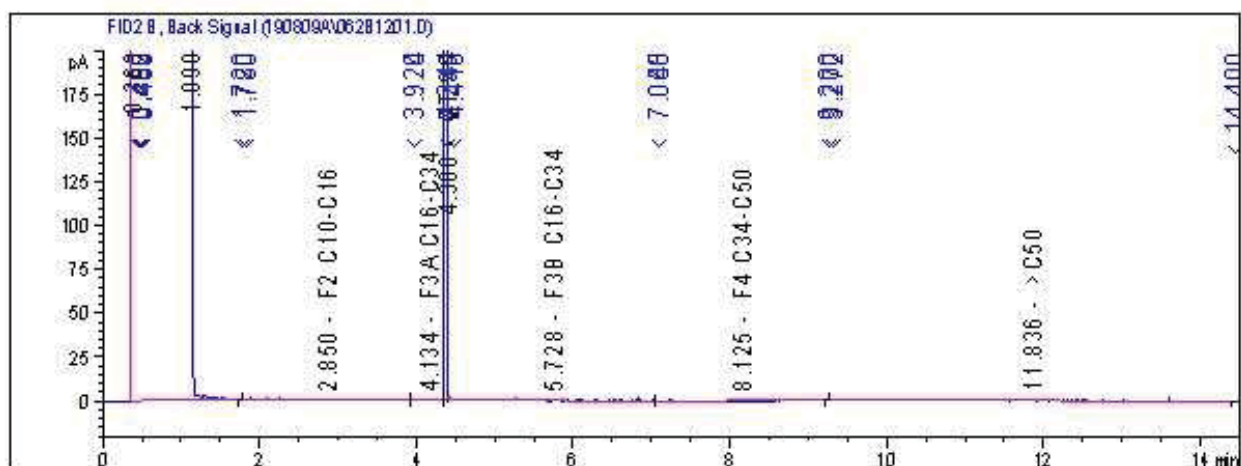
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

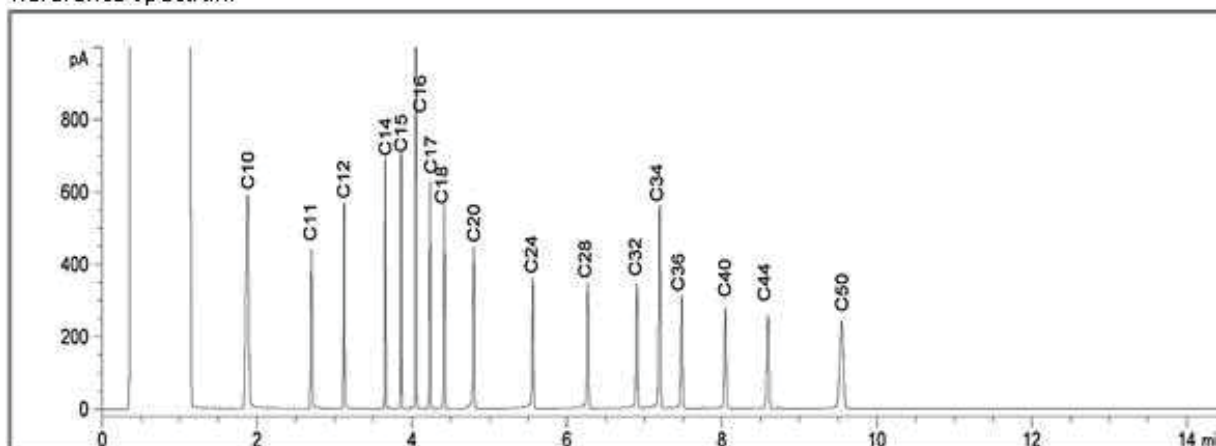
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

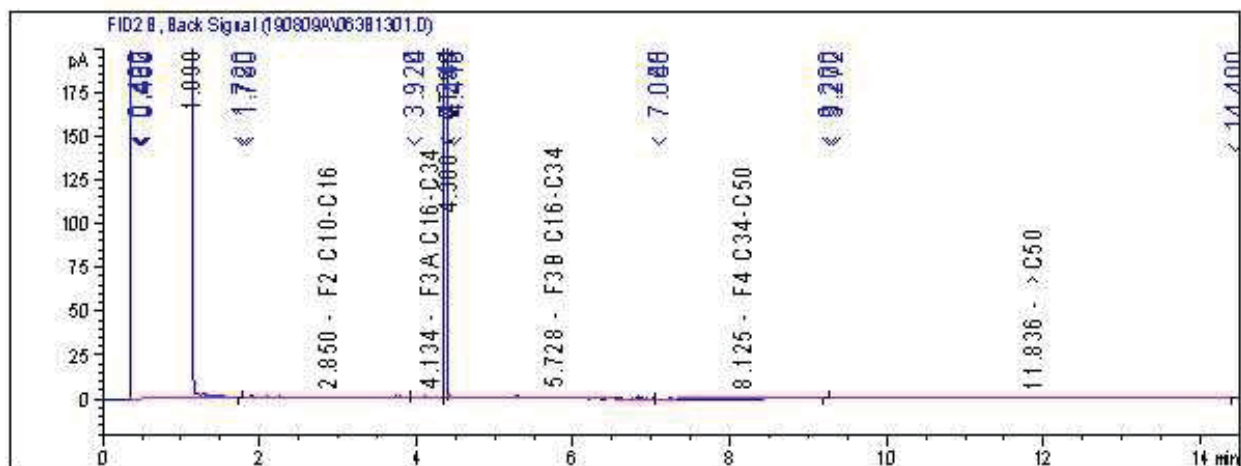
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

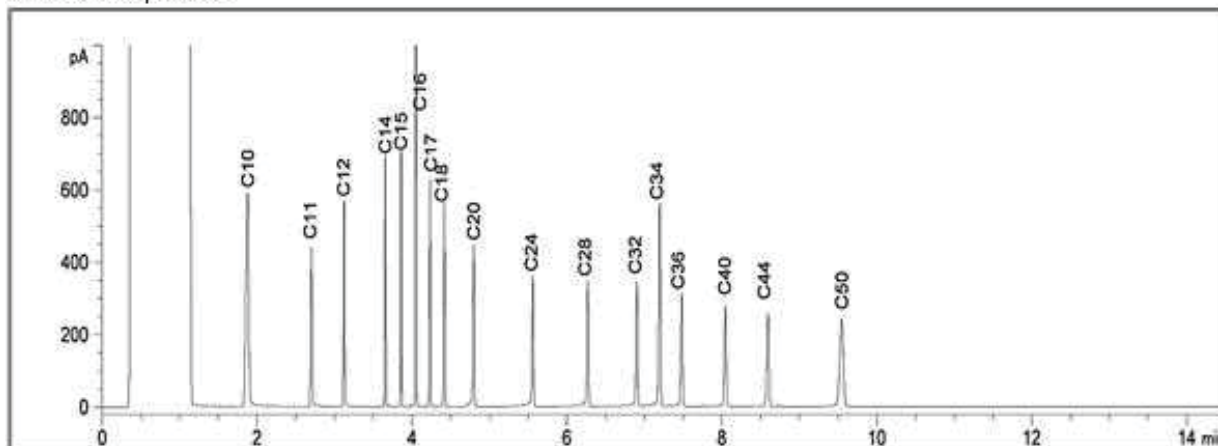
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

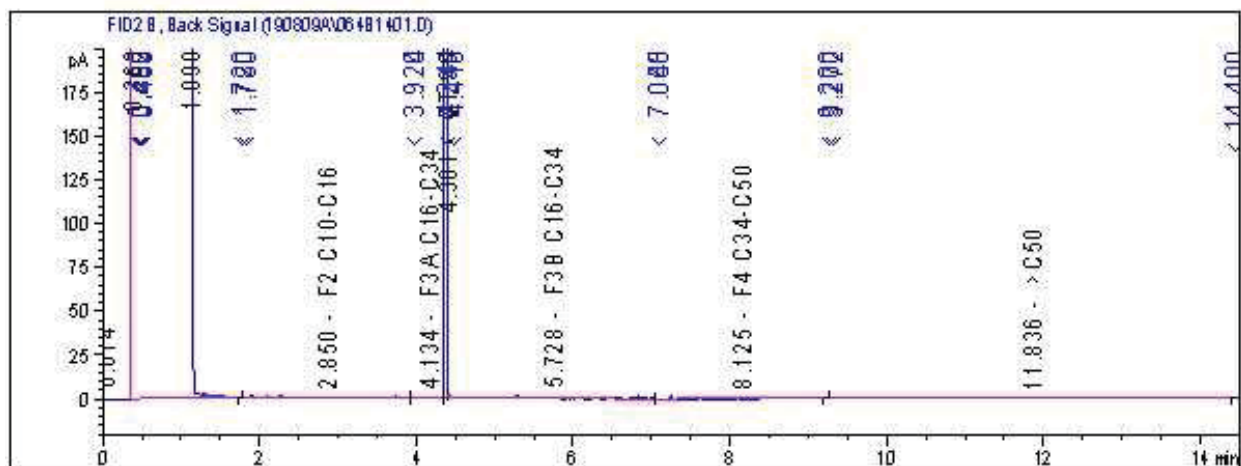
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

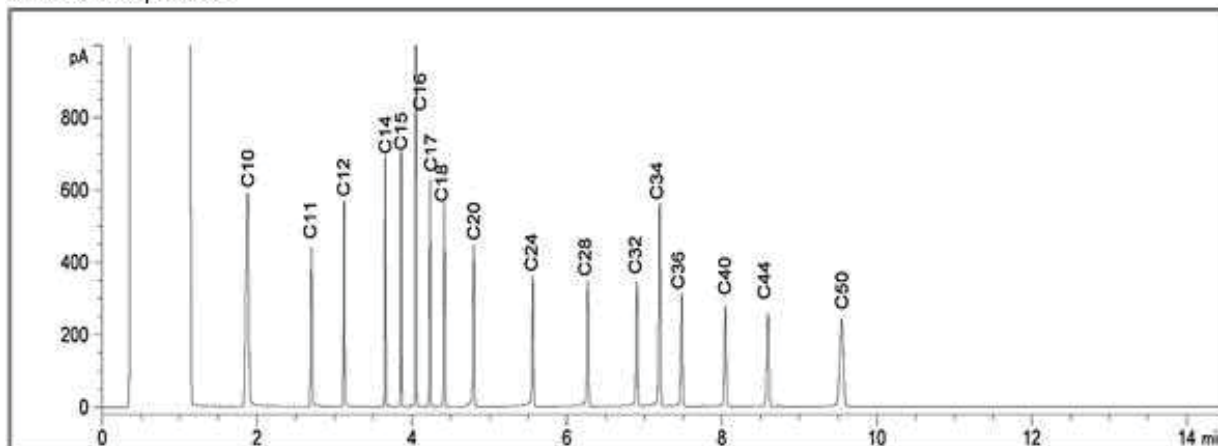
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

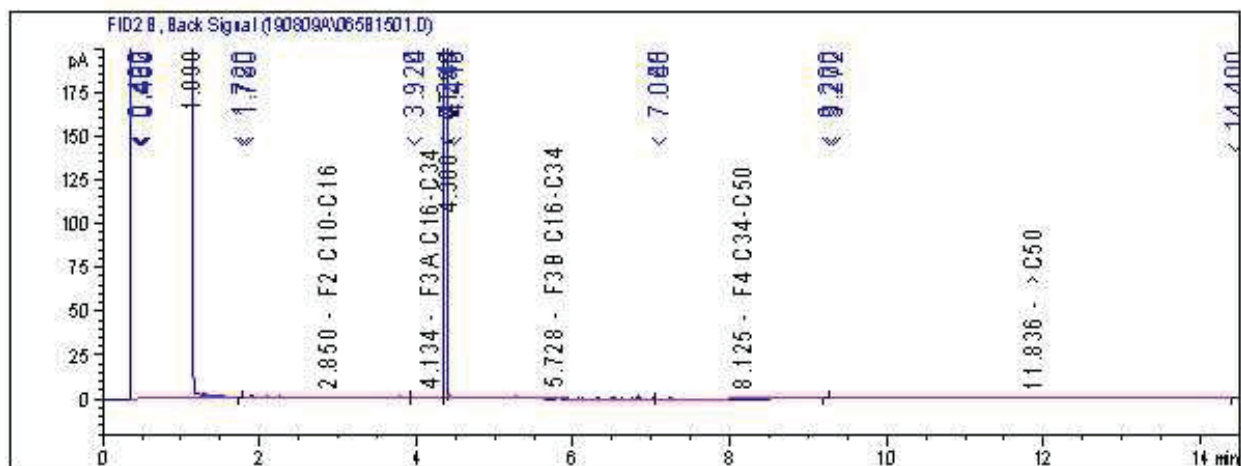
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

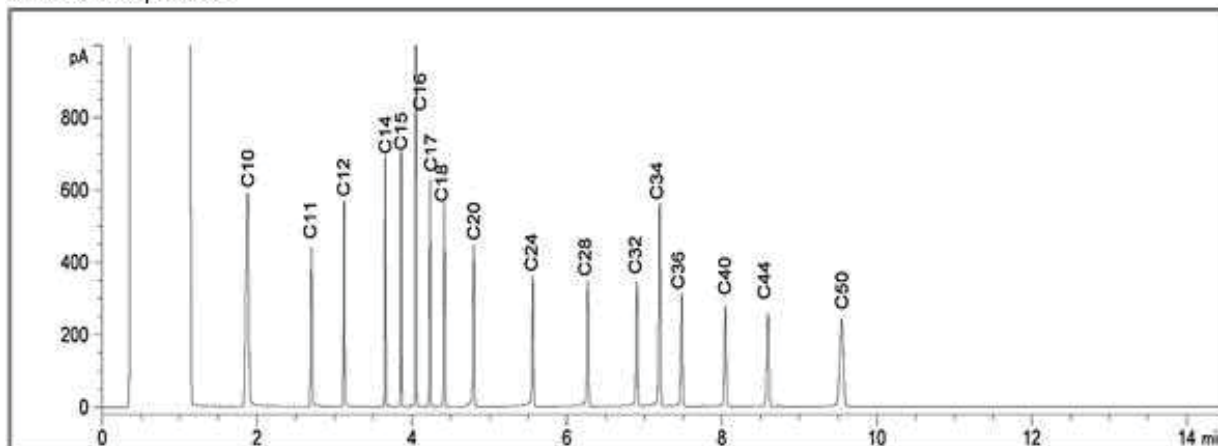
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

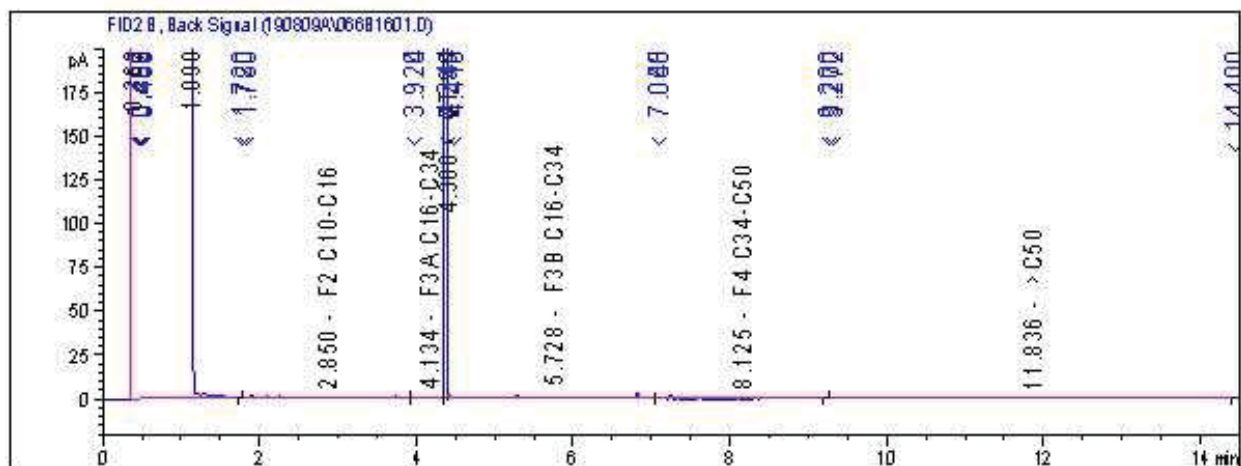
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

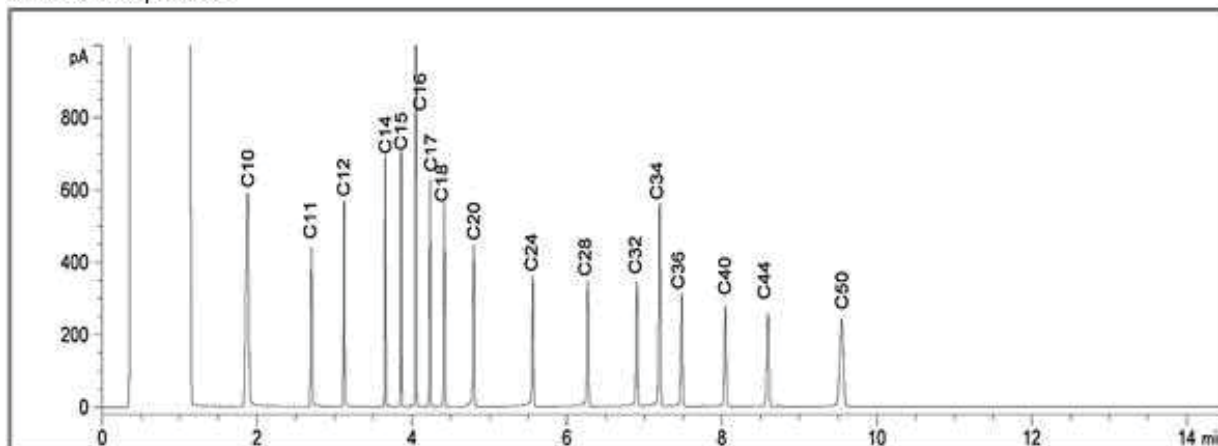
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

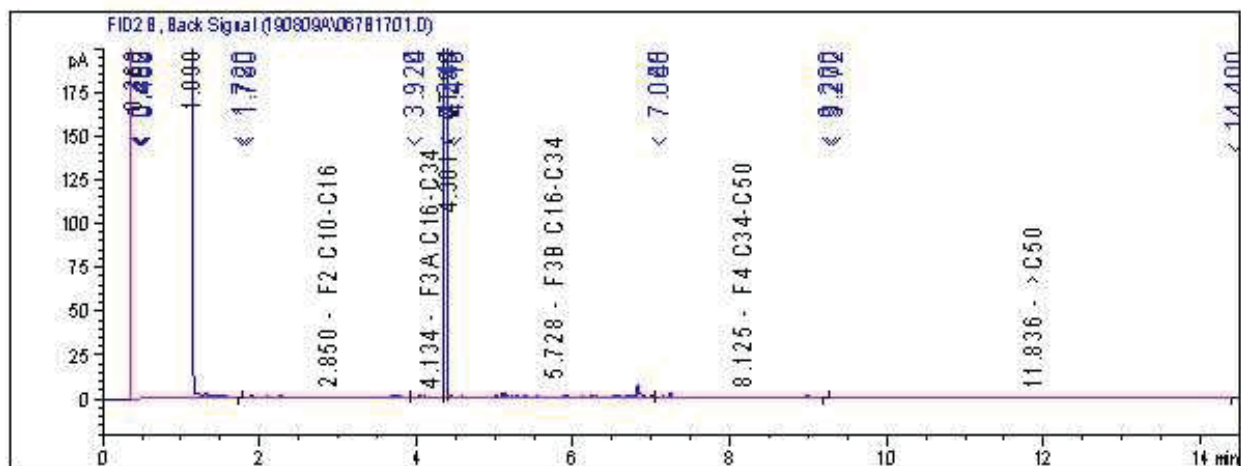
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

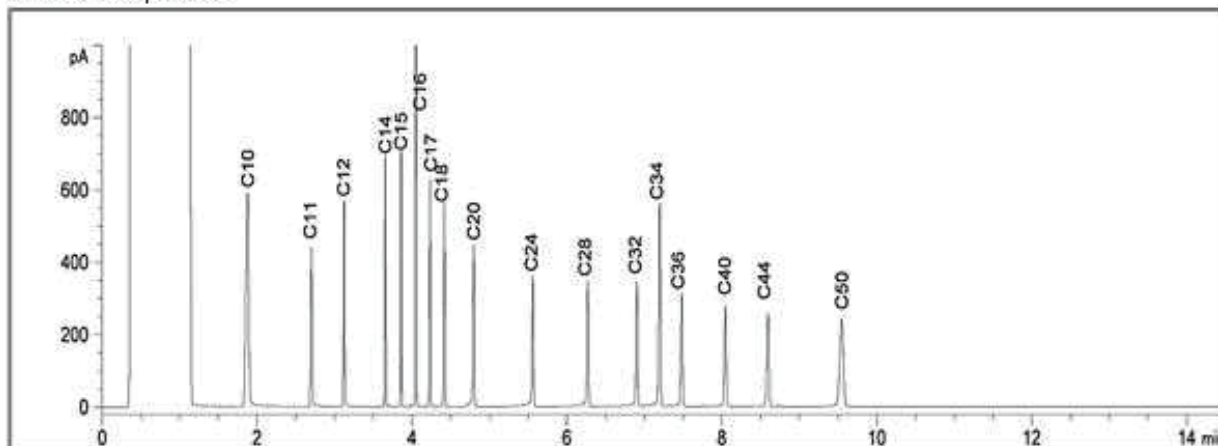
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

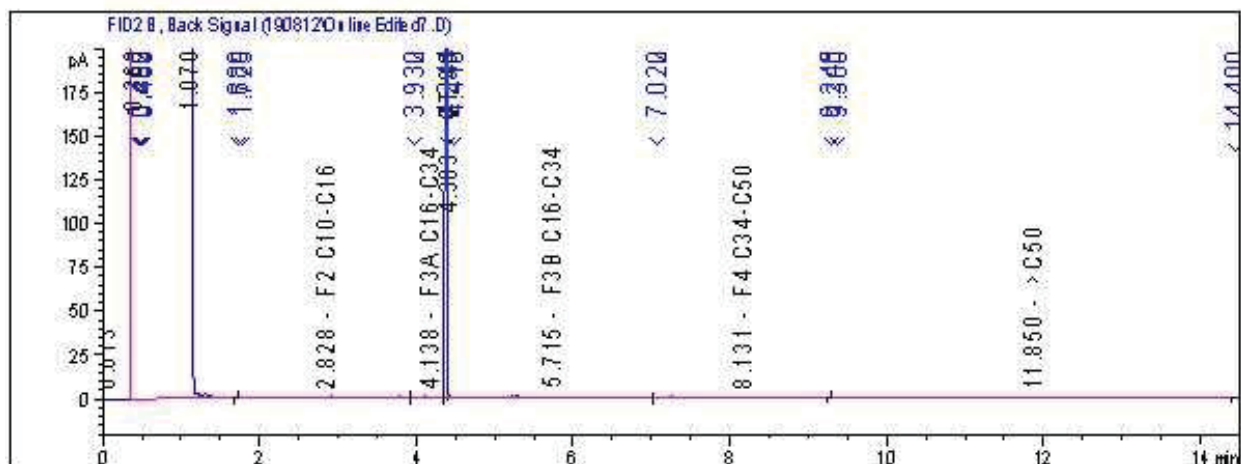
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

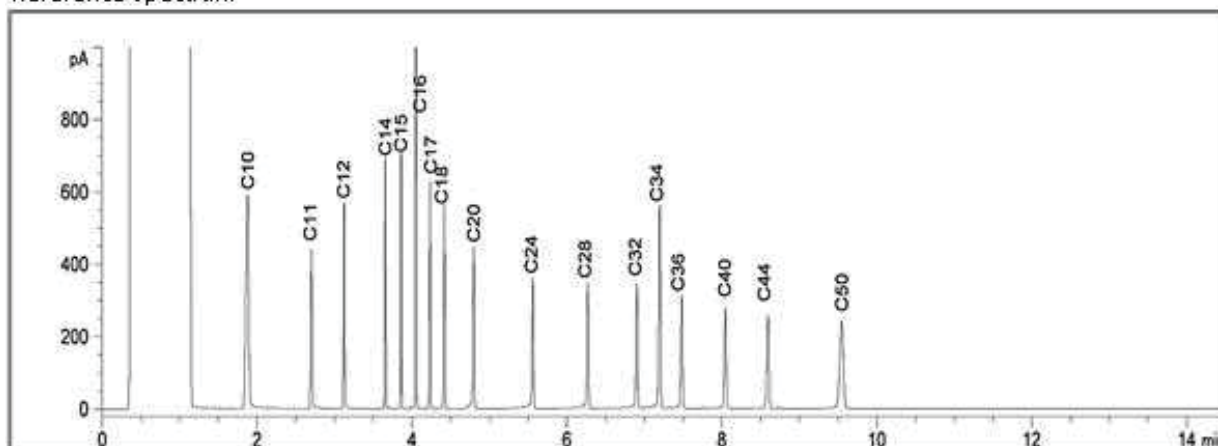
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

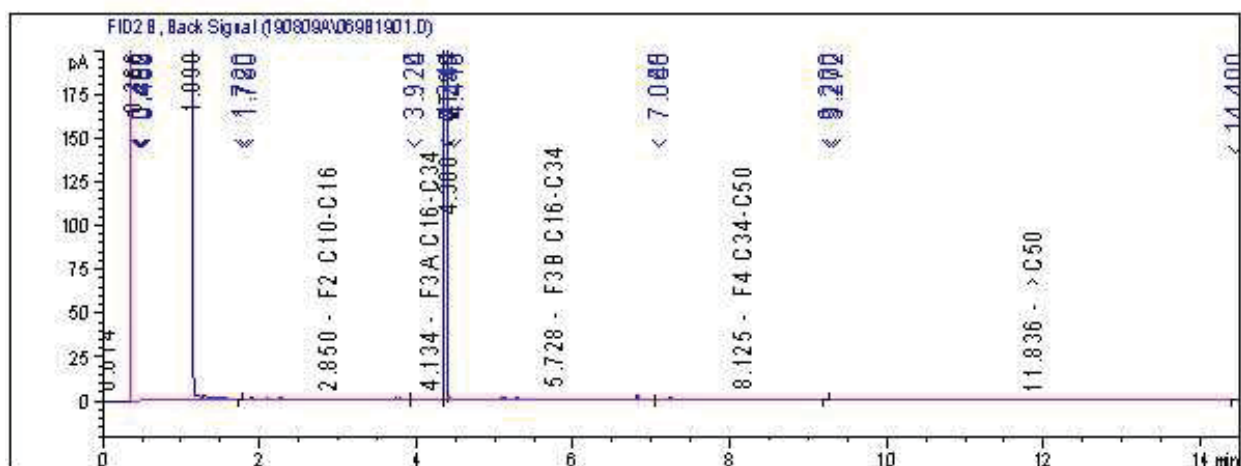
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

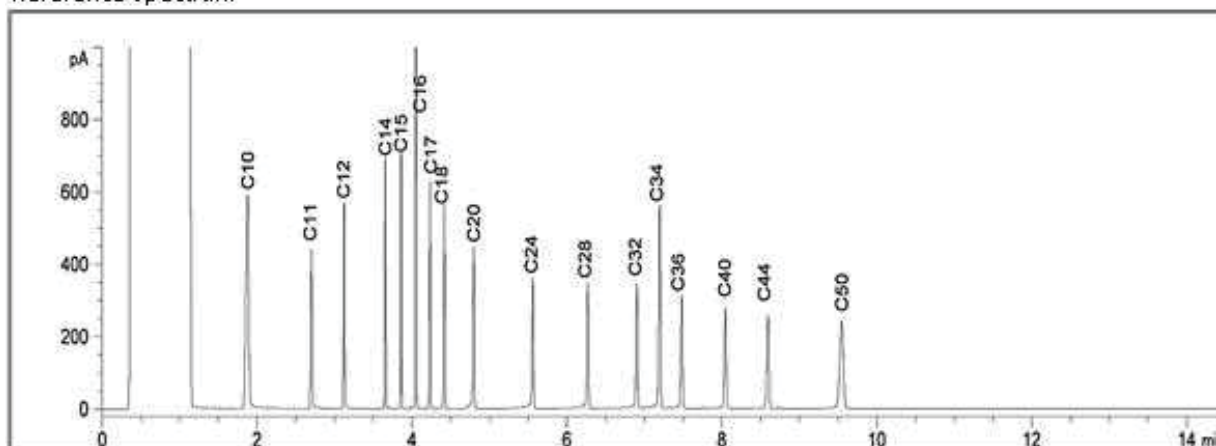
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

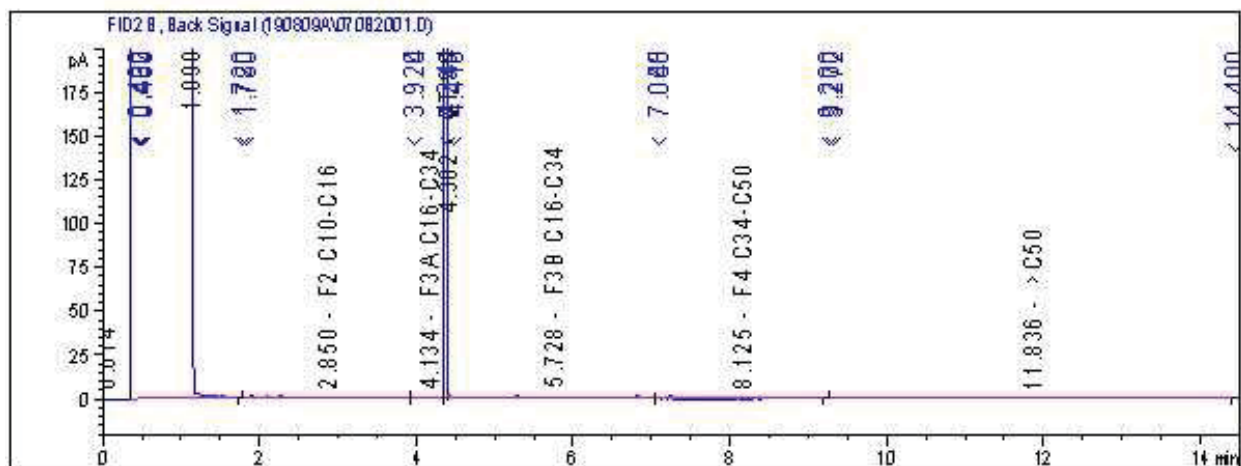
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

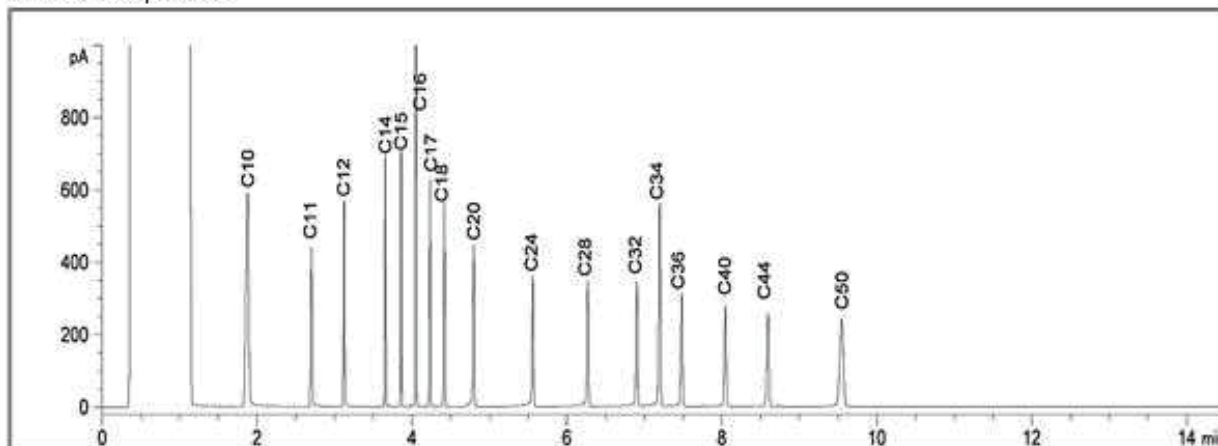
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

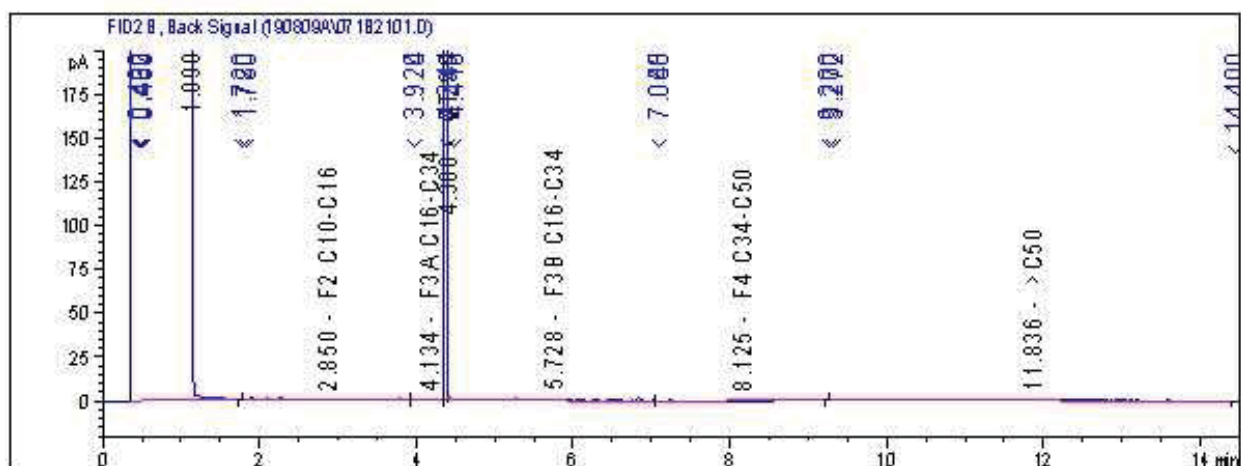
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

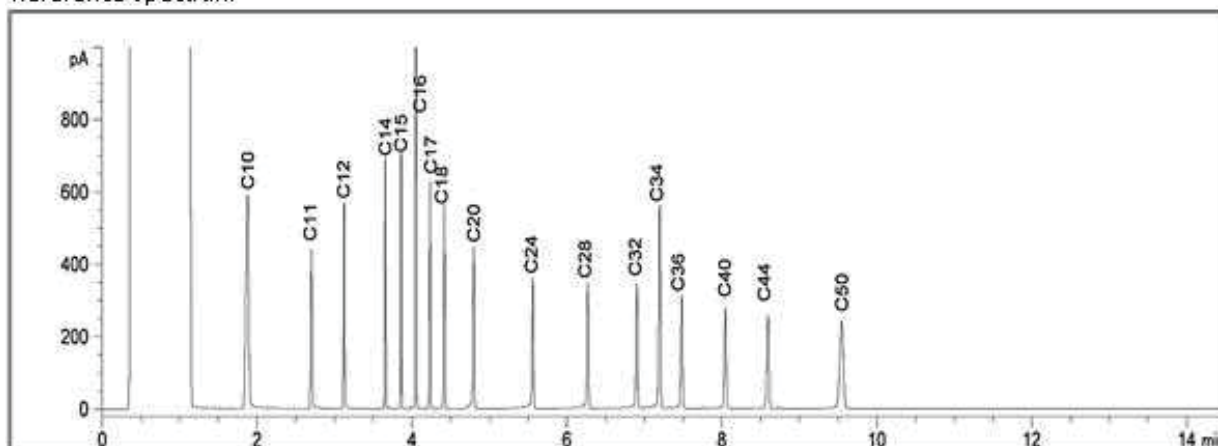
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

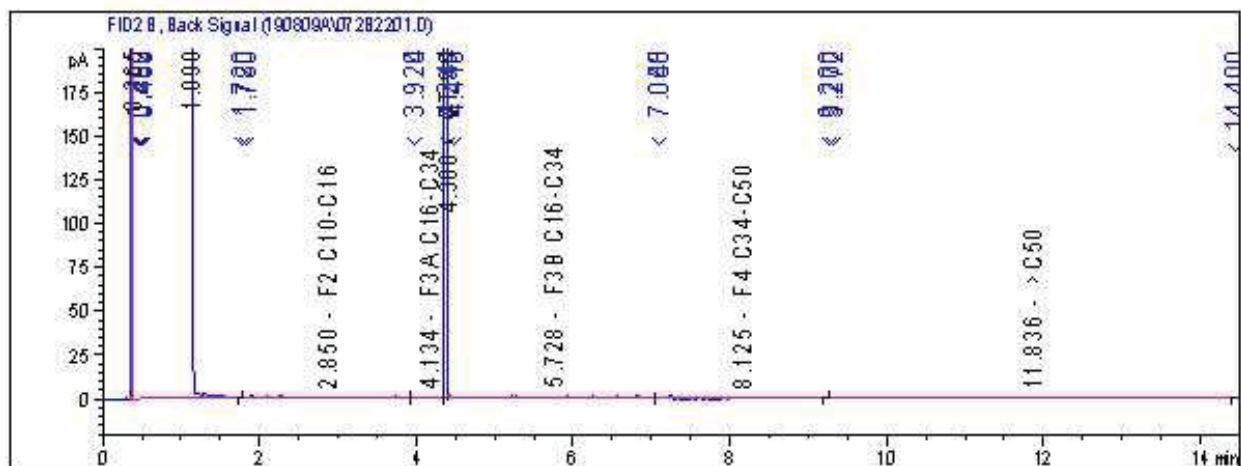
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

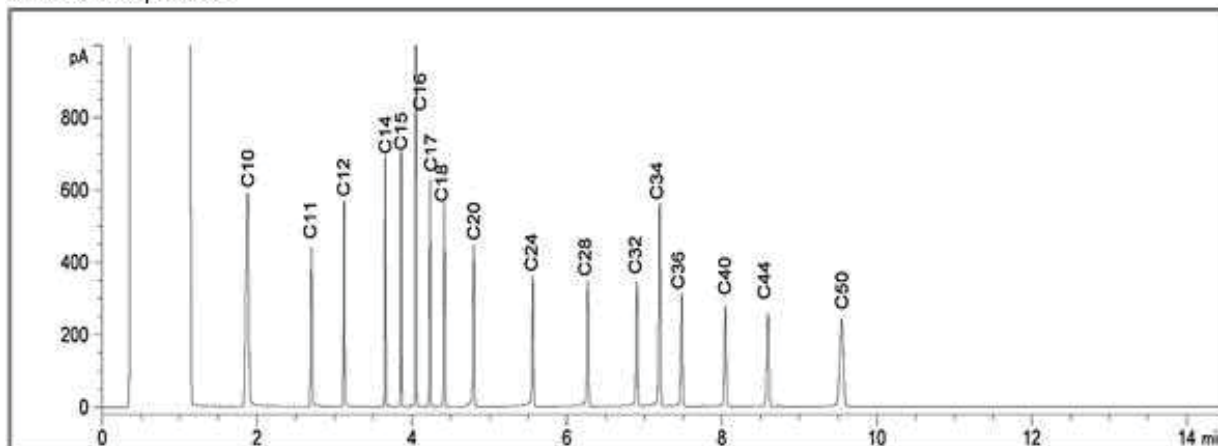
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

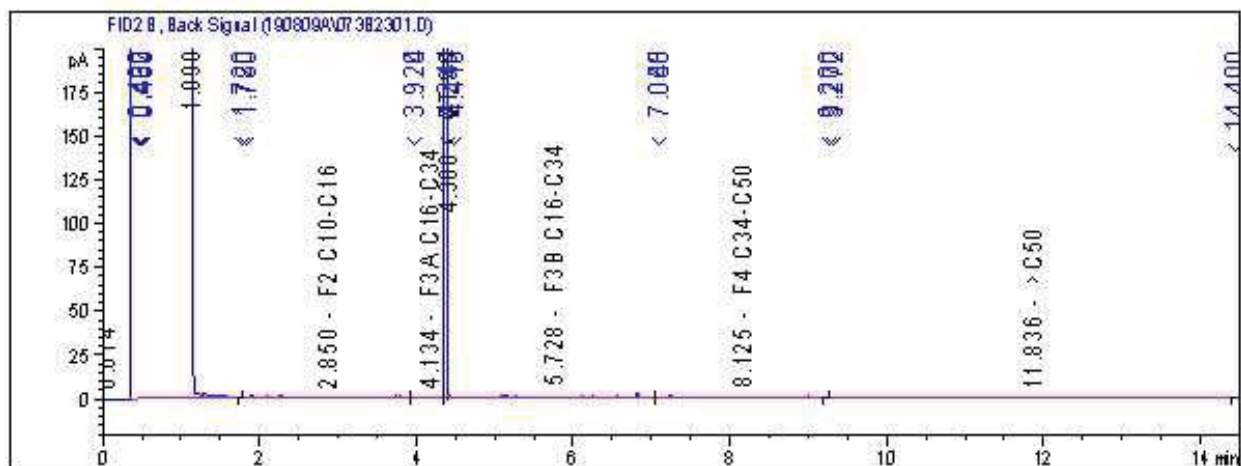
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

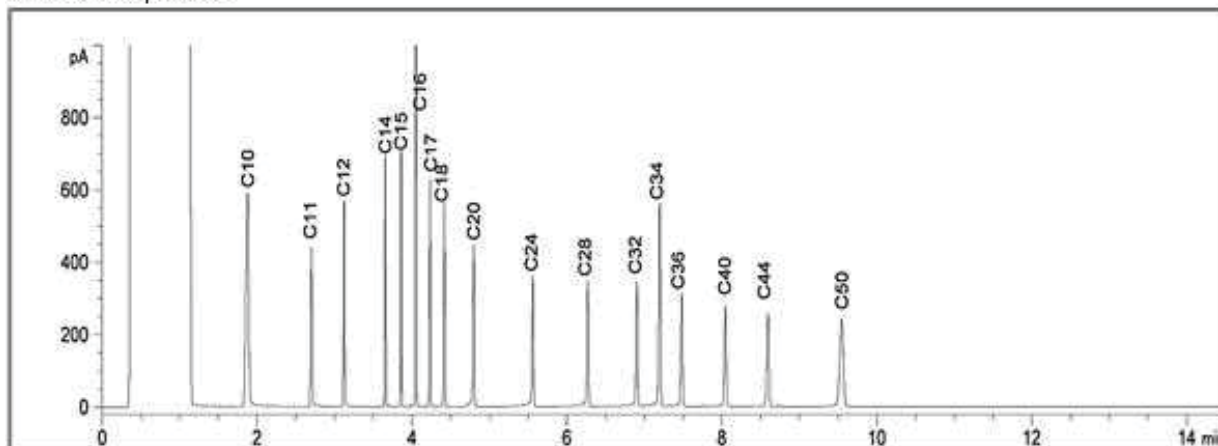
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

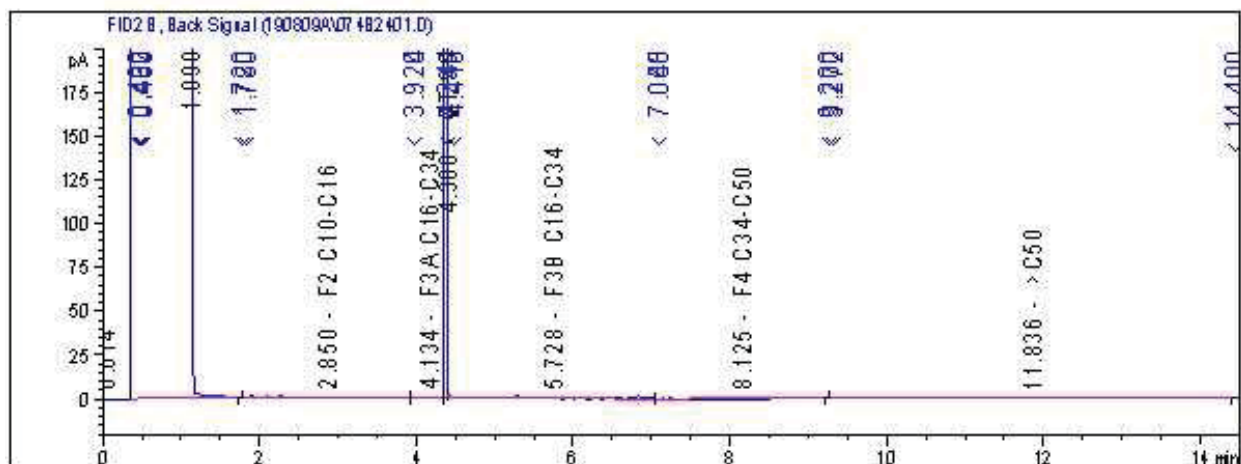
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

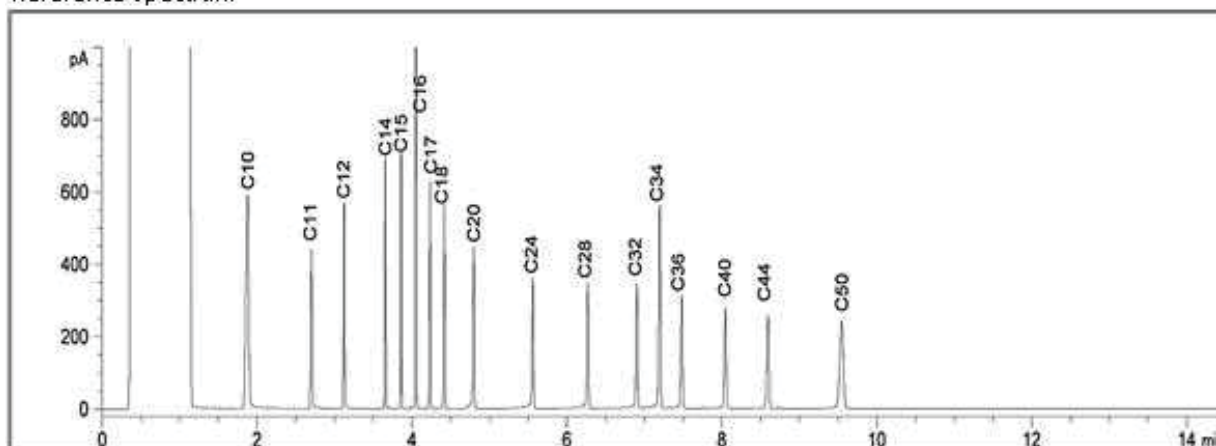
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

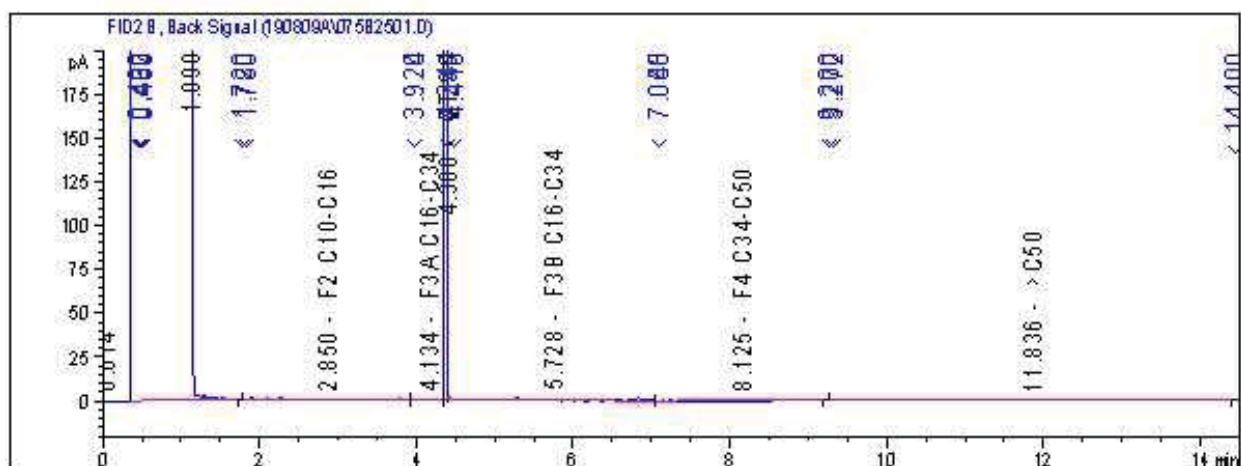
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

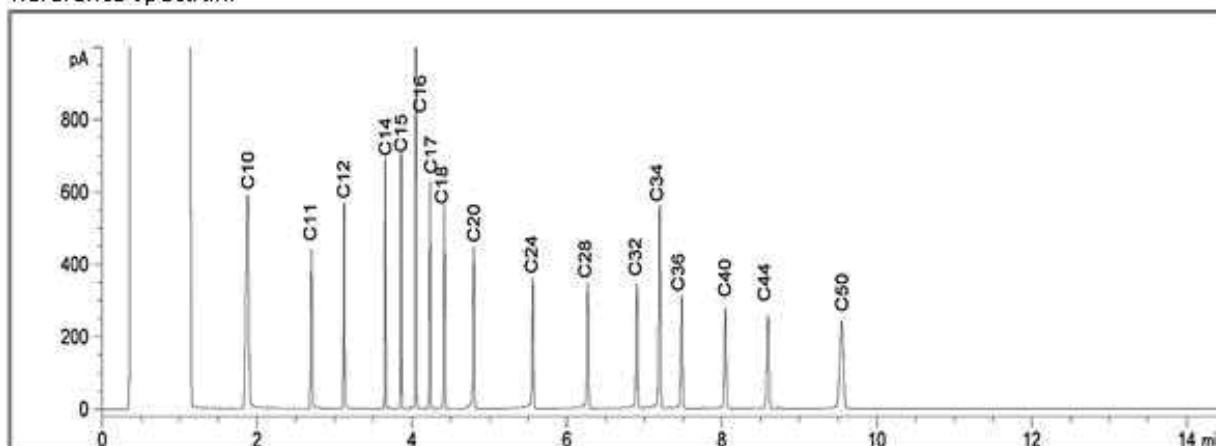
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

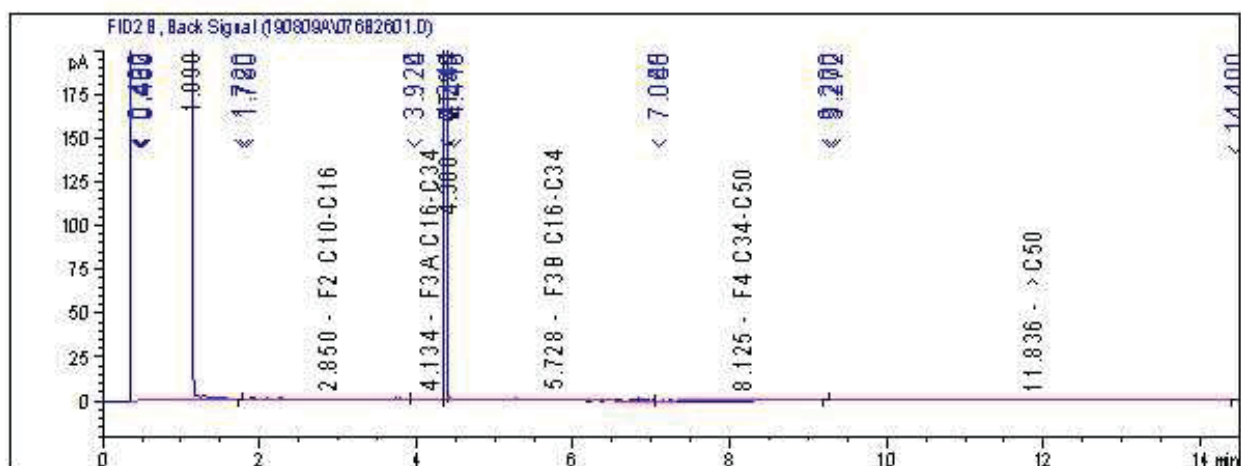
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

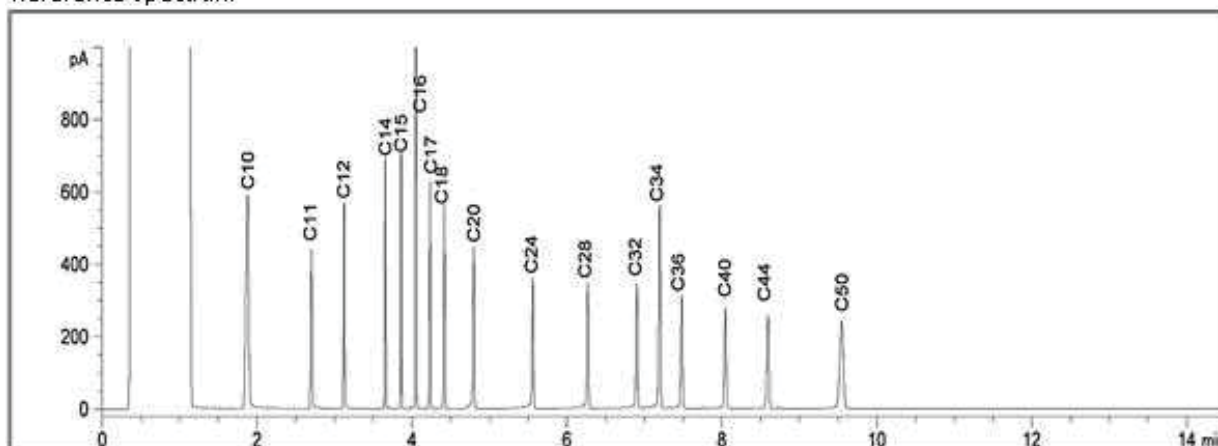
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

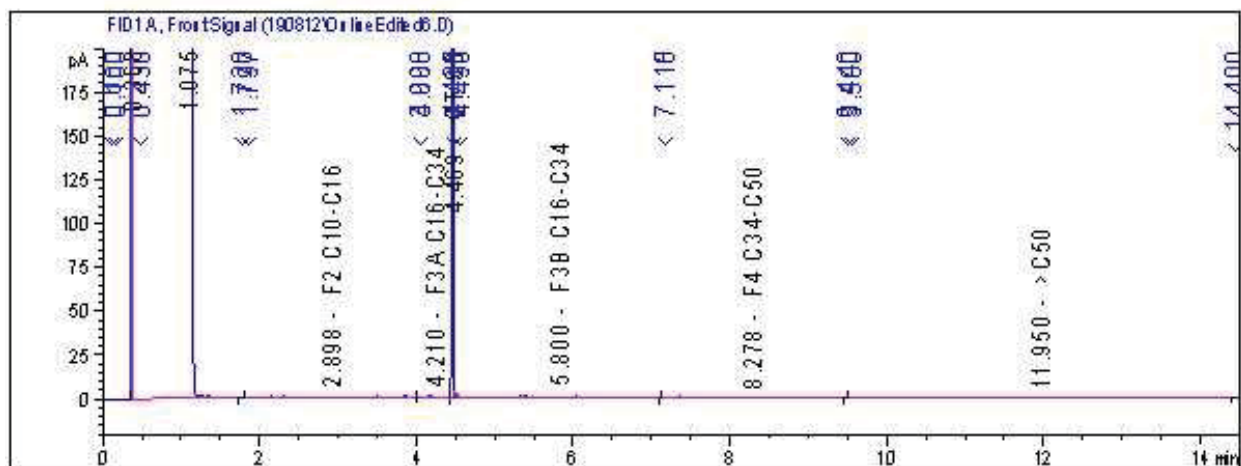
Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

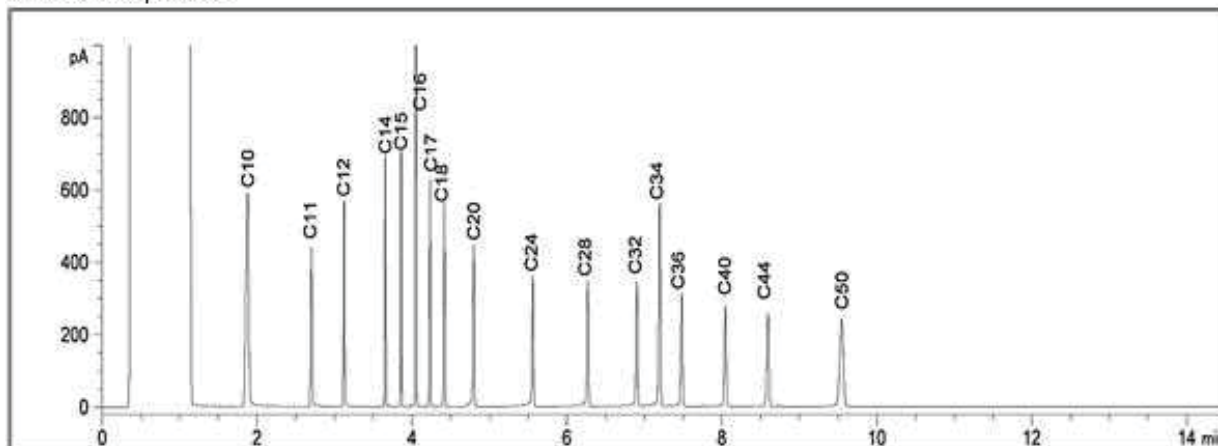
Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Reference Spectrum



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: **C6 - C12**

Diesel: **C10 - C24**

Jet Fuels: **C6 - C16**

Varsol: **C8 - C12**

Fuel Oils: **C6 - C32**

Creosote: **C10 - C26**

Kerosene: **C8 - C16**

Motor Oils: **C16 - C50**

Asphalt: **C18 - C50+**

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Annexe I Cadre législatif et réglementaire et Guide d'intervention - PSRTC du MELCC

CADRE LÉGISLATIF ET RÉGLEMENTAIRE ET GUIDE D'INTERVENTION – PSRTC DU MINISTÈRE DE L'ENVIRONNEMENT ET DE LA LUTTE CONTRE LES CHANGEMENTS CLIMATIQUES DU QUÉBEC (MELCC)

LOI SUR LA QUALITÉ DE L'ENVIRONNEMENT (LQE), SECTION IV DU CHAPITRE 1 ET RÈGLEMENT SUR LA PROTECTION ET LA RÉHABILITATION DES TERRAINS (RPRT)

Depuis le 1^{er} mars 2003, la section IV du chapitre 1 de la *Loi sur la qualité de l'environnement* (ci-après « la Loi ») est modifiée à la suite de l'adoption du projet de Loi 72. Ces modifications ont pour objet l'établissement de nouvelles règles visant la protection des terrains ainsi que leur réhabilitation en cas de contamination. La Loi précise les conditions dans lesquelles une personne ou une municipalité peut être tenue de caractériser et de réhabiliter un terrain contaminé et attribut au MELCC divers pouvoirs d'ordonnance, notamment pour obliger la caractérisation de terrains et leur réhabilitation.

Par l'entremise du RPRT qui est entré en vigueur le 27 mars 2003, la Loi impose aux entreprises appartenant à des secteurs industriels ou commerciaux désignés par le RPRT certaines obligations lorsqu'elles cessent définitivement leurs activités, et ce, dans le but de connaître et de corriger toute contamination éventuelle des terrains où elles ont été établies. La Loi subordonne également le changement d'usage d'un terrain contaminé par suite de l'exercice sur ce terrain de certaines activités industrielles ou commerciales désignées par le RPRT, à la mise en œuvre de mesures de réhabilitation et de publicité. Les municipalités devront aussi constituer une liste des terrains contaminés situés sur leur territoire, et aucun permis de construction ou de lotissement ne pourra être délivré relativement à un terrain inscrit sur cette liste sans une attestation par un expert de la compatibilité du projet avec les dispositions du plan de réhabilitation de ce terrain.

Par ailleurs, l'article 31.57 de la Loi impose aussi le respect des normes établies dans le RPRT dans le cas d'une réhabilitation volontaire d'un terrain. Si les travaux de réhabilitation volontaire prévoient le maintien sur le terrain de contaminants dont les concentrations excèdent les normes réglementaires, une analyse de risque doit alors être effectuée pour appuyer les mesures de gestion du risque que le maintien des contaminants en place nécessite.

Le RPRT est basé sur l'usage de normes préétablies relatives à la contamination des sols et établies en fonction du zonage municipal s'appliquant au terrain. À ce titre, le RPRT inclut une liste de valeurs limites applicables pour une grande variété de composés chimiques (ex. : métaux lourds, hydrocarbures pétroliers, pesticides chlorés, etc.). Les normes servent à évaluer l'ampleur d'une contamination; elles sont également utilisées comme valeurs seuils pour l'atteinte de certains objectifs de décontamination pour un usage donné.

De façon générale, les valeurs limites applicables sont celles indiquées à l'annexe I du RPRT. Il est pertinent de mentionner que les normes de l'annexe I sont équivalentes aux critères génériques « B » du *Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés* (ci-après la « Guide d'intervention – PSRTC »). Toutefois, s'il s'agit de terrains mentionnés ci-après, les valeurs limites applicables sont celles indiquées à l'annexe II du RPRT, équivalentes aux critères génériques « C » du Guide d'intervention – PSRTC du MELCC :

- 1) Aux fins des articles 31.43, 31.45, 31.49, 31.52, 31.54, 31.55, 31.57 et 31.59 :
 - a) Terrains où sont autorisés, en vertu d'une réglementation municipale de zonage, des usages industriels, commerciaux ou institutionnels, à l'exception des terrains suivants :
 - i. Terrains où sont aménagés des bâtiments totalement ou partiellement résidentiels;
 - ii. Terrains où sont aménagés des établissements d'enseignement primaire ou secondaire, des centres de la petite enfance, des garderies, des centres hospitaliers, des centres d'hébergement et de soins de longue durée, des centres de réadaptation, des centres de protection de l'enfance et de la jeunesse ou des établissements de détention;
 - b) Terrains constituant, ou destinés à constituer, l'assiette d'une chaussée au sens du Code de la sécurité routière (L.R.Q., c. C-24.2) ou d'un trottoir en bordure de celle-ci, d'une piste cyclable ou d'un parc municipal, à l'exclusion des aires de jeu pour lesquelles demeurent applicables, sur une épaisseur d'au moins 1 m, les valeurs limites fixées à l'annexe I;
- 2) Aux fins de l'article 31.51, terrains où ne sont autorisés, en vertu d'une réglementation municipale de zonage, que des usages industriels, commerciaux ou institutionnels, à l'exclusion des terrains mentionnés au point ii ci-dessus.

De plus, lorsqu'un contaminant mentionné dans la partie métaux et métalloïdes de l'annexe I ou II est présent dans un terrain en concentration supérieure à la valeur limite fixée à cette annexe et qu'il n'origine pas d'une activité humaine, cette concentration constitue la valeur limite applicable pour ce contaminant.

Dans le cas où un contaminant n'est pas inclus à l'annexe I ou II du RPRT, ce sont alors les critères du Guide d'intervention – PSRTC du MELCC qui doivent être considérés.

RÈGLEMENT SUR L'ENFOUISSEMENT DES SOLS CONTAMINÉS (RESC)

Depuis le mois de juillet 2001, le RESC détermine les conditions ou prohibitions applicables à l'aménagement, à l'agrandissement et à l'exploitation des lieux servant, en tout ou en partie, à l'enfouissement de sols contaminés ainsi que les conditions applicables à leur fermeture et à leur suivi postfermeture. Dans le cas d'un projet de réhabilitation environnementale où des sols contaminés doivent être éliminés hors site, le RESC stipule que les sols contaminés ne peuvent être mis dans un lieu d'enfouissement de sols contaminés si :

- 1) Ces sols contiennent une ou plusieurs substances dont la concentration est égale ou supérieure aux valeurs limites fixées à l'annexe I du RESC, sauf :
 - a) s'ils sont mis dans un lieu visé à l'article 2 du RESC;
 - b) les sols dont on a enlevé à la suite d'un traitement autorisé en vertu de la Loi au moins 90 % des substances qui étaient présentes initialement dans les sols et, dans le cas des

- métaux et métalloïdes enlevés, seulement si ceux-ci ont été stabilisés, fixés et solidifiés par un traitement autorisé;
- c) lorsqu'un rapport détaillé démontre qu'une substance présente dans les sols ne peut être enlevée dans une proportion de 90 % à la suite d'un traitement optimal autorisé et qu'il n'y a pas de technique disponible à cet effet;
- 2) Ces sols contiennent plus de 50 mg de BPC par kilogramme de sol;
 - 3) Ces sols, après ségrégation, contiennent plus de 25 % de matières résiduelles;
 - 4) Ces sols contiennent une matière explosive ou une matière radioactive au sens de l'article 3 du *Règlement sur les matières dangereuses* ou une matière incompatible, physiquement ou chimiquement, avec les matériaux composant le lieu d'enfouissement;
 - 5) Les sols contaminés qui contiennent un liquide libre, selon un essai standard réalisé par un laboratoire accrédité par loi.

Les sols contaminés présentant des concentrations excédant les valeurs limites fixées à l'annexe I du RESC ne peuvent donc être enfouis sans avoir préalablement subi un traitement permettant d'enlever au moins 90 % des substances qui y étaient présentes initialement. La prise en compte de ces valeurs seuil a donc une influence sur les coûts de gestion des sols contaminés, ceux nécessitant un traitement préalable avant l'enfouissement étant plus chers à gérer que ceux pouvant être enfouis directement.

GUIDE D'INTERVENTION – PROTECTION DES SOLS ET RÉHABILITATION DES TERRAINS CONTAMINÉS

Au Québec, l'évaluation de la qualité environnementale des sols et de l'eau souterraine des terrains s'effectue depuis juillet 2016 en fonction du Guide d'intervention – PSRTC du MELCC. Ce guide a été mis à jour en mars 2019 et remplace l'ancienne *Politique de protection des sols et de réhabilitation des terrains contaminés* du MELCC de 1998.

Critères relatifs aux sols

Le Guide d'intervention – PSRTC du MELCC est basé sur l'usage de critères génériques préétablis et associés à l'utilisation prévue du terrain. À ce titre, le Guide d'intervention – PSRTC du MELCC inclut une liste de critères pour une grande variété de composés chimiques (ex. : métaux lourds, hydrocarbures pétroliers, pesticides chlorés, etc.). Tous les composés de cette liste sont associés à trois valeurs seuils (critères « A », « B » et « C »).

Les critères génériques pour les sols permettent d'évaluer l'ampleur d'une contamination et de fixer les objectifs de décontamination pour un usage donné. Ils sont aussi utilisés comme outil de gestion des sols contaminés excavés. Ils ont été établis de façon à assurer la protection des futurs utilisateurs et pour sauvegarder l'environnement. La décontamination d'un terrain aux critères génériques correspondant à son usage constitue un mode de réhabilitation facile à réaliser et celui qui demande le moins de suivi et d'engagement pour l'avenir. La définition des trois valeurs seuils est fournie ci-après.

Critères « A » : Teneurs de fond pour les paramètres inorganiques et limite de quantification pour les paramètres organiques.

La limite de quantification est définie comme la concentration minimale qui peut être quantifiée à l'aide d'une méthode d'analyse avec une fiabilité définie.

Critères « B » : Limite maximale acceptable pour des terrains résidentiels ou des terrains où se déroulent certains usages institutionnels (établissements d'enseignement primaire ou secondaire, centres de la petite enfance, garderies, centres hospitaliers, centres d'hébergement et de soin longue durée, centres de réadaptation, centres de protection de l'enfance ou de la jeunesse, établissements de détention) et le premier mètre des aires de jeux des parcs municipaux.

Critères « C » : Limite maximale acceptable pour des terrains industriels, commerciaux, institutionnels non sensibles et récréatifs (pistes cyclables et parcs municipaux, sauf le premier mètre des aires de jeu), de même que pour ceux destinés à former l'assiette d'une chaussée ou d'un trottoir en bordure de celle-ci.

Critères relatifs aux eaux souterraines

Pour toutes les eaux souterraines contaminées ou susceptibles de l'être, l'estimation du risque et des impacts se fait dans un premier temps par l'entremise de la grille de critères de qualité pour les eaux souterraines du Guide d'intervention – PSRTC du MELCC. Le respect des critères est attendu sur le terrain et à la limite du terrain visé en fonction de la direction d'écoulement de l'eau souterraine de façon à ce que les puits d'observation installés se situent en aval hydraulique des sources de contamination sur le terrain.

Les critères de qualité pour les eaux souterraines ont pour objectif d'assurer la protection de l'eau souterraine, des usages qui peuvent en être faits et de ses utilisateurs. À cet effet, deux séries de critères d'usage ont été établies, soit les critères « EDC » et les critères « RES ». Les normes municipales de rejet à l'égout peuvent aussi s'appliquer dans les municipalités qui en ont adoptées. Toutefois, dans le cas de l'infiltration dans un égout pluvial, ce sont les critères de résurgence dans l'eau de surface qui s'appliquent, à moins que la municipalité n'exige également l'application de sa norme pour l'égout pluvial.

C'est la comparaison des résultats analytiques avec les critères de qualité pour les eaux souterraines qui, dans tous les cas, permettra de déterminer si cette eau représente un risque d'effet et s'il est nécessaire d'intervenir. Les usages qui sont faits de cette eau permettront de déterminer s'il y a un risque d'effets actuels ou appréhendés et ainsi de décider s'il y a nécessité d'agir. Le choix des critères auxquels seront comparés les résultats analytiques pour déterminer s'il y a un risque d'effet s'effectue en fonction de l'usage qui est fait ou peut être fait de l'eau souterraine. Si un puits ou un aquifère est destiné à plusieurs usages (ex. : eau potable et résurgence), le plus sévère des critères est retenu pour déterminer l'ampleur du risque d'effet.

Une eau souterraine est jugée contaminée lorsqu'on y trouve des substances en concentration supérieure à la teneur naturelle du milieu et que cet apport de contaminants est dû à une activité anthropique. Pour plusieurs substances, cela correspond à leur limite de détection. La présence de

ces contaminants indique une altération de la qualité de l'eau et que, par conséquent, une évaluation des impacts sur les eaux souterraines doit être réalisée.

Le risque d'effets est décrit comme avéré si l'eau contaminée au-delà du critère est déjà utilisée. Il est considéré comme appréhendé s'il est prévu d'utiliser l'eau contaminée au-delà du critère dans le futur ou qu'un panache de contamination se dirige vers une eau souterraine déjà utilisée ou que l'on prévoit utiliser. Dans les deux cas, il devra y avoir intervention sur la source de contamination que constituent sur le terrain les sols et les matières résiduelles. Cette intervention pourra consister en une décontamination de la source ou en son confinement. Dans le cas de l'infiltration de vapeurs, il faudra s'assurer qu'elles ne peuvent pénétrer dans les bâtiments.

Les interventions et suivi à effectuer en cas de dépassement de l'un ou l'autre des critères sont présentées aux tableaux 11 et 12 du Guide d'intervention – PSRTC du MELCC.

Grille de gestion des sols excavés

La gestion des sols excavés doit se faire en fonction de la *Grille de gestion des sols excavés* du Guide d'intervention – PSRTC du MELCC présentée ci-après. Cette grille présente les options de gestion possibles en fonction des niveaux de contamination des sols excavés et du milieu récepteur. La *Grille de gestion des sols excavés* du Guide d'intervention – PSRTC du MELCC a été conçue pour favoriser les options de gestion visant la décontamination et la valorisation des sols et s'inscrit dans les orientations du REIMR et du RESC.

La *Grille de gestion des sols excavés* du Guide d'intervention – PSRTC du MELCC ne s'applique, pour les critères supérieurs à « A », que pour une contamination de nature anthropique.

Si la concentration naturelle dans les sols est supérieure aux critères « A », la gestion des sols contenant cette concentration naturelle est considérée comme équivalente à celle attribuable aux critères « A » et ces sols peuvent être gérés sans restriction. Il est toutefois recommandé que ces sols soient déposés sur des terrains situés à proximité de leur terrain d'origine, de façon à ce que les sols récepteurs, de par leur origine et les teneurs naturelles qu'on est susceptible d'y trouver, soient apparentés aux sols déposés. Finalement, dans certains cas, si la teneur naturelle excède largement la teneur de fond régionale et atteint un niveau de concentration tel qu'il soulève des préoccupations de la part de la Direction de santé publique de la région concernée, une gestion particulière de ces sols pourrait tout de même être requise.

Niveau de contamination	Options de gestion ⁽¹⁾
≤ critères « A » ⁽²⁾	1. Utilisation sans restriction sur tout terrain.
< critères « B »	<ol style="list-style-type: none"> 1. Ailleurs que sur le terrain d'origine, les sols ne peuvent être déposés que sur des sols dont la concentration en contaminants est égale ou supérieure à celle des sols remblayés (article 4 du RSCTSC) et s'ils n'émettent pas d'odeurs d'hydrocarbures perceptibles. 2. Aux mêmes conditions, déposés sur ou dans des terrains destinés à l'habitation s'ils sont utilisés comme matériau de remblayage dans le cadre de travaux de réhabilitation de terrains faits conformément à la LQE.
≤ critères « B »	<ol style="list-style-type: none"> 1. Valorisés sur le terrain d'origine ou sur le terrain à partir duquel a eu lieu l'activité à l'origine de la contamination. 2. Valorisés comme matériau de recouvrement journalier ou final dans un lieu d'enfouissement technique (LET) ou comme matériau de recouvrement hebdomadaire ou final dans un lieu d'enfouissement en tranchée ou comme recouvrement mensuel ou final dans un lieu d'enfouissement de débris de construction ou de démolition, conformément au REIMR aux conditions des articles 42, 50, 90, 91, 105 ou 106. 3. Valorisés comme recouvrement final dans un lieu d'enfouissement de sols contaminés (LESC) aux conditions décrites à l'article 38 du RESC ou valorisés dans un système de captage des gaz prévu à l'article 13 du RESC. 4. Valorisés comme recouvrement final d'un lieu de dépôt définitif de matières dangereuses aux conditions de l'article 101 du RMD. 5. Valorisés comme matériau de recouvrement final dans un système de gestion qui comporte le dépôt définitif par enfouissement de déchets de fabriques de pâtes et papiers, aux conditions de l'article 116 du <i>Règlement sur les fabriques de pâtes et papiers</i> (RFPP). 6. Valorisés sur un lieu d'élimination nécessitant un recouvrement, aux conditions prévues au certificat d'autorisation en vertu de l'article 22 de la LQE. 7. Valorisés avec ou sans MRF, comme matériau apte à la végétation dans des projets de restauration d'aires d'accumulation de résidus miniers⁽³⁾ ou dans la couverture de lieux visés par le RFPP, le RESC ou le RMD. Ne doit dégager aucune odeur d'hydrocarbures perceptible. Dans le cas d'ajout de MRF, le projet doit être autorisé et respecter le Guide sur l'utilisation de matières résiduelles fertilisantes pour la restauration de la couverture végétale de lieux dégradés⁽⁴⁾. 8. Valorisés comme couche de protection d'une géomembrane utilisée dans un système multicouche lors de la restauration d'une aire d'accumulation de résidus miniers générateurs d'acide⁽³⁾. 9. Éliminés dans un lieu d'enfouissement visé par le RESC. 10. Éliminés dans un LET, un lieu d'enfouissement en tranchée, un lieu d'enfouissement en milieu nordique, un lieu d'enfouissement de débris de construction ou de démolition ou un lieu d'enfouissement en territoire isolé, conformément à l'article 4 du REIMR.
≥ critères « B » et ≤ critères « C »	<ol style="list-style-type: none"> 1. Utilisés sur le terrain d'origine comme matériau de remblayage à la condition que les concentrations mesurées respectent les critères ou valeurs limites réglementaires applicables aux sols selon l'usage et le zonage. 2. Valorisés comme matériau de recouvrement dans un LET ou comme matériau de recouvrement hebdomadaire dans un lieu d'enfouissement en tranchée, aux conditions des articles 42, 50 ou 90 du REIMR. Ces conditions incluent notamment que les concentrations de composés organiques volatils (COV) soient égales ou inférieures aux critères « B ». 3. Traités sur place ou dans un lieu de traitement autorisé. 4. Éliminés dans un lieu d'enfouissement visé par le RESC.

Niveau de contamination	Options de gestion ⁽¹⁾
< annexe I du RESC	<ol style="list-style-type: none"> Utilisés pour remplir des dépressions naturelles ou des excavations sur le terrain d'origine lors de travaux de réhabilitation aux conditions prévues dans le plan de réhabilitation approuvé dans le cadre d'une analyse de risques (dossiers GTE), à la condition que les HP C₁₀-C₅₀ et les COV respectent les critères d'usage. Traités sur place ou dans un lieu de traitement autorisé. Éliminés dans un lieu d'enfouissement visé par le RESC.
≥ annexe I du RESC	<ol style="list-style-type: none"> Décontaminés sur place ou dans un lieu de traitement autorisé et gestion selon le résultat obtenu. Si cela est impossible, éliminés dans un lieu d'enfouissement visé par le RESC pour les exceptions mentionnées à l'article 4.1° a, b ou c.
Cas particuliers	<ol style="list-style-type: none"> Des sols contaminés peuvent être utilisés, à condition de ne dégager aucune odeur d'hydrocarbures perceptible, pour la construction d'un écran visuel ou antibruit dont l'utilité est démontrée : <ol style="list-style-type: none"> Sur un terrain résidentiel avec des sols du terrain d'origine : <ol style="list-style-type: none"> dont les concentrations sont ≤ « B »; dont les concentrations sont ≤ « C », lors de travaux de réhabilitation sur le terrain réalisés conformément au plan de réhabilitation approuvé dans le cadre d'une analyse de risque (dossiers GTE), sous les mesures de confinement, à condition que les sols contiennent des concentrations ≤ « B » en HP C₁₀-C₅₀ et en composés organiques volatils (COV)⁽⁵⁾; dont les concentrations sont < annexe I du RESC, lors de travaux de réhabilitation sur le terrain réalisés conformément au plan de réhabilitation approuvé dans le cadre d'une analyse de risque (dossiers GTE), sous les mesures de confinement, à condition que les sols en place soient de niveau > C et que les sols déposés contiennent des concentrations ≤ « B » en HP C₁₀-C₅₀ et en COV⁽⁵⁾; Sur un terrain commercial/industriel avec des sols du terrain d'origine : <ol style="list-style-type: none"> dont les concentrations sont ≤ « C »; dont les concentrations sont ≤ « C », lors de travaux de réhabilitation sur le terrain réalisés conformément au plan de réhabilitation approuvé dans le cadre d'une analyse de risque (dossiers GTE), sous les mesures de confinement; dont les concentrations sont < annexe I du RESC, lors de travaux de réhabilitation sur le terrain réalisés conformément au plan de réhabilitation approuvé dans le cadre d'une analyse de risque (dossiers GTE), sous les mesures de confinement, à condition que les sols en place soient > « C », et que les sols déposés contiennent des concentrations ≤ « C » en HP C₁₀-C₅₀ et en COV⁽⁵⁾. La valorisation de sols contaminés dans un procédé en remplacement d'une matière vierge est possible aux conditions de l'autorisation. Les sols ≥ « B » peuvent être acheminés sur les aires de résidus miniers, s'ils sont contaminés exclusivement par des métaux ou métalloïdes résultant des activités minières de l'entreprise responsable de l'aire, aux conditions de l'autorisation délivrée par le Ministère (article 6 du RSCTSC). Les sols ≥ « B » peuvent être acheminés dans un lieu de dépôt définitif de matières dangereuses aux conditions du certificat d'autorisation détenu par ce lieu pour recevoir des sols.

Notes :

- S'il y a présence de matières résiduelles dans les sols, se référer à la figure 12 de la section 7.7.2. du Guide d'intervention – PSRTC du MELCC;
- S'il est établi que la concentration naturelle dans le sol importé est supérieure aux critères « A » et à la concentration du sol récepteur, il est recommandé au propriétaire du terrain récepteur de garder une trace du remblayage (localisation, niveau de contamination, provenance des sols importés), de façon à

ce qu'il puisse, le cas échéant, démontrer qu'il ne s'agit pas d'une contamination anthropique. Faute de l'existence d'une telle trace, le MELCC considérera que les sols ont été contaminés par l'activité humaine et ils devront donc être gérés comme tels. Advenant le cas où les concentrations naturelles excèdent largement les critères génériques recommandés pour l'usage qui est fait du terrain récepteur, un avis sur les possibles risques à la santé et l'à-propos du remblayage avec de tels sols pourra être demandé à la Direction de santé publique;

- 3) Ne s'applique pas aux sols contaminés = « B », à moins que ces sols n'aient d'abord transité par un lieu visé à l'article 6 du *Règlement sur le stockage et les centres de transfert de sols contaminés* (RSCTSC). Les sols excavés « ≥B » ne peuvent en effet être acheminés directement que dans des lieux légalement autorisés à les recevoir et listés à l'article 6 du RSCTSC;
- 4) Il faudra toutefois s'assurer que la valorisation de sols « A-B », auxquels on aura ajouté des matières fertilisantes ou non, entraîne un effet bénéfique, par exemple, sur la croissance de la végétation, et que ces sols répondent à un besoin réel, l'ajout de sols n'étant pas essentiel dans tous les cas de restauration minière. Il sera possible de s'assurer du bien-fondé du projet de valorisation et de son contrôle dans le cadre du certificat d'autorisation délivré préalablement à sa réalisation;
- 5) L'écran visuel ou antibruit doit être recouvert de 1 m de sols ≤ « A » ou de 40 cm ≤ « A » aux endroits recouverts d'une structure permanente (asphalte ou béton). Il est possible d'utiliser des MRF dans la couche apte à la végétation selon les orientations du *Guide sur l'utilisation des matières résiduelles fertilisantes pour la restauration de la couverture végétale des lieux dégradés* si la résultante est ≤ « A ».

RÈGLEMENT SUR LE STOCKAGE ET LES CENTRES DE TRANSFERT DE SOLS CONTAMINÉS (RSCTSC)

Le RSCTSC est entré en vigueur le 15 février 2007. En bref, le RSCTSC prévoit les conditions d'implantation, d'exploitation et de fermeture des centres de transfert. Les sols qui sont acceptés dans les centres de transfert doivent être acheminés obligatoirement vers une unité de décontamination et les sols entreposés temporairement doivent être valorisés. Seuls sont visés par le RSCTSC les sols contaminés dans des concentrations égales ou supérieures aux valeurs de l'annexe I (équivalant au critère « B »), sauf exception de l'article 4. L'article 4 stipule l'interdiction de déposer ailleurs que sur le terrain d'origine des sols contaminés en concentration inférieure aux valeurs de l'annexe I (critère « B ») sur ou dans des sols dont la concentration de contaminants est inférieure à celle contenue dans les sols déposés. Ces sols visés à l'article 4 ne peuvent pas non plus être déposés sur ou dans des terrains destinés à l'habitation, sauf comme matériaux de remblayage dans le cadre de travaux de réhabilitation de terrains faits conformément à la Loi et si leur concentration de contaminants est égale ou inférieure à celle contenue dans les sols en place. Le RSCTSC stipule également qu'il est interdit, à quelque moment que ce soit, de mélanger des sols contaminés avec des sols propres ou avec des sols ou des matériaux dont la différence de contamination aurait pour effet d'en modifier le niveau de contamination et de permettre d'en disposer d'une façon moins contraignante.

De plus, l'article 10 du RSCTSC encadre le stockage de sols contaminés dans le cadre de projets linéaires (exemple la construction de routes) ou en raison de la petite superficie des terrains où il est impossible de stocker les sols contaminés sur les terrains d'origine. Enfin, mentionnons l'article 11, qui encadre le stockage de sols contaminés destinés à la valorisation ailleurs que sur le

terrain d'origine lorsque les teneurs sont inférieures ou égales aux valeurs limites fixées à l'annexe II (critère « C »).

RÈGLEMENT SUR LES MATIÈRES DANGEREUSES (RMD)

Depuis le 1^{er} décembre 1997, le *Règlement sur les matières dangereuses* remplace le *Règlement sur les déchets dangereux*. Lors d'études de caractérisation environnementale d'un site, il n'est pas rare d'observer la présence de matières résiduelles enfouies dans les sols. La caractérisation des matières résiduelles doit être réalisée afin de déterminer si cette matière résiduelle est dangereuse ou non dangereuse et en définir son mode de gestion. Une matière dangereuse est définie entre autres par ses propriétés physico-chimiques, soit une matière comburante, corrosive, explosive, gazeuse, inflammable, radioactive, lixiviable et toxique. Pour ces deux dernières propriétés, on devra s'assurer que les matières résiduelles telles les scories de bouilloires, les cendres et autres résidus similaires retrouvés dans les sols ne sont pas lixiviables, ni toxiques. Il est également à noter que plusieurs matières résiduelles sont par définition non dangereuses. Entre autres, peuvent être assimilés à une matière dangereuse, certains récipients ou objets contenant ou contaminés par une matière dangereuse telle que des huiles, des graisses, des BPC ou équipement au-delà de concentrations prescrites par règlement.

RÈGLEMENT SUR L'ENFOUISSEMENT ET L'INCINÉRATION DE MATIÈRES RÉSIDUELLES (REIMR)

Le REIMR, édicté le 11 mai 2005, est en vigueur depuis le 19 janvier 2006. Au terme d'une période transitoire de trois ans, soit depuis le 19 janvier 2009, le REIMR a remplacé le *Règlement sur les déchets solides*¹. Le REIMR a permis de donner suite à sept actions prévues dans la *Politique québécoise de gestion des matières résiduelles* 1998-2008.

L'objectif du REIMR consiste à s'assurer que les activités d'élimination de matières résiduelles s'exercent dans le respect de la sécurité des personnes et la protection de l'environnement.

Le REIMR régit les matières résiduelles non dangereuses selon le RMD. Le REIMR a notamment pour objet d'identifier les matières résiduelles admissibles dans les installations d'élimination autorisées et les conditions d'aménagement et d'exploitation de ces installations. Le REIMR précise les conditions applicables à la fermeture et à la gestion postfermeture des installations d'élimination.

Le REIMR permet, sous certaines conditions, l'utilisation de sols contaminés comme matériau de recouvrement de lieux d'enfouissement technique (LET). Selon le REIMR, les sols utilisés à des fins de recouvrement doivent présenter des concentrations en composés organiques volatils inférieures ou égales aux valeurs limites fixées à l'annexe I du RPRT. Les concentrations maximales admissibles pour les autres contaminants des sols utilisés à des fins de recouvrement doivent respecter les valeurs limites présentées à l'annexe II du RPRT. Ces valeurs limites ne sont toutefois pas applicables aux contaminants qui ne proviennent pas d'une activité humaine. Des

¹ Le RDS est remplacé, mais continue de s'appliquer ainsi qu'il est prévu aux articles 156 à 168 du REIMR.

exigences granulométriques et de conductivité hydraulique sont également prévues pour l'utilisation de sols contaminés comme matériau de recouvrement.

Le REIMR précise les concentrations maximales acceptables pour l'enfouissement de sols contaminés dans un LET. Ces concentrations sont celles de l'annexe I du RPRT, et ce, pour tous les paramètres.

CRITÈRES DE QUALITÉ DE L'EAU DE SURFACE AU QUÉBEC

Pour la première fois en 1990, le Ministère publiait officiellement une liste de critères de qualité de l'eau pour l'évaluation de la qualité des eaux de surface et des effluents du Québec. Une nouvelle version du répertoire remplace maintenant les documents précédents intitulés « *Critères de qualité de l'eau* » (MENVIQ, 1990a, rév. 92) et « *Critères de qualité de l'eau de surface au Québec* » (MEF, 1998).

Le document de référence actuel intitulé « *Critères de qualité de l'eau de surface au Québec* », novembre 2009 est un répertoire qui contient, pour plus de 300 contaminants, des critères de qualité descriptifs, chimiques et de toxicité globale relatifs à chacun des usages de l'eau. Les usages de l'eau identifiés sont : les sources d'eau potable, la consommation d'organismes aquatiques, la vie aquatique, la faune terrestre piscivore, de même que les activités récréatives. Les contaminants y sont classés en ordre alphabétique à partir de la nomenclature internationale française; de plus, un index de synonymes ainsi qu'un index de numéros CAS (Chemical Abstract Service) permettent aussi de retrouver les contaminants. Les critères de qualité de l'eau ne sont pas des normes. Ces valeurs n'ont pas force de loi en tant que telle; elles s'intègrent dans des procédures globales où elles servent de base à la définition de niveaux d'intervention d'assainissement ou à l'évaluation de la qualité des eaux. Les critères de qualité sont des valeurs associées à un seuil sécuritaire protégeant un usage de tout type d'effets délétères possibles : toxicité, dégradation esthétique ou organoleptique.

